

The Trajectory of Healthcare Utilization for Chronic Disease: Findings from the Economic Value of Community Paramedicine Study

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Abstract

The Economic Value of Community Paramedicine Programs Study was a randomized controlled trial (RCT) in two Eastern Ontario communities – one urban and one rural, to determine whether Community Paramedicine services (the intervention) could reduce hospital service utilization for high-frequency chronic condition clients. The Study also sought to establish whether Community Paramedicine could influence self-perceived quality of life, and thereby determine the cost-effectiveness and cost-efficiency of the intervention for a specific population.

A total of 200 eligible clients, recruited in early 2015, were randomly assigned to either the intervention group (receiving Community Paramedicine services for 12 months) or the control group (receiving conventional treatment).

Community Paramedicine was found to reduce total visits to the Emergency Room, although not necessarily hospital admissions or length of stay in in-patient care. Study results suggest that the effectiveness of Community Paramedicine is highly sensitive to target group selection, the degree to which the target group is experiencing disease progression, and to the degree of integration of Community Paramedicine into a local healthcare system.

Introduction

Well promoted theory has it that good community based primary care represents the solution to the otherwise traditional path of expensive hospital resources being used to manage acute on chronic episodes of chronic disease. It is accepted that chronic diseases such as diabetes, chronic obstructive lung disease, hypertension and congestive heart failure account for much of the small (5%) portion of the population that consumes over half of healthcare budgets [1]. It is felt that, while there will always be a small segment of the population that remains unwell, changing their health and wellbeing profile is key to a sustainable healthcare system.

The Canadian Institute for Health Information's (CIHI) High User's Symposium speaks to 'distinct approaches to high users' and 'operational approaches which seek to identify high user with the goal of management and reduction.' With regards to implementing CIHI theory on practice, one of the main innovations suggested was the use of 'community paramedics (CPs)' who are very much close to the members of regions and areas and understand 'high users' needs as a result of responding to their frequent 911 calls. In fact, the Symposium speaks to the ability of CPs to perform 'hot-spotting' of clients who need high service levels and 'contribute through collaborative care within and across service agencies [2].'

Community paramedicine has been described as one of the innovations that stands a good chance of transforming the healthcare system. Community Paramedicine (CP) refers to a broad and developing field of paramedic practice focused on proactive and non-emergent activities (within the scope of a paramedic) which better influences health outcomes. CP allows paramedics to apply their training and skills in "non-traditional" roles, largely outside the usual emergency response and transportation to the emergency room [3].ii

The Economic Value of Community Paramedicine Study was sponsored by the Canadian Safety and Security Program (CSSP) to more fully understand the potential impact of CP in cost effectively

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improving the resilience of communities through better caring for those most in need [4]. Although considered a fledgling literature to date, current reviews and anecdotal reports indicate significant reductions in emergency room and hospital utilization for clients receiving community paramedicine service. This article reports on findings on an ambitious project aimed at providing augmented community based primary care through community paramedicine for the highest utilizers of healthcare in two separate environs, one rural and one urban.

From the 2011 Census, Belleville was found to have a population density of 200 persons per square kilometer and Quinte West (Trenton) was at 87. These communities can be considered urban. In contrast, Renfrew County's population density was reported at 10.5 persons per square kilometer and is considered rural.

Inclusion criteria for this study were aimed to mitigate utilization of paramedic services and subsequent ER assessment and potential hospitalization of those people with at least one chronic disease found to be at the highest level of 911 calls. Agborsangya et al. speak especially to multi-morbidities leading to increased ER and hospital utilization: 'Persons with multimorbidity are twice as likely to be hospitalized or visit an emergency department compared to persons without multimorbidity, an observation that has been reported in other studies. Multimorbidity is associated with increased likelihood of referrals, increasing costs of care and preventable hospitalization in patient populations [5, 6].'

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Based on Study eligibility criteria, the two Paramedic Services used their own databases^{xiii} to generate a comprehensive list of all potentially eligible persons in their respective areas. To be eligible a person would have had to meet all of the following criteria:

- Three or more ambulance transports to a hospital ER in the preceding twelve months
- Presence of one or more of five chronic conditions (COPD, CHF, Diabetes Hypertension, Stroke)
- Lived in the Study area (for Quinte: City of Belleville or urban area of Quinte West/Trenton; for Renfrew: anywhere in rural Renfrew County)
- Still residing in own home/not admitted to long-term care (individuals living in a retirement residence in either independent living or assisted living accommodations were eligible for participation).
- Permanent resident of the Study area (not a visitor)
- Not be part of another research study in the same timeframe.
- Had local retrospective health care data for the 12 months preceding enrolment in the Study
- Had no significant physical, cognitive or other mental disability that would make full participation in the Study difficult or impossible (e.g. unable to complete the EuroQol questionnaire with assistance.)
- Be living at the start of the Study period.
- Has not withdrawn consent or notified the Study (or any of the partner organizations) that they do not wish to be considered for research studies.

Methods

This study was designed as a randomized controlled trial (RCT) to provide scientific rigor to the hypothesis that the innovative use of paramedics focusing on health promotion and disease prevention to clients in the home would decrease overall healthcare costs [4].

The process for sample selection began with the identification of 718 potential participants, 485 in the urban areas of Quinte and 233 in the rural/small town areas of Renfrew County. In the Quinte area, the ability to contact potential participants was especially challenging: only 30% of the sample could be contacted; 70% were unreachable. This issue was not quite as pronounced in Renfrew County where just 18% could not be reached. In Renfrew County, it was easier to determine if a potential participant was deceased (11.1%) or had moved – either to long term care or out of the area: 23.6%. By contrast, in Quinte, just 3.7% could be confirmed as deceased and very few potential participants could be confirmed as having moved. The inability to contact potential participants may have had an influence on the profile of the ultimate sample, particularly in Quinte, but this cannot be validated with the available data (Table 1).

Both communities used random number generation as the method of ‘blind’ assignment of clients to a group. Randomization and assignment to intervention and control groups took place on a batch basis to allow the Community Paramedics to begin service provision starting in late January. They were therefore able to take on clients at a manageable pace rather than having say, 60 or 40 clients all coming into the intervention group at the same time. As a result, the “wait time” for an intervention group client was less than two weeks.

Sample Disposition Category	Hastings-Quinte (#) Target = 120	Renfrew (#) Target = 80	Total (#) Target = 200
Total Number of Eligible Clients (met criteria)	485	233	718
Deceased (at time of recruitment)	18	26	44
Moved to LTC or outside Study area	2	55	57
Declined to participate at initial contact	5	30	35
Unable to contact	340	42	382
Recruited into Study	120	80	200

Figure 1: Summary of Disposition of Potential Study Participants, by community and disposition category. Source: Study documentation.

Once an individual had given consent for participation and was randomized into the Intervention group, the CPs sought to begin service as quickly as possible to prevent health status degradation.

Visitation supplemented by response to CP requests for in home service as undertaken in Renfrew’s Aging at Home program was chosen as best poised to address the needs of high healthcare system utilisers. This was based on early reports and emerging evidence that reductions through the Renfrew Community Paramedicine programs in ER and hospital use were approaching 50% for regional community members [3,7].

While in place for a decade in Renfrew County, CP service through this study was a new phenomenon and practice in Hastings County. Nonetheless, training for both programs as provided through Premergency Inc. was consistent among the programs and practitioners. As part of the training, the Hastings Quinte CPs accompanied experienced Renfrew community paramedics during their home visitations as part of the training practicum.

Recruitment of participants into the program was reflective of the challenges to be faced by medics due to the heightened morbidity of clients involved. The Study’s original work plan called for recruitment to conclude by December 31, 2014. This process was extended slightly due to the time-consuming nature of the recruitment process.

- Paramedic Services databases often do not have the most up to date telephone or address information. They may have moved, and as noted earlier, significant numbers of potential participants may have been either deceased or have moved with the past 12-18 months. This information is typically not available to the Paramedic Service and was therefore obtained, as much as possible, either by talking to other family members or making door to door visits. Although this is an extremely time-consuming process, it did enable both Hastings-Quinte and Renfrew Paramedic Services to get in touch with potential participants and avoid biasing the sample toward those easiest to reach. Door-to-door enquiries also enabled the Paramedic Services to update their databases, whether or not the PS client wished to take part in the study.
- Paramedic Services are unlikely to have the full suite of information from the various service providers from whom an individual client might receive service. As a result, it was not

clear whether all relevant diagnostic information was available to ascertain eligibility. Careful – and time-consuming – record-level review, including reference to paper-based systems was therefore required.

In order to best assess the impact of this intervention on clients with progressive chronic disease, a three year retrospective analysis was undertaken to plot all participants' utilization of paramedic, ER and hospital admissions. Among the intervention and control groups through the field phase, a comparative interruption in this utilization trajectory was postulated to inform the success of the trial. To better understand financial impact, activity based costing of healthcare service units was conducted with available information from paramedic services, hospitals and other primary care organizations. This included Community Care Access Centers (CCACs) and Family Health Teams (FHTs).

Results

Attrition through the field phase of the study was significant as shown in Table 2.

	Hastings-Quinte			Renfrew		
Status	Intervention	Control	Total	Intervention	Control	Total
Deceased	8	10	18	4	5	9
Moved	1	2	3	4	3	7
Hospitalized	4	1	5	2	0	2
Long Term Care	6	5	11	0	0	0
Unreachable	0	0	0	3	12	15
Withdrew	1	0	1	11	0	11
Discharged	0	0	0	1	0	1
Complete	46	42	88	15	20	35
TOTAL:	66	60	126	40	40	80

Table 2: Sample Disposition, by community and disposition status. Source: Study documentation.

Nonetheless, the data collected for paramedic service (PS) transports to ER are accurate for those clients who completed the study. This holds for both the field phase and for the three year retrospective data collection. A significant positive trajectory of utilization in this regard was noted for all clients, both urban and rural, throughout the 4 year period. This is consistent with the expected outcomes for progressive chronic disease.

Hastings-Quinte: Figure 3 above portrays both total visits to a hospital Emergency Room (Belleville or Trenton sites only) as well as the total number of transports via the Hastings-Quinte Paramedic Service over the four years considered in this Study. These data represent ER visits and transports for the 123 Study participants who remained in the Study for the entire twelve-month Field Phase:

- **Hospital ER Visits:** From 2012-2013 to 2013-2014, the number of ER visits (by any means of arrival) rose sharply for both Intervention and Control groups; this pattern would be expected of clients with progressive illnesses. ER visits by the Intervention Group declined in 2014-2015 and declined further in 2015-2016 (the Field Phase) (141 to 124). ER visits by the Control Group continued to climb in 2014-2015 before declining in 2015-2016 (200 to 159). The drop in ER visits for the Intervention Group might be expected due to the additional service rendered (Community Paramedicine) but

the decline in Control Group visits is counter- intuitive since this group did not receive CP services.

- **Paramedic Service Transports:** Transports to a hospital ER rose sharply from 2012-2013 for both the Intervention and Control Groups. PS transports declined in 2014-2015 (139 to 104) then remained flat through the Field Phase (104 to 106). By contrast, PS transports for the Control Group rose in 2014-2015, then declined somewhat in 2015-2016 (140 to 114). This latter result is counter-intuitive since this group did not receive CP services.

Renfrew County: Due to less than 100% participation in this Study by Renfrew hospitals, this portion of the analysis is based on Paramedic Service Transports only (which are comprehensive for all Study participants and all hospitals in the County).

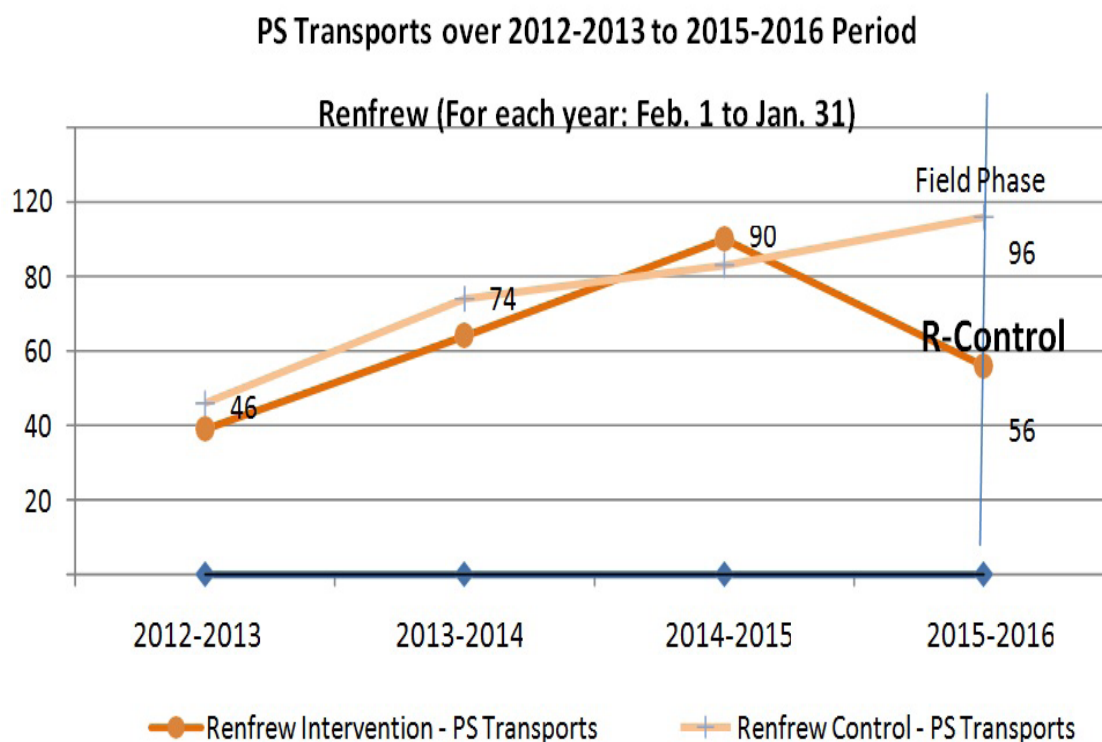
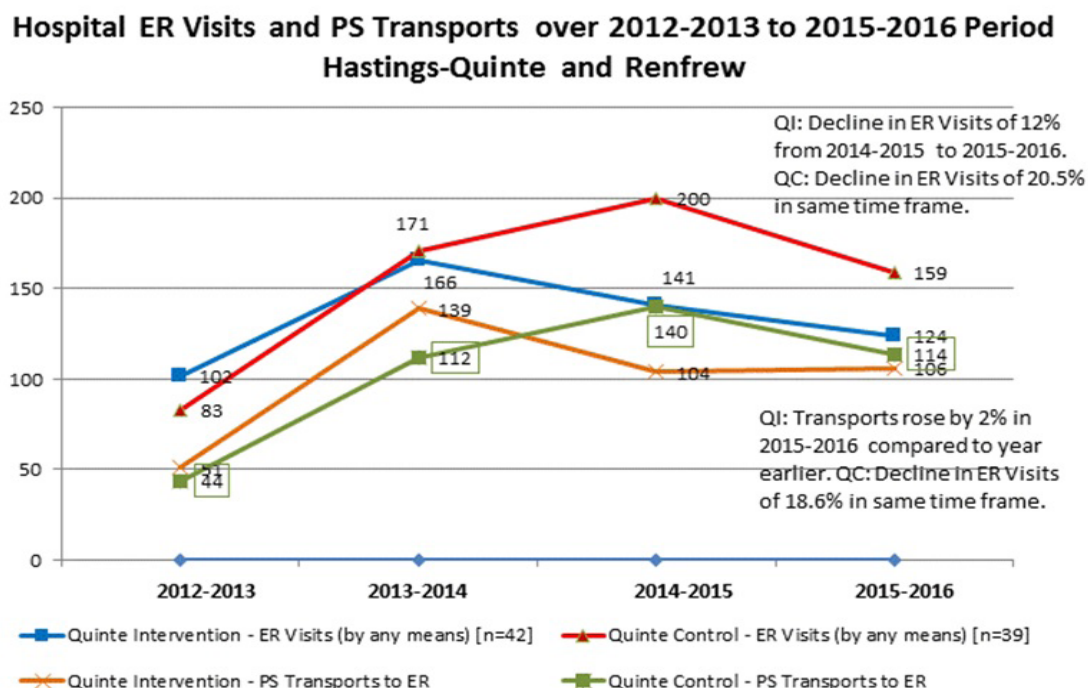
- **Paramedic Service Transports:** Transports to a hospital ER rose sharply from 2012-2013 through to 2014- 2015 then declined for the Intervention Group in 2015-2016 (from 90 to 56 transports).

Transports for the Control Group showed the same upward trend in earlier retrospective years, then continued the upward

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Paramedic Service Transports: Transports to a hospital ER rose sharply from 2012-2013 through to 2014- 2015 then declined for the Intervention Group in 2015-2016 (from 90 to 56 transports). Transports for the Control Group showed the same upward trend in earlier retrospective years, then continued the upward trajectory in 2015-2016 (from 83 to 96 transports). These results are what would be expected for one group receiving the Community Paramedicine intervention (Intervention Group) and the other receiving standard service (Control Group).



Figures 3 and 4: Hospital ER and Paramedic Service Transports for Hastings-Quinte and PS Transports for Renfrew

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To understand the overall intensity of health care service utilization, to be able to compare patterns of service utilization between communities as well as between intervention and control groups, and ultimately, to be able estimate the cost of health care services for the target population, the Study collected both retrospective and field phase data on the actual “units” of service received by the four sample groups. For this portion of the Study, a “unit” of service was defined by each health service provider for their services, as follows:

Hospitals: (data provided by Quinte Health Care, Renfrew Victoria Hospital, St. Francis Memorial Hospital and Pembroke Regional Hospital):

- A visit to the Emergency Room, arriving by any means (ambulance transport, walk-in or other self-transport)
- An admission to the hospital, to in-patient care for one or more days of stay.
- A day’s stay in in-patient care (utilization of an overnight bed).

Paramedic Services (data provided by the Hastings-Quinte and Renfrew Paramedic Services):

- A call to the Paramedic Service for possible transport purposes.
- A transport by ambulance to an Emergency Room. A transport could be from one hospital to another at which admission might take place. In this case, each transport would be considered as a separate “unit” of service.
- A community paramedicine visit. A visit is defined as the presence of the Community Paramedic at the client’s home, regardless of duration. Note that in addition to a physical presence at the clients’ home, Community Paramedics might also be in touch with other health care providers while away from the client’s home. This collaborative work is considered part of the “visit”.

Community Care Access Centres (data provided by the Champlain and South East CCACs):

- A visit by a nurse to the client’s home
- An hour’s service by a Personal Support Worker (PSW)
- A visit by a Physiotherapist
- A visit by an Occupational Therapist
- A visit by another health care professional working on behalf of the CCAC (“Other”).

Note that it was not possible to determine the extent of primary care services (e.g. physician visits) for the sample groups in this Study.

Table 5 provides a summary of the total number of units of all services provided to each of the sub-sample groups as well as to Hastings-Quinte sample, the Renfrew sample, and the entire Study sample. This figure tracks service utilization for those participants who remained in the Study for the full twelve months of the Field Phase. The figure is instructive in that it demonstrates the escalation of the specific target population’s health care service needs over the course of three retrospective years. This pattern is quite pronounced in both communities and suggests that significant chronic disease progression was taking place in the period leading up to the Study’s Field Phase. Table 6, describing average units of service per participant over the same timeframe, shows the same pattern.

While there appeared potential for cost mitigation due to decreased utilization of PS for the Renfrew intervention group, this was offset by the costs of the study service itself.

The approach taken to estimating the impact of Community Paramedicine as an Intervention for the particular target population (high frequency users of Paramedic Service transports plus the presence of one or more of five designated chronic conditions) is to compare the total extent of specific health care services provided to the sample groups and the associated costs, then to compare the Intervention and Control groups in each of the two communities (Hastings-Quinte and Renfrew County). The global costs for providing health care to the sample can be viewed retrospectively in the absolute (total dollar value) because the sample sizes for each sub-sample are identical. If in the Field Phase, the sub-sample sizes had remained identical in number (e.g. the same number of participants in each of the Intervention and Control groups), comparison of absolute costs would have been appropriate in the Field Phase as well. However, if the sub-sample sizes are quite

Total Service Utilization, in “Units” (n= refers to number of participants in sample or sub-sample)	2012-2013 (Retrospective) (# of units)	2013-2014 (Retrospective) (# of units)	2014-2015 (Retrospective) (# of units)	2015-2016 (Field Phase) (# of units)
Hastings-Quinte Intervention (n=46)	1,834	4,344	7,975	8,911
Hastings-Quinte Control (n=42)	774	2,489	4,960	4,879
Hastings-Quinte Total (n=88)	2,608	6,833	12,935	13,790
Renfrew Intervention (n=15)	2,805	4,274	7,810	7,079
Renfrew Control (n=20)	2,774	4,643	6,638	6,050
Renfrew Total3 (n=35)	5,579	8,916	14,447	13,129
STUDY TOTAL (Hastings-Quinte and Renfrew) (n=123)	8,187	15,749	27,382	26,919

Table 5: Total Units of Service for each sub-sample group, for each of three retrospective years and the field phase year. Note that this analysis tracks service utilization for the 123 Study participants who remained in the Study for the full 12 months.

Average Service Utilization, in "Units" (n= refers to number of participants in sample or sub-sample)	2012-2013 (Retrospective) (average # of units/pp)	2013-2014 (Retrospective) (average # of units/pp)	2014-2015 (Retrospective) (average # of units/pp)	2015-2016 (Field Phase) (average # of units/ pp)
Hastings-Quinte Intervention (n=46)	40	94	173	194
Hastings-Quinte Control (n=42)	17	54	108	106
Hastings-Quinte Total (n=88)	29	76	144	153
Renfrew Intervention (n=15)	100	153	279	253
Renfrew Control (n=20)	96	160	229	209
Renfrew Total (n=35)	98	99	161	146
STUDY TOTAL (Hastings-Quinte and Renfrew) (n=123)	48	97	171	172

Figure 6: Utilization of Unit Services.

different between communities and between the sub-samples in each of the two communities. It is therefore important to compare average costs per participant in each of the sub-samples rather than absolute costs. Regardless, the only way to obtain an average cost is to calculate the total cost then divide it by the number of Study participants in that sub-sample.

The total cost of health care services received by each of the Study samples has been derived by in four stages:

- Obtaining and consolidating Retrospective and Field Phase record-level data for all study participants, then identifying those participants who remained in the Study throughout the full twelve-month Field Phase.
- Obtaining and validating with health service providers (Paramedic Services, hospitals, Community Care Access Centres) the direct cost of a 'unit' of service
- Totalling the units of each service for each participant in each of the sub-samples
- Multiplying the total units of each service by the direct cost of a 'unit' of service as validated by the health care organization.
- Adding up all the costs of each type of service by sub-sample.

While there appeared potential for cost mitigation due to decreased utilization of PS for the Renfrew intervention group, this was offset by the costs of the study service itself.

The approach taken to estimating the impact of Community Paramedicine as an Intervention for the particular target population (high frequency users of Paramedic Service transports plus the presence of one or more of five designated chronic conditions) is to compare the total extent of specific health care services provided to the sample groups and the associated costs, then to compare the Intervention and Control groups in each of the two communities (Hastings-Quinte and Renfrew County). The global costs for providing health care to the sample can be viewed retrospectively in the absolute (total dollar value) because the sample sizes for each sub-sample are identical. If in the Field Phase, the sub-sample sizes had remained identical in number (e.g. the same number of participants in each of the Intervention and Control groups), comparison of absolute costs would have been appropriate in the Field Phase as well. However, if the sub-sample sizes are quite different between communities and between the sub-samples in each of the two communities. It is therefore important to compare average costs per participant in

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- Multiplying the total units of each service by the direct cost of a 'unit' of service as validated by the health care organization.
- Adding up all the costs of each type of service by sub-sample.

The following Table 7 shows total and average costs, year over year and summarily for all four groups:

Quinte: Based on the methodology described earlier, the total DIRECT cost of all services provided to the Quinte sample over the four-year period (2012-2013 to 2015-2016) was \$2.57 million for the Intervention group and \$1.44 million for the Control group, for a total sample cost of \$4.01 million (including the cost of Community Paramedicine). Without Community Paramedicine, the cost was \$3.74 million. The total cost of services was higher for the Intervention group than for the Control group, a phenomenon that carried through all four years of the Study, with or without the additional intervention of Community Paramedicine.

The average cost of services per Study participant for all four Study years (three retrospective and one Field Phase) was \$50,064 for the Intervention group and \$32,716 for the Control group. Again, the Intervention group average cost was higher than the Control group.

In the 2014-2015 retrospective year, the average per client cost for services utilized by the Intervention group was \$14,599 as compared to \$14,082 for the Control group. In the following year (Field Phase:

³Note that not all Renfrew County hospitals participated in the Study; as a result, the total units of service for both the intervention and control groups are almost certainly underestimated. However, the change in total service needs is still relevant and striking, particularly in the three retrospective years (2012-2013, 2013-2014, and 2014-2015).

Renfrew County					
	Dollar V	Dollar Value (\$)	Dollar Value (\$)	Dollar Value (\$)	Total
Service Utilized (Activity)	2012-2013	2013-2014	2014-2015	2015-2016	2012-2016
Intervention Group					
Transport to ER by Ambulance	\$ 19,511	\$ 32,658	\$ 46,844	\$ 29,730	\$ 128,743
ER Visit	\$ 1,173	\$ 1,963	\$ 2,366	\$ 4,270	\$ 8,598
Day Stay in Hospital	\$ 1,886	\$ 3,157	\$ 31,395	\$ 96,069	\$ 130,621
CCAC - PSW -Hour	\$ 151,235	\$ 232,485	\$ 456,667	\$ 415,539	\$ 1,255,927
CCAC - Nursing Visit	\$ 9,820	\$ 15,571	\$ 19,227	\$ 22,074	\$ 66,693
CCAC- PT	\$ 4,600	\$ 8,992	\$ 23,130	\$ 8,813	\$ 45,536
CCAC - OT	\$ 5,099	\$ 5,490	\$ 7,516	\$ 5,561	\$ 23,666
CCAC - Other	\$ 374	\$ 2,541	\$ 1,814	\$ 3,437	\$ 8,167
Total Activities (Units of Service) -All Types	193,697	\$ 302,858	\$ 588,959	\$ 585,494	\$ 1,667,950
Community Paramedicine Visits				\$ 158,896	\$ 1,826,846
Sample Size based on PS Data	N=28				
Average Per Participant (without Community Paramedicine)	\$ 6,918	\$ 10,816	\$ 21,034	\$ 20,911	\$ 59,570
With Community Paramedicine				\$ 26,585	
Control Group					
Transport to ER by Ambulance	\$ 23,013	\$ 37,761	\$ 43,201	\$ 50,966	\$ 154,941
ER Visit	\$ 8,591	\$ 14,096	\$ 13,286	\$ 9,468	\$ 36,850
Day Stay in Hospital	\$ 65,893	\$ 108,123	\$ 62,790	\$ 97,711	\$ 268,623
CCAC - PSW -Hour	\$ 143,202	\$ 252,741	\$ 376,861	\$ 324,690	\$ 1,097,493
CCAC - Nursing Visit	\$ 8,541	\$ 10,927	\$ 20,155	\$ 27,506	\$ 67,130
CCAC- PT	\$ 3,578	\$ 10,426	\$ 12,363	\$ 4,881	\$ 31,247
CCAC - OT	\$ 2,408	\$ 4,190	\$ 1,916	\$ 4,509	\$ 13,023
CCAC - Other	\$ 1,869	\$ 508	\$ 2,203	\$ 8,461	\$ 13,041
Total Activities	\$ 257,094	\$ 438,772	\$ 532,774	\$ 528,192	\$ 1,682,347
Sample Size based on PS Data	N=29				
Average Per Participant	\$ 8,865	\$ 15,130	\$ 18,372	\$ 18,214	\$ 58,012
Total Sample (Both Intervention and Control)	\$ 450,791	\$ 741,629	\$ 1,121,733	\$ 1,113,686	\$ 3,350,297
Total Sample in Community	57		Percentage of Total Starting Sample		71
Average Per Participant - All Services, All Participants	\$ 5,009	\$ 8,240	\$ 12,464	\$ 12,374	\$ 37,226
Additional Global Cost or Savings Per Participant for CP Service (Positive Number = Cost; Negative Number Implies Saving)				\$ 8,536	
Hastings-Quinte					
	Dollar Value (\$)	Dollar Value (\$)	Dollar Value (\$)	Dollar Value (\$)	Total
Service Utilized (Activity)	2012-2013	2013-2014	2014-2015	2015-2016	2012-2016
Intervention Group					
Transport to ER by Ambulance	\$ 24,241	\$ 67,389	\$ 51,429	\$ 53,466	\$ 201,759
ER Visit	\$ 20,686	\$ 34,339	\$ 29,751	\$ 26,687	\$ 114,712
Day Stay in Hospital	\$ 62,249	\$ 298,515	\$ 114,061	\$ 216,910	\$ 709,886
CCAC - PSW -Hour	\$ 85,466	\$ 198,097	\$ 422,450	\$ 412,722	\$ 1,140,418
CCAC - Nursing Visit	\$ 5,741	\$ 7,150	\$ 27,951	\$ 26,187	\$ 68,229
CCAC- PT	\$ 277	\$ 13,671	\$ 10,080	\$ 3,133	\$ 27,932
CCAC - OT	\$ 2,266	\$ 10,403	\$ 12,183	\$ 5,211	\$ 30,866
CCAC - Other	\$ 249	\$ 2,414	\$ 3,629	\$ 2,644	\$ 9,122
Total Activities (Units of Service) -All Types	\$ 201,175	\$ 631,978	\$ 671,533	\$ 746,961	\$ 2,302,923
Community Paramedicine Visits				\$ 263,627	\$ 2,566,550
Sample Size based on PS Data	N=46				
Average Per Participant (without Community Paramedicine)	\$ 4,373	\$ 13,739	\$ 14,599	\$ 16,238	\$ 50,064
With Community Paramedicine				\$ 21,969	
Control Group					
Transport to ER by Ambulance	\$ 20,913.41	\$ 54,298.83	\$ 69,231.01	\$ 57,501.30	\$ 201,945
ER Visit	\$ 16,832.95	\$ 35,373.53	\$ 42,200.00	\$ 34,219.98	\$ 128,626
Day Stay in Hospital	\$ 15,794.44	\$ 121,301.33	\$ 175,924.84	\$ 77,890.24	\$ 390,911
CCAC - PSW -Hour	\$ 23,471.74	\$ 87,110.29	\$ 248,457.00	\$ 274,463.64	\$ 633,503
CCAC - Nursing Visit	\$ 6,312.00	\$ 15,076.47	\$ 10,098.00	\$ 8,616.96	\$ 40,103
CCAC- PT	\$ -	\$ 4,611.76	\$ 8,160.00	\$ 2,643.84	\$ 15,416
CCAC - OT	\$ 1,133.22	\$ 8,091.18	\$ 10,742.00	\$ 3,874.98	\$ 23,841
CCAC - Other	\$ -	\$ 1,778.89	\$ 2,851.30	\$ 528.79	\$ 5,159
Total Activities	\$ 84,458.60	\$ 327,642.28	\$ 567,664.15	\$ 459,739.72	\$ 1,439,505
Sample Size based on PS Data	N=42				
Average Per Participant	\$ 2,011	\$ 7,801	\$ 13,516	\$ 10,946	\$ 34,274
Total Sample (Both Intervention and Control)	\$ 285,633	\$ 959,620	\$ 1,239,197	\$ 1,206,701	\$ 3,742,428
Total Sample in Community	90		Percentage of Total Starting Sample:		75
Average Per Participant - All Services, All Participants	\$ 3,246	\$ 10,905	\$ 14,082	\$ 13,713	\$ 42,528
Additional Global Cost or Savings Per Participant for CP Service (Positive Number = Cost; Negative Number Implies Saving)				\$ 2,526	

Table 7: total and average costs, year over year and summarily for all four groups.

2015-2016), the average per client cost for services utilized by the Intervention group rose to \$16,238 (an 11% increase) even without inclusion of the costs of Community Paramedicine. For this group, the reduction in costs associated with ER visits and CCAC services was overridden by increased utilization of increased days of in-patient hospital. By contrast, the average cost for the Control group dropped to \$10,946 – a drop of 23%; this was due to fewer units of service being required for all services except Personal Support Worker hours. These data suggest that the health status of the Intervention group may have been different than the Control group.

Renfrew: The total DIRECT cost of all services provided to the Renfrew sample over the four-year period (2012-2013 to 2015-2016) was \$1.83 million for the Intervention group and \$1.68 million for the Control group, for a total sample cost of \$3.50 million (including the cost of Community Paramedicine). Without Community Paramedicine, the cost was \$3.36 million. The total cost of services was lower for the Intervention group than for the Control group in 2012-2013 and 2013-2014. Total costs for the Intervention group exceeded the Control group for 2014-2015 and 2015-2016, with or without the additional intervention of Community Paramedicine.

In the 2014-2015 retrospective year, the average per client cost for services utilized by the Intervention group was \$21,034 as compared to \$18,372 for the Control group. In the following year (Field Phase: 2015-2016), the average per client cost for services utilized by the Intervention group fell slightly to \$20,911 (a 0.002% drop) without inclusion of the costs of Community Paramedicine. For this group, the reduction in costs associated with fewer transports to the ER, CCAC services (other than nursing visits) was counterbalanced by increased days of in-patient hospital care. The average per client cost for the Control group fell to \$18,214 – a 0.002% drop. This was due to more transports to the ER and higher levels of most CCAC services (particularly nursing) being counterbalanced by increased days in hospital. Note that hospital service utilization is almost certainly under-represented in the cost calculations due to the incomplete participation of Renfrew County hospitals.

Analysis

Dixon et al. state that ‘several changes in resource use are associated with the use of PP (Paramedic Practitioners) [8, 9].’ The UK PP RCT was far more focused on emergent care with 90% of medic visits being to assist with falls. The current study had a far broader scope in that the major effort was to manage elderly clients with chronic disease in their home; as such the impact on other service provision could be expectedly significant. For all four groups, a definitive and significant upwards trajectory was demonstrated with most service providers giving more care to clients over the four year period. This was seen most definitively in the three years prior to the Field phase.

An increased utilization finding for the Hastings Quinte intervention group compared to controls seems counter-intuitive. The Renfrew PS use curve is more consistent with our hypothesis that augmented primary care would divert clients away from scarce hospital resources and promote care at home. There are a number of potential explanations for these findings:

Agborsangya et al. portends that people having chronic conditions for a long period of time may alter their expectations, resulting in changes in their internal standards, values and conceptualization of HRQL (Health Related Quality of Life, a subjective measure), referred to as “response shift [5].”

As clients learn to self manage more appropriately their chronic disease(s), become more accustomed to them and learn to rely less on external support, expectations of what constitutes ‘good health’ are lowered. It is possible that the intervention in Hastings Quinte maintained patients’ expectations of good health and, as such, in the face of progressive disease, clients in the intervention group continued to seek hospital support compared to the control group who experienced true response shift.

Comparing the PS transports between all four groups also raises some interesting concepts. Improved collaboration with other primary and social care services with a more mature service as found in Renfrew County may have led to a greater ability to marshal the resources which are comfortable with home management, especially physicians remotely. Hastings Quinte may have, through their community partners, spawned more utilization of PS transports to err on the side of caution when confronted with a novel service.

Social isolation is considered a major health challenge [10], particularly for people with chronic disease(s). It could be considered that this isolation would be more acute in the rural environment of Renfrew compared to the urban settings of Belleville and Quinte West. As such, visitations and communications with the Renfrew Community Paramedic Service may have had a higher impact on those study clients who experience chronic social isolation.

Conclusion

A recent conversation held with a prominent Health Minister and the authors reflected the present thinking regarding healthcare expenditures. It is believed that healthcare costs cannot be lowered; only the rate of inflationary spending can potentially be curbed. While not the case proven in Beleville, there are indications from this study that CP service can be cost effective in many circumstance according to both this study and that of Dixon et al. [8]. The promise of leveraging technology to remotely monitor clients’ well being and status at home holds promise to allow CPs to follow a greater number of clients, reducing overall costs of the service.

The striking positive trajectory of healthcare resource utilization in people with chronic disease(s) (CDs) is a major finding of this study. CDs not only intensify, they give rise to multiple entities and multi-morbidities. At this point, the evidence confirms the highest use of resources [5]. Given the fact that the inclusion criteria for this RCT predicted that the highest system users would be the participants, the challenge presented overall to the CPs to reduce utilization through care at home may have been too ambitious.

This strong positive trajectory begs the question, at which point would it be more effective and efficient to provide this promising service to clients with chronic disease. The authors are unaware of evidence using community paramedicine in clients with a more recent diagnosis of chronic disease

To our knowledge, this is the first RCT which, over its course, provides a four year snapshot on specific healthcare services for those

people with congestive heart failure, chronic obstructive lung disease, hypertension, diabetes and stroke [11]. These findings are significant not only for community paramedics but also for other practitioners and decision makers who are looking at transforming the health status of patients with CD and multi-morbidities. Where and how to intervene in the trajectory of utilization remains a recommended area of further study.

Competing Interests

The authors declare that they have no competing interests

References

1. Health Quality Ontario. QMonitor (2012) 2012 Report on Ontario's Health System.
2. Canadian Institute for Health Information's (CIHI) High User's Symposium. 2014.
3. Ruest M, Stitchman A, Day C (2012) Evaluating the impact on 911 calls by an in-home programme with a multidisciplinary team. *International Paramedic Practice* 1: 125-132.
4. Canadian Safety and Security Program. Project Charter. Hastings-Quinte EMS – Economic Value of Community Paramedicine Programs. CSSP-2014-CP-2017.
5. Agborsangaya C, Lahtinen M, Cooke T, Johnson J (2014) Comparing the EQ-5D 3L and 5L: measurement properties and association with chronic conditions and multimorbidity in the general population. *Health Quality Life Outcomes* 12: 74.
6. Symposium Proceedings. Patient Reported Outcomes Measurement in Alberta. Potential of the EQ-5D.
7. O'Meara P, Ruest M, Stirling C, Martin A (2016) Community paramedicine model of care: an observational, ethnographic case study. *BMC Health Serv Res* 16: 39.
8. Dixon S, Mason S, Knowles E, Colwell B, Wardrope J, et al. (2009) Is it cost effective to introduce paramedic practitioners for older people to the ambulance service? Results of a cluster randomized controlled trial. *Emergency Medicine Journal* 26: 446-451.
9. Mason S, Knowles E, Colwell B, Dixon S, Wardrope J, et al (2007) Effectiveness of paramedic practitioners in attending 999 calls from elderly people in the community: cluster randomised controlled trial. 335: 919.
10. Public Health Agency of Canada (PHAC) (2011) What Determines Health?
11. Bigham B, Kennedy S, Drennan I, Morrison L (2013) Expanding Paramedic Scope of Practice in the Community: A Systematic Review of the Literature. *Prehosp Emerg Care* 17: 361-372.