Community Paramedicine Remote Patient Monitoring (CPRPM): Benefits Evaluation & Lessons Learned

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List of Appendices

Glossary of Terms

CHF	Congestive Heart Failure
COPD	Chronic Obstructive Pulmonary Disease
CIHI	Canada Institute for Health Information
CPRPM	Community Paramedic Remote Patient Monitoring
DAD	Discharge Abstract Database
ED	Emergency Department
EMS	Emergency Medical Service
FHS	Future Health Services
FTE	Full-time Equivalent
ICES	Institute for Clinical Evaluative Sciences
Infoway	Canada Health Infoway
MOU	Memorandum of Understanding
NACRS	National Ambulatory Care Reporting System
OHIP	Ontario Hospital Insurance Plan
OTN	Ontario Telemedicine Network
PCP	Primary Care Providers
PCT	Patient Client Time
PTP	Patient Time on Program
RPDB	Registered Persons Database
SCCDC	South Central Community Development Corporation

CPRPM Program Highlights

Total Patients Enrolled (as of December 2017) Patient in Evaluation (enrolled by June 2017)	1109 745
Total Retention (>3 months on program)	650/745 (87%)
Total # of Devices	1,922
Total # of Device Readings	368,510
Total Medical Alerts	28, 703 (1 Alert / 12.8 Readings)
# of Paramedic-Patient Coaching Interactions	3, 281
911 Call Reduction (Interdev)	26% (453 Calls)
Time Reallocated to Paramedic Services Total Savings to Paramedic Services	764 Hours $331, 576
Actual Reduction in ED Transport (Interdev) Actual Reduction in ED Visits (ICES)	31% (460 Transports) 26% (467 ED Visits)
Actual Reduction in Hospital Admissions (ICES)	32% (170 Admissions)
Actual Reduction in Hospital Readmissions (ICES)	35% (18 7-day Readmits) 41% (59 30-day Readmits)
Estimated Savings to Overall Health System (650 patients)	$ 4,731,350 $7,279/patient
Estimated Cost to Implement CPRPM Program (assuming 6-month program duration)	$ 737,100 $1,134/patient
Estimated ROI to Overall Health System	542%

Chapter 1: Introduction

1.1 Background

In chronic conditions such as congestive heart failure (CHF) and chronic obstructive pulmonary disease (COPD), there is a growing shift from doctor-driven care towards more patient-centered integrated care with active involvement of and self-management by the patient and/or family members. The Community Paramedicine Remote Patient Monitoring (CPRPM) program enlists the expertise of community paramedics to provide at-home patient education and remote patient monitoring services to people living with CHF and/or COPD. The program also included patients with co-morbidities of diabetes and hypertension (high blood pressure). Patients living with CHF, COPD, diabetes or hypertension, are often regarded as 'high users' of the healthcare system. To be enrolled in the CPRPM program, patients had to have a diagnosis of CHF and/or COPD as well as a minimum of either three 911 calls, two ED visits or one hospitalization in the 12 months prior to enrollment.

As of December 2017, CPRPM had enrolled 1109 patients in Ontario. As the target program duration was six months, 745 patients were eligible to be included in the evaluation as they were enrolled prior to June 30, 2017. Of the 745 eligible, 650 patients (87%) participated in the program for longer than three months. The 13% that did not complete the program either deceased within the first 3 months (3%), were hospitalized, moved to long term care facilities or involved in other programs (3%), were not cognitive enough or found it difficult to take daily readings (6%), or devices would not connect due to cellular network access issues (1%). Funded by Canada Health Infoway, Future Health Services (FHS) has managed all aspects of the program including onboarding Emergency Medical Services (EMSs), supporting EMS services in recruiting and on-boarding patients, conducting in-depth analytics on patient data, and communicating results to policy makers and funding partners in the broader healthcare community. FHS is a wholly owned subsidiary of the South Central Community Development Corporation (SCCDC), that provides telehome monitoring services to chronically ill patients in Southern Ontario.

High-level goals were established for the CPRPM program as follows:

1. Help patients take a more active role in self-managing their conditions so they can stay in the comfort of their home longer;
2. Provide access to medical professionals who can provide real-time coaching and feedback to patients on how to better manage their conditions and proactively respond to concerns in a more timely manner (as opposed to a reactively respond to 911 calls);
3. Reassure patients their health is being monitored in an effort to provide comfort and decrease stress and anxiety;
4. Build a circle of care around the patient that would allow the community paramedic to share results with primary care providers and family members via the Patient Portal; and
5. Reduce costs and burden on the health care system through reduced 911 calls, ED visits and hospitalizations.

1.2 CPRPM Overview

The intervention was a home-based remote patient monitoring system that transmitted data about a patient's health status from home to healthcare providers through the patient use of at-home medical devices. Consistent with the definition of telemonitoring (Paré et al. 2007), patients use medical devices to take daily biometric readings and transmit this information via a communications network to a secure health tracking and information management platform (IdealLife®). The platform generates two types of alerts:

1) Non-Compliance alerts: When no readings have been recorded within a 24-hour period;

2) Medical alerts: Alerts when readings of blood pressure, weight, oxygen saturation, and/or blood glucose are outside the patient's clinical thresholds (either too high or too low), as established by a clinical advisory board (i.e., primary care physicians and chronic disease specialists).

Both types of alerts are logged in the platform's task manager tool used by the health provider – in this case, the community paramedic. A recent trend in health care and health promotion recognizes paramedics as an important health human resource, especially relevant to home telemonitoring, as they are uniquely mobile in most communities (Abrashkin et al. 2016; Knodel 2014). Paramedics have always been trained to assess emergencies and treat life-threatening situations, but in the last decade the scope of practice for paramedics has expanded (Boyle 2017) to include assessment of chronic illnesses (Mason et al. 2008); provision of alternative care pathways to facilitate further assessment, treatment, and follow-up (Cooper et al 2008); and providing home-based health promotion education and chronic illness surveillance (Shah et al. 2010).

Implementation of the home telemonitoring system was managed by the CPRPM program. Program guidelines, documentation and training procedures were designed and modified to align to the goals of the program. Table 1.2.1 describes the features and program tasks for both patients and providers.

Telemonitoring Feature	Feature Description	Role of Paramedic	Role of Patient
Daily Readings (BP cuff, oximeter, glucometer, scale).	Daily readings capture information about patient vital signs.	Daily trend analysis on the patient readings.	Take daily readings
Medical Alert Detection	Alerts the provider there has been a discrepancy. Compliance alerts detect when a patient has not taken readings in more than 24 hours. Medical alerts detect when patient's vital signs are outside of normal range.	Manage daily workflow to check and filter priority of alerts.	Patient does not receive alerts but they learn what their readings should be and when they need to retake a reading (e.g., blood pressure).
Compliance Alert Communication	Communication protocol between the patient and the paramedic related to taking daily readings.	Contact patients that are out of compliance, check 'contacted' box to date and time stamp that patient contact was made.	Receive message from provider reminding them to take daily readings.
Patient Portal	Internet site used by the patient, paramedic and other invited stakeholders to share program-specific information.	Visit the portal to share information with patient and other stakeholders.	Use the portal to track readings,
Medical Alert Communication	Communication protocol between the patient and the paramedic related to clinical readings outside of normal range.	Contact patient, check 'contacted' box to date and time stamp that patient contact was made, and review and document a set of validation and clinical questions.	Answer validation and clinical questions.
Medical Alert: Blood Pressure Example	Validation Questions: • Was the cuff properly placed on the same arm you usually take it on? • Was your arm at heart level or below? • Were you sitting when you took it? • Did you take your Blood Pressure medication as directed? At what time? • Have you been doing strenuous activity in the past 30 minutes?		Clinical Questions: • Are you having chest pain? • Are you short of breath? • Do you have a headache? • Are you anxious or upset?
Task (Interaction) Manager	List of alerts, alert filter and tasks (e.g., call patient, left message, call back).	Daily workflow to filter by alert type, check tasks, and add new tasks.	Patient does not have direct access to these technology features.
Notes Repository	Free form text box used to capture information about task (interaction) and specific patient information.	Take notes to document relevant information related to the task and action recommended.	
Change Alert Thresholds	Changes medical thresholds used by the system to generate alerts.	Get consent (written or verbal) from primary care provider and document in notes repository. Make updates to patient-specific reading thresholds as directed.	Take subsequent readings to validate need to adjust alert thresholds. Communicate with paramedic.
Technical Support	Traffic table – system reports when batteries are low, connectivity low etc.	Maintain functionality of devices by repairing and/or replacing devices.	Report device problems if necessary.

Table 1.2.1: Features of the CPRPM System

All features of the home telemonitoring system, with the exception of alert detection, were voluntary in terms of use. Providers and patients were trained using carefully developed guidelines and protocols established by an independent Clinical Advisory Committee (CAC) with clinical specialist representation.

Semi-annual meetings with paramedics provided the opportunity to discuss and revise guidelines and protocols where appropriate. In addition, a Paramedic Advisory Board (PAB) met monthly and provided a forum for paramedics and other program stakeholders to share feedback and identify possible improvements to the CPRPM program.

Chapter 2: System Benefits

2.1 Evaluation by Patient Level

To be eligible for the CPRPM program, patients had to have CHF and/or COPD, may have a comorbidity of diabetes or hypertension and must satisfy one of the following conditions indicative of patient acuity.

- Level 0: At least one hospitalization in the last 12 months (41%)[1];
- Level 1: At least 2 ED visits (measured by EMS transports) in the last 12 months (15%);
- Level 2: At least 3 911 calls in the last 12 months (44%).

The distribution of the 650 patients across these three levels is indicated in the brackets. As the average number of 911 calls ranged from 3 to 30 for Level 2 patients, an additional level of acuity was created to stratify results. Level 3 patients were defined as those with greater than 5 911 calls pre-program. The average number of 911 calls for Level 3 patients was 8.43; as such, components of the evaluation further stratify Level 3 patients to provide additional interpretation and clarity. By adding additional levels, the distribution adjusted to the following:

- Level 0: At least one hospitalization in the last 12 months (41%)
- Level 1: At least 2 ED transports in the last 12 months (15%)
- Level 2: 3-4 911 calls in the last 12 months (21%)
- Level 3a: 5-8 911 calls in the last 12 months (15%)
- Level 3b: >8 911 calls in the last 12 months (8%).

Emergency (911) call data and Emergency Medical Service transport data was available through Interdev Technology Solutions (Interdev). Interdev is the largest data management and solutions provider for paramedic services in Ontario. They capture real-time 911 call management data and hospital transport data and manage that data to meet the specific needs and requirements of paramedic services.

Hospitalization Data (i.e., Discharge Abstract Database (DAD)) and Emergency Department (ED) data (National Ambulatory Care Reporting System (NACRS)) were available through the Institute for Clinical Evaluative Sciences (ICES). ICES is a non-profit organization that applies the study of health informatics for health services research and population-wide health outcomes research in Ontario, Canada. The challenge with ICES is a 6+ month lag in data availability which meant that there was a smaller sample set of patients for full analysis. As such, system benefits were evaluated using two approaches:

Interdev Evaluation: Interdev data was used to evaluate pre-program and on-program 911 calls and hospital transfers. Interdev released pseudonomized patient data to the CPRPM program on a monthly basis allowing for regular tracking of 911 calls and hospital transports. This data was linked using the CPRPM ID# that was uniquely assigned for each patient. All patients that were enrolled by June 2017, participated on the program for 3 or more months and had consented to participate in the evaluation were included in the analysis. As Interdev did not have hospitalization data, only patients with pre-12 month program activity that included at least 2 ED visits (Level 1) or at least 3 911 calls (Level 2 & 3) were included in the Interdev evaluation.
Of the 650 patients that had participated in the program for more than 3 months by December 31, 2017:

- 66 patients (10%) could not be linked to Interdev databases. (These patients may been referred to the program from a 3rd party partner such as a local hospital or primary care clinician.);
- 240 patients (37%) had fewer than 2 ED transports or fewer than 3 911 calls and therefore could not be analyzed using Interdev data. (This can happen for a few different reasons. It might have been that patients were enrolled due to one hospitalization (Level 0) during the 12-month period preceding their enrollment. Another reason is that patients were referred in from another source and were felt to meet the overall program criteria.)
- 344 patients (53%) were therefore remaining in scope for the Interdev Evaluation. For details see Section 2.2 below.

I**CES Evaluation**: The project Sponsor was aware of some of the limitations with the Interdev data from the beginning and proposed a more formal ICES evaluation to evaluate pre-program and on-program data. Specifically this included all ED visit data (including those who came by ambulance (captured above), as well as those who walk/drove themselves), as well as hospital admission and readmission data (7-day and 30-day). As ICES releases data on a 6-month cycle this limited the window we could use for analyzing our patient data. The final ICES evaluation was completed in January/February 2018 using patient data up to September 2017. The CPRPM program provided ICES with a list of 460 patient OHIP numbers for patients who had signed the CPRPM enrolment form and provided their express consent to be part of the project evaluation with ICES.
To further protect patient identity, ICES matched the OHIP number to an ICES key number. The ICES key number could not be identified for 8 patients, 2 patients had duplicate records, 1 patient could not be linked to all requested databases (see below) and 6 patients were missing required demographic information. In total, 17 of these patients were removed, resulting in a total of 443 patients eligible for analyses.

Due to delay in ICES data availability, patients enrolled by April 1, 2017 were included in the on-program analysis allowing for 5 months of on-program data to be analyzed. The project and evaluation teams felt reducing the on-program threshold from 6-months (N=212 patients) to 5-months (N=294 patients) was worthwhile to increase the sample size. Patients discharged by May 31, 2017 (N=182) were also included in a post-program analysis that analyzes ED visit, hospital admission and readmission data for 3 months after patients were discharged to determine whether benefit of the CPRPM program was sustained or deteriorated after patients were discharged.

[1] While this was a criteria the CPRPM program did not have access to this data so it was not used for patient selection. The large percentage of patients in this level were likely referred to the CPRPM program by community partners.

The ICES evaluation included data from the following linked databases.

- Canadian Institute for Health Information (CIHI)'s Discharge Abstract Database (DAD)
- CIHI's National Ambulatory Care Reporting System (NACRS)
- MOHLTC's Ontario Hospital Insurance Plan Claims Database (OHIP)
- MOHLTC's Registered Persons Database (RPDB)

2.2 Interdev Evaluation

The average 911call reduction across all levels was 26% (see Table 2.2.1) ranging from 14% for low acuity patients (Level 1) to 37% for very high acuity patients (Level 3b). The average ED transport reduction was 31% ranging from 15% for low acuity to 46% for very high acuity. The combined impact of ED transport reduction and 911 call reduction is explained by the changes in the **transport rate**. The transport rate represents the percentage of times a patient is transported to the ED after a 911 call. The 89% pre-transport rate average means 89 out of 100 patients that called 911 pre-program were transported to the ED. The reduction to 85% post-program means paramedics were able to address the issue in the home for an additional 5/100 patients as opposed to transporting them to hospital. This is a net 6% reduction in patient transports to emergency. The transport rate reduction is significantly higher (15%) for very high acuity patients (Level 3b) suggesting a significant benefit of RPM for this cohort as EMS is addressing acute situations in the home as opposed to transporting patients to hospital.

Graphing the 911 call trend across the program month (12 months pre-program with 6 months on-program) provides further insight into how the CPRPM program influenced 911 call reductions. The cumulative trend (top line in Figure 2.2.2) shows pre-program 911 calls increasing over time, then starting to decrease at Month +2 post enrollment and increase again at Month +5/6 when patients often start to come off the program. The other three lines indicate the average monthly 911 calls for three levels of patients – Level 1 is the lowest line, Level 2 the second, and Level 3 the third line from the bottom. As the graph illustrates, there was no significant change pre-program vs on-program for Level 1 patients (2 ED transports in previous 12 months) and only a moderate effect for Level 2 (3 or more 911 calls) likely because these patient groups started with relatively few ED transports and/or 911 calls. However, the 911 call reductions for high and very high users (Level 3) is a direct consequence of the program. Rather than waiting until there is an acute episode, the RPM data alerts the paramedic of a developing issue and they are able to intervene early. This suggests the core program objective is being achieved – particularly for those patients requiring frequent use of 911 services.

	Low Level 1	Moderate Level 2	High Level 3A	Very High Level 3B	Total / Average
Total (N)	**90**	**122**	**90**	**42**	344
% of Total	26%	35%	26%	12%	100%
Pre 911 Calls	180	421	554	588	1,742
Post 911 Calls	155	324	438	372	1,289
911 Calls Reduced	25	97	116	216	453
911 Call Reduction	**14%**	**23%**	**21%**	**37%**	**26%**
Pre ED Transports	177	380	454	470	1,481
Post ED Transports	150	273	346	252	1,021
ED Transports Reduced	27	107	107	217	460
ED Transport Reduction	**15%**	**28%**	**24%**	**46%**	**31%**
Pre Transport Rate	98%	90%	82%	80%	89%
Post Transport Rate	97%	84%	79%	68%	84%
Transport Rate Reduction	2%	7%	3%	15%	6%

Table 2.2.1: 911 Call and ED Transport Reduction by Level

The graph (Figure 2.2.2) also provides insight into the eligibility criteria for the program. Data by level is displayed for Level 1 (bottom line), Level 2, Level 3, and Total (top line). As there are higher 911 reductions associated with Level 2 and Level 3 patients, focusing program enrollment on patients with 3 or more 911 calls (pre-12 months) is likely to increase the overall benefit of the CPRPM program. This said, it is important to also be aware that the program may help keep less acute patients at home safely and may prevent or delay their conditions from becoming more acute. This is an area for future research and further investigation. **As 56% of patients enrolled between April 2015 and June 2017 were Level 0 and Level 1, the program is encouraged to enroll a higher percentage of Level 2 and 3 patients moving forward. Doing so will likely further improve the net business case for the program.**

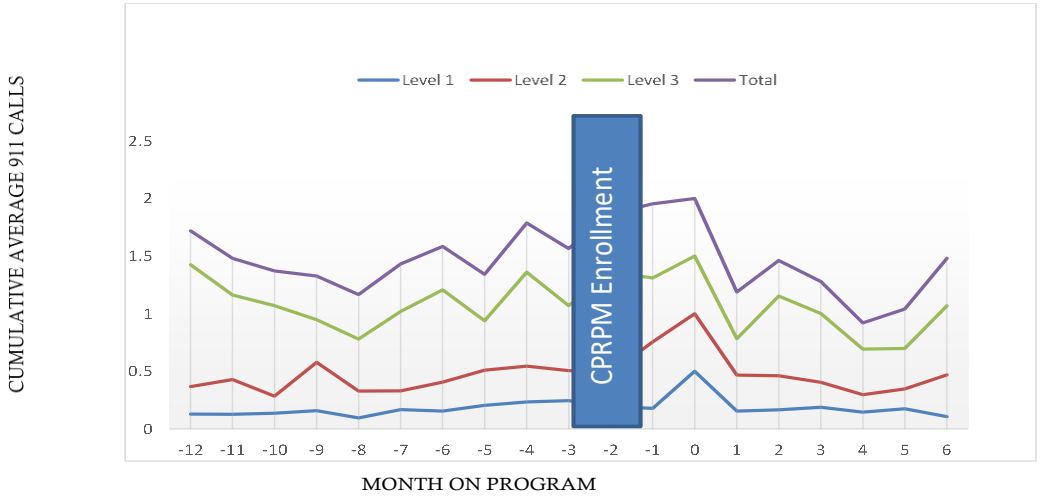

Figure 2.2.2: Pre-Post 911 Call Activity

2.3 Benefits by Patient Time on Program (PTP)

Analysis by Patient Time on Program (PTP) (Figure 2.3.1) draws attention to the possible limitations of discharging patients prior to the 6 month enrollment target. Although 911 call reductions are evident for moderate (Level 2) and very high (Level 3b) acuity patients, benefits for low and high acuity are not as clear. The result for low (Level 1) acuity patients may be because they started with relatively few 911 calls, but the negative result for high acuity patients (Level 3a) is interesting. One explanation is that it takes time (at least 2-3 months) for benefits of the program to start to be realized. Patients need to get used to using the technology, and change their behavior and only then do the benefits start to appear. So discharging patients after 6 months (or earlier) may have negative program implications for some patient cohorts. Other cohorts, specifically moderate (Level 2) and very high (Level 3b) patients, suggest there is an immediate benefit of the RPM program. Short-term reduction in 911 calls is attributed to patients being monitored daily and paramedics responding to alerts as opposed to patients turning to the hospital for care.

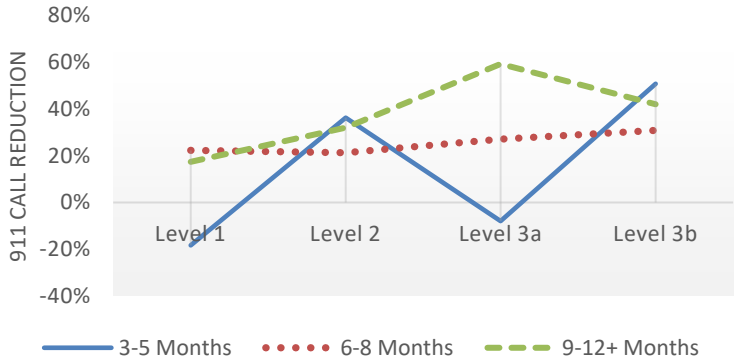

Figure 2.3.1: 911 Reduction by Level and Patient Time on Program (PTP)

The overall program benefit is more consistent for patients on the program longer than 5 months. This result suggests patients learn how to use the technology, make changes to adapt and change their lifestyle, and reduce use of the healthcare system (i.e., reduced 911 calls and ED transports). While the analysis does show benefits appearing after 5 months on the program, it is not all that clear what happens post 6-months – whether patients maintain these reduced service demand levels, or pre-program behaviors reappear. The ICES evaluation provides some insight into the post discharge impact and whether or not patient learning while on-program will sustain benefits after patients are discharged. This is a priority for future research and evaluation.

As the original intent of the program was to discharge patients after 6 months, insights from the patient cohort who remained on the program >6 months was unexpected. Interviews with paramedic staff concluded that in some cases, paramedics felt very uncomfortable removing the equipment – particularly for patients who were very frail and may have been living alone. So our hypothesis is that these individuals were already frail and complex and given the lack of other supports may have grown dependent on the RPM program. Several paramedics and patients surveyed said they felt the program reduced their stress and anxiety knowing someone was "keeping an eye on them". When allowed to stay on the program longer, the benefits appear to increase. A note of caution however is the costs incurred to generate these benefits also increase as the EMS remains responsible for responding to patient alerts and supporting patient needs.

2.4 Benefits by Diagnosis and Demographics

Figure 2.4.1 illustrates 911 Call and ED transport reductions by patient demographics. All age groups saw a positive and meaningful reduction in 911 call and ED transport volumes. Younger patients also saw neutral to positive reduction in transport rates[2] highlighting the ability for paramedics to deal with situations in the home as opposed to transporting these patients to hospital. Older patients called 911 less; however, when they called 911 while on the program they were more likely to be transported to hospital. One interpretation of this result is that the RPM program helped older patients learn when it was appropriate to call 911. When they called 911, the situation was urgent and needed hospitalization for treatment and management. Alternatively, perhaps having the RPM program in place made both patients and paramedics more comfortable avoiding a patient transport to the ED as they could 'keep an eye' on the patient remotely once the patient was assessed. Older populations requiring more frequent hospital care is not surprising, it is the impact of the RPM program to reduce 911 calls for older patients that is important.

Overall benefits did not vary significantly by patient condition. Diabetes patients had lower 911 call reductions but higher transport reduction rates (24% reduction), suggesting patients are calling 911 only 10% less often but paramedics are better able to deal with their issues in the home. We also looked at patients with one comorbidity (e.g., one of CHF, COPD or Diabetes) versus two or three. The data shows that patients with one chronic condition experienced a 29% reduction in 911 calls, a similar 32% reduction in ED transports resulting in only a 4% reduction in transport rate. Surprisingly, patients with 2 conditions had only a 18% reduction in 911 calls but a higher ED transport reduction (27%) resulting in a 9% reduction in transport rate (i.e., an improvement in the paramedics ability to deal with patient condition in the home). The most significant benefit was for patients with 3 chronic conditions with a 44% 911 call reduction and 47% ED transport reduction; even with 3 conditions, paramedics were able to reduce transport rates by 7% which is very impressive.

[2] Transport rate is the # of ED transports divided by the # of 911 calls. A reduction in transport rate means paramedics are able to manage 911 calls at home as opposed to transporting to hospital. A negative reduction may be because a patient condition is getting more severe over time and paramedics are less able to deal with patient issues in the home or the CPRPM program is helping patients learn when calling 911 to transport to hospital is needed and necessary.

		911 Call Reduction			ED Transport Reduction			Transport Rate Reduction		
	N	Pre	Post	%	Pre	Post	%	Pre	Post	%
Female	182	983	646	34%	832	535	36%	85%	83%	2%
Male	164	761	643	15%	649	486	25%	85%	76%	10%
Total/Average	**346**	**1,744**	**1,289**	**26%**	**1,481**	**1,021**	**31%**	**85%**	**79%**	**6%**
18-34 Years	1	5	2	52%	5	2	52%	100%	100%	0%
35-49 Years	10	63	40	37%	57	36	36%	90%	91%	-1%
50-64 Years	51	281	255	9%	244	159	35%	87%	62%	25%
65-74 Years	89	466	338	27%	361	251	30%	77%	74%	3%
75-84 Years	116	579	456	21%	511	368	28%	88%	81%	8%
85-94 Years	70	319	169	47%	278	179	36%	87%	106%	-19%
95+ Years	9	32	28	14%	25	25	-1%	78%	92%	-14%
Total/Average	**346**	**1,744**	**1,289**	**26%**	**1,481**	**1,021**	**31%**	**85%**	**79%**	**6%**

Table 2.4.1: 911 Call and ED Visit Reduction by Patient Demographics and Condition

		911 Calls			ED Transports			Transport Rate		
	N	Pre	Post	Reduction	Pre	Post	Reduction	Pre	Post	Reduction
CHF	169	801	592	26%	685	496	28%	86%	84%	2%
COPD	245	1274	926	27%	1079	734	32%	85%	79%	5%
Diabetes	59	256	231	10%	217	140	36%	85%	60%	24%
Total/Average	**473**	**2331**	**1749**	**25%**	**1981**	**1370**	**31%**	**85%**	**78%**	**7%**
1 Comorbidity	230	1195	851	29%	1018	692	32%	85%	81%	4%
2 Comorbidities	103	497	409	18%	411	302	27%	83%	74%	9%
3 Comorbidities	13	47	27	44%	47	25	47%	100%	93%	7%
Total/Average	**346**	**1739**	**1287**	**26%**	**1476**	**1018**	**31%**	**85%**	**79%**	**6%**

Table 2.4.2: Reduction by Patient Demographics and Condition

The purpose of analyzing benefits related to patient demographics and diagnosis is to better understand the target population for the CPRPM program and which groups will yield the best outcomes. Patients with COPD and CHF generate similar results, patients with only one condition are suitable for the program, and patients with all three conditions provide significant opportunity for CPRPM moving forward.

2.5 Benefits to Paramedic Services

The bars in Figure 2.5.1 illustrate the number of patients across each of the paramedic services. The data table for benefits by paramedic service is included in Appendix A. The average 911 call reduction was 26% and ED transport reduction was 31% across paramedic services. Results suggest services adopted different approaches for implementing the CPRPM program. Some services had higher ED transport reductions indicating a strategy to provide patients with care in the home to prevent transports to hospital and other services had higher 911 reductions suggesting a strategy that encourages patients to leverage community paramedics as opposed to calling 911. There may be additional strategies as well. **The CPRPM program is encouraged to explore different CPRPM-related strategies as a way to recognize that the technology can be used in a variety of ways to generate different benefits.**

To further explore the influence of paramedic services on system benefits, 911 call and ED transport reduction results were compared to an evaluation of how well each service adapted their day-to-day routines to implement the CPRPM program. Section 6.4 provides a full description of this evaluation, but in short paramedic service adaptation is the capability of the paramedic service to implement and sustain CPRPM tasks into the day-to-day workflow of the paramedic service. Services high in adaptation were also high in 911 and ER visit reduction. This means that EMS services that dedicated resources and provided strong leadership for the program generated better results. Programs such as CPRPM are difficult to get up and running because they are very different from the traditional 'lights and sirens' part of the business, require new supporting structures (i.e., funding, routines, roles and responsibilities) and staff with different skills.

Services with lower # of patients tended to have higher 911 and ED Visit reductions suggesting perhaps that lower patient enrollments allowed services more time and resources to coach patients and provide extra feedback. Services with higher enrollments and high reductions (i.e., Essex-Windsor, Renfrew) reported having to dedicate significant time and energy to the CPRPM program. The point here is that because there were differences in how the program worked in different communities this lead to some variation in the program. In general, achieving optimal benefit includes services onboarding a critical mass of patients, targeting patients with frequent 911 calls and/or ER Visits, and allocating sufficient paramedic resources to patient interactions to produce meaningful patient and health system outcomes.

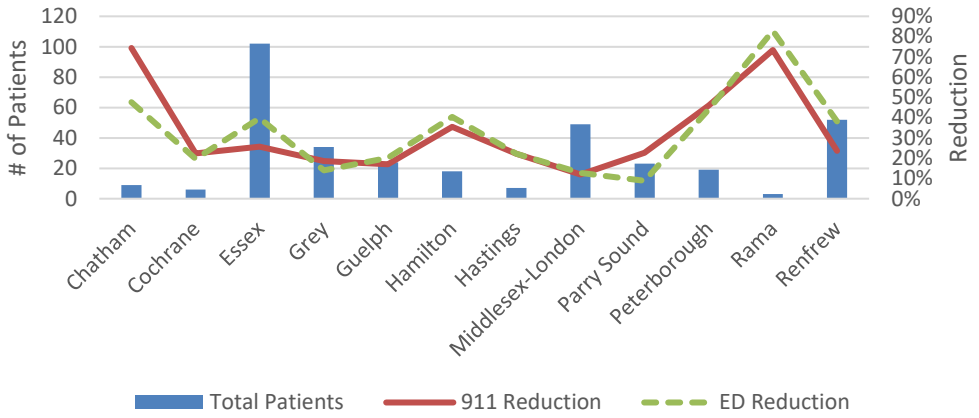

Figure 2.5.1: 911 and ED Reduction by Paramedic Service

2.6 Cost to Implement CPRPM

The total cost to implement the CPRPM program is estimated to be **$189/month** that includes the cost of equipment ($75/month) plus a cost category created for this evaluation called *Paramedic Client Time (PCT)* estimated at $114/month. PCT was estimated by analyzing the 5,593 notes analyzed in the behavioral evaluation (full data tables in Appendix B). Table 2.6.2 shows the breakdown that describes how the $114/patient monthly cost was calculated. It takes into account the average number of patient interactions, the time spent coaching, and the time spent documenting notes. The total time was divided by the number of patients as well as the average patient time on program (PTP) to determine the monthly time per patient for each service. The average was weighted according to the number of patients for each service (i.e., Grey had 33/212 = 15% of patients, so their average cost of $135 was given a weight of 15% in the final average). This cost structure (Table 2.6.1) was discussed with paramedics in June 2017 and used to calculate the standard rate for paramedic client time (PCT) for the program.

Cost Category	Description	Sources
Home Visit (12% of interactions)	30 minutes: Travel Time to Scene (TTS) + Time at Scene (TAS)	Source: City of London / Middlesex County
Phone Call (88% of interactions)	5 minutes	CPRPM Paramedic Interviews
Note Taken	2 minutes	
Cost Per In-Service Hour	$175/hour. Adjusted from $217/hour average in-service hour to remove the 19.8% of time paramedics spend in hospital[3].	2016 Municipal Benchmarking Network Canada (DMS Total Cost per Weighted Vehicle In-Service Hour)

Table 2.6.1: Cost Categories for Paramedic Client Time (PCT)

[3] 'In-Service Hour' refers to only the hours that vehicles are available for service. Costs include paramedic, administrative, medical supply, building, operating, supervision and overhead.

			Coaching Time		Documentation Time		Paramedic Client Time ($434/Hour)			
	#Patients Interactions		Total Coaching Time (Hours)	Time / Patient	Total Doc Time	Time / Patient	Total Time / Patient	Average Patient Time on Program	Patient Time / Month (Hours)	Monthly Cost
Chatham	6	82	10.9	1.82	16	2.65	4.47	6.86	0.65	$114
Cochrane	9	68	9.1	1.01	13	1.45	2.46	9.43	0.26	$ 46
Essex-Windsor	81	1314	175.2	2.16	249	3.07	5.23	7.67	0.68	$119
Grey	33	850	113.3	3.43	161	4.86	8.30	10.74	0.77	$135
Guelph	5	66	8.8	1.76	12	2.49	4.25	5.97	0.71	$125
Hastings	6	18	2.4	0.40	3	0.57	0.97	10.15	0.10	$17
Parry Sound	9	43	5.7	0.64	8	0.90	1.54	8.60	0.18	$31
Peterborough	19	312	41.6	2.19	57	2.97	5.16	5.28	0.98	$171
Renfrew	44	635	84.7	1.92	120	2.72	4.64	7.77	0.60	$104
Total / Average	**212**	**3,388**	**451.7**	**1.70**	**638**	**2.41**	**4.11**	**8.08**	**0.65**	**$ 114**

Table 2.6.2: Average Paramedic Client Time (PCT)

On average, the ratio for time spent coaching and time spent documenting notes was 60:40[4]. Documenting patient notes provides many benefits that will be discussed further in Chapter 6. Although the average service spent 4.11 hours, the average time spent by services that had the highest patient adaptation rates as determined in Chapter 6 was 26% higher (5.20 hours)[5]. Using the ratio and an average PTP of 6 months, it is recommended that the CPRPM program consider setting a standard 3 hours documentation and 2 hours coaching per CPRPM patient over the 6 month period. Making an added investment in coaching and documentation would increase the cost to $215/month but it is believed this would have an off-setting clinical benefit as well (not calculated)[6]. These recommended standards are illustrated by the dotted lines in Figure 2.6.3) to show some services invested more hours/patient coaching and documenting and other services invested less. Effort to standardize the approach will make the patient experience more consistent across services allowing services to share best practices and leverage solutions (i.e., patient portal) to improve the overall program benefit moving forward.

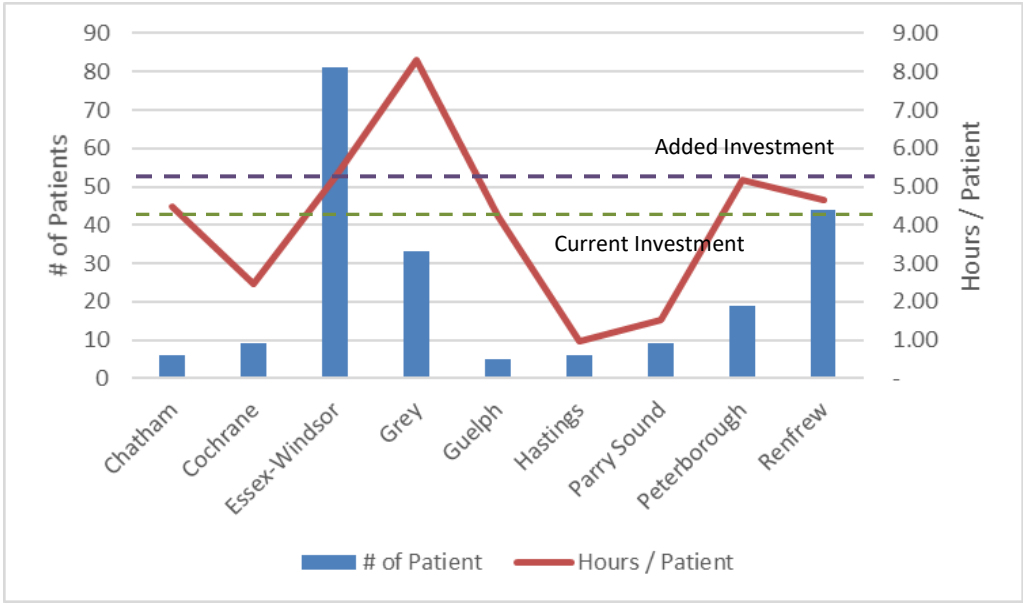

Figure 2.6.3: Paramedic Client Time (PCT) by Service

[4] Avg coaching time 1.70/4.11 total time = 41% and Avg documentation time 2.41 /4.11 total time = 59%.

[5] Average of Essex (5.23) and Peterborough 5.16 = 5.20 hours

[6] 4.11 hours = $114/month so an increase to .5.00 hours = $140 + $75 = $215/month.

2.7 Savings to Paramedic Services

The CPRPM program resulted in total savings of $331,576 attributable to EMS Services. The source of the savings is 764 reallocated service hours as a result of overall reductions in both 911 calls and ED transports (see Table 2.7.2). It is important to note that these are not savings that go directly back to the service, they are expected benefits in terms of reallocating paramedic time to generate the most benefit for patients, the paramedic and the broader healthcare community. For example, when a transport to hospital is prevented, it is estimated to save 100 minutes of paramedic time that could be reallocated to monitoring and coaching patients and documenting their interactions to help patients learn to better manage their conditions, use telemonitoring devices more effectively, or determine when they need to seek help. It could also mean the paramedic has time to have lunch preventing their service from incurring a missed meal premium or a reduction in overtime. There is also cost avoidance savings of not having to add additional vehicles and paramedics as result of not meeting response time targets. Table 2.7.1 provides the estimates, descriptions and sources used to calculate savings to paramedic services.

Table 2.7.2 provides a summary of savings across paramedic services. Although the average is $117/patient/month, savings range from $29 (Grey) to $357 (Peterborough). Lower savings/month should not be interpreted as a negative result, it is not savings that go directly back to the service. It is recommended services use this indicator to manage patient enrollment (i.e., patients will higher 911 calls pre-program offer more potential savings/month) as well as evaluate the influence of patient time on program (PTP) to recognize there is a cost to paramedic services for keeping patients on the program longer than 6 months. For example, both Guelph and Middlesex London reallocated approximately 40 hours but as Guelph's average PTP is lower (5.81 months) their savings per patient per month is higher ($120/month).

Savings Category	Description	Sources
911 Call with Transport	100 minute average: 75 minutes (Urban) – 120 minutes (Rural)	Source: City of London / Middlesex County
911 Call no Transport	Travel Time to Scene (TTS) + Time at Scene (TAS)	Source: City of London / Middlesex County
Cost Per In-Service Hour	$434/hour is the $217/hour average in-service hour for municipalities x 2 to add the 50% provincial contribution[7].	2016 Municipal Benchmarking Network Canada (DMS Total Cost per Weighted Vehicle In-Service Hour)

Table 2.7.1: Savings Categories for Paramedic Services

			Reallocated Service Hours			Paramedic Service Cost Savings		
	N	PTP	911 Call and Transport	911 Call Only	Total Time Saved	Cost Savings	Savings / Month	Savings / Patient / Month
			100 minutes	30 minutes	Hours	$434 / Hour		
Chatham	9	7.27	51	9	60	$ 26,103	$ 3,590	$ 399
Cochrane	6	6.87	10	1	10	$ 4,348	$ 633	$ 105
Essex-Windsor	102	7.55	288	(13)	275	$ 119,450	$15,824	$ 155
Grey	34	11.84	23	3	27	$ 11,661	$ 985	$ 29
Guelph	24	5.81	40	(1)	39	$ 16,736	$ 2,883	$ 120
Hamilton	18	7.25	56	(0)	55	$ 23,985	$ 3,309	$ 184
Hastings	7	11.12	12	-	12	$ 5,308	$ 477	$ 68
Middlesex London	49	6.50	39	2	41	$ 17,878	$ 2,750	$ 56
Parry Sound	23	7.99	13	8	21	$ 9,047	$ 1,132	$ 49
Peterborough	19	5.32	80	4	83	$ 36,045	$ 6,774	$ 357
Rama	3	12.56	10	0	10	$ 4,369	$ 348	$ 116
Renfrew	52	8.30	146	(16)	130	$ 56,535	$ 6,811	$ 131
Total / Average	**346**	**8.20**	**767**	**(4)**	**764**	**$ 331,576**	**$40,446**	**$ 117**

Table 2.7.2: Summary of Estimated Paramedic Service Savings

[7] 'In-Service Hour' refers to only the hours that vehicles are available for service. Costs include paramedic, administrative, medical supply, building, operating, supervision and overhead.

2.8 Savings to Hospitals (ICES Evaluation)

Hospital savings resulting from the CPRPM program were evaluated using both the Interdev and ICES data analysis. First, 911 call reduction and ED transport reduction data from the Interdev analysis (346 patients) were translated into hospital savings using estimates (see Table 2.8.1). All estimates were based on 460 ED transport reductions.

Next, results from the Institute for Clinical Evaluative Sciences (ICES) were evaluated to determine actual ED visit, admission, and readmission reductions for a smaller **(294 patients)** cohort. To compare results, benefits were calculated per patient.

Table 2.8.2 provides a summary of estimated hospital savings. Based on estimates, the CPRPM program decreased 460 ED transports resulting in an estimate of 299 avoided hospital admissions and 2,123 avoided hospital days (assuming an Average Length of Stay of 7.1 days). The total cost savings to hospitals for the 346 patients included in the Interdev analysis is estimated to be $2,326,547 ($6,724/patient).

Table 2.8.3 provides a summary of estimated hospital savings using ICES data. An actual reduction of 467 ED visits (26%) and 170 hospital admissions (32%) were avoided. ICES also provided actual readmission reductions showing a 35% reduction in 7-day readmits and 41% reduction in 30-day readmits. The Average Length Of Stay of 7.1 days was used to calculate the total number of avoided hospital days. The total cost savings to hospitals for 294 patients included in the ICES analysis is estimated to be $1,856,994 ($6,316/patient)[8].

As the ICES data resulted in reductions that were very consistent with the Interdev results, the level of confidence in the net result is felt to be very high. Specifically, the average ED visit reduction was slightly lower with the ICES analysis (26%) suggesting that Interdev results may be over estimated for ED transport reductions; however the reduction in admissions between pre-program and on program was very consistent (31% and 32% respectively). As the majority of hospital costs are incurred by admissions, consistency in admissions between the two approaches is very important.

Savings Category	Description	Sources
ED Visit Reduction	Cost of Exacerbation of COPD – Moderate: $515/ED Severe: $774/ED **Average: $644**	Source: COPD in Ontario: Health, Care and Costs, Canadian Foundation for Healthcare Improvement, 2015.
Hospital Admissions	CHF Patients: 68.7% Average COPD: 63% Average: 65%	Source: BMJ Qual Saf 2014: 23: 981-988 (CHF) and Gershon et al. 2013: AJRCCM 187(6): 596-601 (COPD).
Average Length of Stay (ALOS)	ALOS for CHF in Ontario: 6.5 days ALOS for COPD and Bronchitis in Ontario: 7.8 days Average ALOS for both: 7.1 days	CIHI (2012): Readmission to Acute Care.
Net hospitalization cost	CHF Average Cost/Day in Ontario: $868 COPD Average Cost/Day in Ontario: $1,041 Average net cost per day: $954	CIHI (2012): Readmission to Acute Care.

Table 2.8.1: Estimates Used for Interdev Analysis of Hospital Savings

	Interdev (12 months)			
	Pre-Program	**On Program**	**Savings**	**Reduction**
ED Visits	1481	1021	460	31%
Admissions (65% admitted)	963	664	299	31%
% of ED Visits Admitted	65%	65%		
# of Readmissions (7 Days)	Not Included			
% of ED Readmitted (7 Days)				
# of Readmissions (30 Days)				
% of ED Readmitted (30 Days)				
Hospital Days (7.1 Days Estimate)	6,835	4,712	2,123	31%
Total Hospital Savings - ED ($655 Estimate)	$ 970,055	$ 668,755	$ 301,300	31%
Total Hospital Savings - Admissions ($954/day Estimate)	$6,520,414	$4,495,167	$2,025,247	31%
Total Hospital Savings	**$7,490,469**	**$5,163,922**	**$2,326,547**	**31%**
Total Savings / Patient (N =346)			**$ 6,724**	

Table 2.8.2: Summary of Estimated Hospital Savings (Interdev analysis)

[8] Hospital costs only included admissions and 30-day readmissions as 7-day readmissions were represented in the 30 day readmission total.

	Pre-Program	On Program	Savings	Reduction
ED Visits	1,780	1,313	467	26%
Admissions	535	365	170	32%
% of ED Visits Admitted	30%	28%	2%	8%
# of Readmissions (7 Days)	52	34	18	35%
% of Admissions Readmitted (7 Days)	10%	9%	1%	10%
# of Readmissions (30 Days)	143	84	59	41%
% of Admissions Readmitted (30 Days)	27%	23%	4%	14%
Hospital Days (7.1 days Estimate)	4,814	3,188	1,626	34%
Total Hospital Cost - ED ($655 Estimate)	$ 1,165,900	$ 860,015	$ 305,885	26%
Total Hospital Cost - Hospital Days ($954/day Estimate)	4,592,365	3,041,256.60	1,551,109	34%
Total Hospital Savings	**5,758,265**	**3,901,272**	**1,856,994**	**32%**
Total Savings / Patient (294 patients)			**$ 6,316**	

Table 2.8.3: Summary of Estimated Hospital Savings (ICES analysis)

Further evaluation is currently underway to examine the impact of CPRPM on length of stay using ICES actual hospitalization data. As this was outside the original scope of this evaluation, results are preliminary and require further evaluation. As illustrated in Appendix C, the average length of stay prior to joining the program was 4.9 days (versus the provincial 7.1 day average based on CIHI data). Patients admitted the hospital while being on the CPRPM stayed for an average of 5.8 days. We expect this result is indicative of the deteriorating condition of patients that participated on the CPRPM program. That said, we feel this needs further analysis as the project team felt targeted patients were at least as ill as average CHF and COPD patients (CIHI 7.1 day length of stay). While the decrease length of stay may lower the total savings per patient, the program benefits still outweigh the costs.

2.9 Sustainable Impacts of CPRPM

The sustainable impacts of CPRPM were evaluated to determine if the benefits from being on the program (with target enrollment of 6 months) continued once patients were discharged. Due to the project timing we elected to use a post discharge timeframe of 3 months that yielded data for 182 patients. (Note: Selecting a longer post-discharge timeframe would have significantly reduced the number of patients for analysis. It is recommended this be revised at some future date using a longer post-discharge timeframe to validate these findings over a longer period.) Table 2.9.1 compares 12-month pre-program, 5-month on program, and 3-month post discharge ED visits, admissions. Total numbers were adjusted by number of months in order to compare reductions using monthly totals.[9] No results are reported for 7-day and 30-day re-admissions due to insufficient data[10].

Results show that without the CPRPM program, some costs return to the health care system. In other words, keeping patients enrolled in CPRPM keeps them out of hospital. Patients who were discharged from the CPRPM program experienced a 34% reduction in ED visits and increased by 6% in the 3 months after being removed from the program.

Figure 2.9.2 graphically illustrates the pre-on-post program trend to highlight the benefits of being on the CPRPM program. While these results are quite limited given they are based on only 182 patients and only include 3 months of post-program data, it shows monthly ED visits and go down as a result of being on the CPRPM program and start to increase again post discharge. Further evaluation will be conducted once more ICES data becomes available but early results suggest costs return to the health care system. In other words, patients return to hospital when they do not feel comfortable the support of the CPRPM when attempting to self manage their chronic condition from home.

[9] Monthly averages for on program (5 months) and post discharge (3 months) were used to calculate 12 month estimates.

[10] ICES policy dictates that call cell counts smaller than six must be suppressed.

Total Patients (N) = 182	Pre	On	(-)	Post	(-)
ED Visits / Month	86	57	34%	60	-6%
Admissions / Month	26	15	44%	17	-17%
% of ED Visits Admitted	31%	26%	5%	29%	-3%

Table 2.9.1: Pre-On-Post Discharge ED Visit and Admission Reductions (-) (ICES analysis)

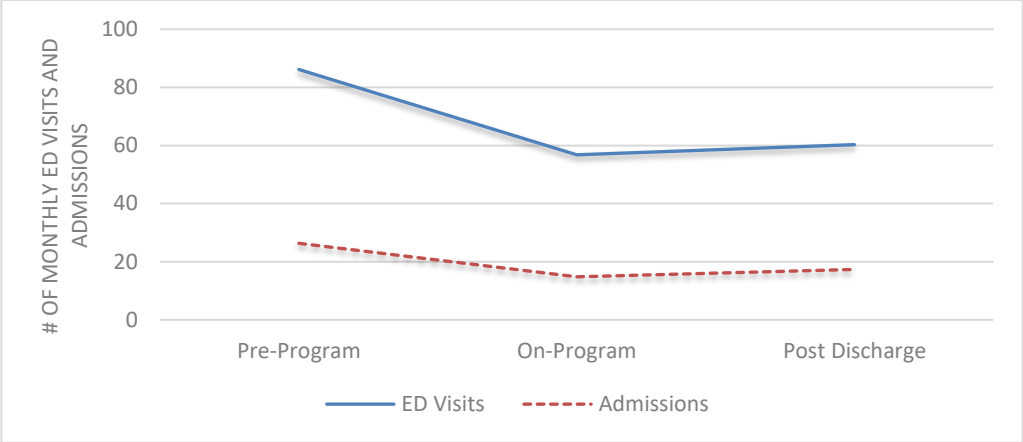

Figure 2.9.2: Pre-On-Post Discharge Trend (ICES analysis)

2.10 CPRPM Return on Investment

Although the Interdev evaluation generated higher per patient benefits, the lower actual savings per patient from the ICES evaluation ($6,316) was used to calculate CPRPM return on investment as it was believed this figure was more accurate (See Table 2.8.3). Table 2.7.2 estimates EMS savings per patient was $958 ($331,576 total savings/346 patients) and Table 2.8.3 explains hospital savings of up to $6,316/patient. Table 2.10.1 extends the total program benefit to the 650 patients that completed the program to show a total savings of $**4,728,100** from the CPRPM program. Using the cost of $189/patient/month and assuming patients participate according to the 6 month target, the ROI to the overall health system is 541%. **For each $1 invested, there is a net $5 savings to the health system!**

As the majority of the benefits from CPRPM accrue to the health system as a result of reduced ED Visits and Hospital Admissions (as opposed to reduced 911 calls), long-term sustainability of the program is dependent on equitable sharing of program costs and benefits. The benefits of $958 accruing to EMS does not cover the $1,134/patient cost of running the program. To create a net positive return, as well as build capacity and commitment to effectively manage and dedicate resources to the CPRPM program, it is recommended the funding model be designed to generate a significant ROI for all parties involved. The proposed funding model (Table 2.10.2) includes cost structures for both the basic service as well as an extended service that includes additional funding for increased investment in coaching and documentation (see Section 2.6). The proposed funding model generates a net ROI of 541% using the current (basic) service model and still generates a net ROI of 464% if the service model is extended to add resources for additional coaching and patient support.

	Per Patient	#	Total Savings/Costs
EMS Savings	$ 958	650	$ 622,700
Hospital Savings	$6,316	650	$4,105,400
Total Savings	**$7,274**	**650**	**$4,728,100**
Hospital ED Savings	*$1,040*	*650*	*$ 676,000*
Hospital Admission Savings	*$ 3,917*	*650*	*$2,546,050*
Hospital Readmission Savings	*$1,359*	*650*	*$ 883,350*
Technology Costs ($75/month)	$450	650	$ 292,500
Monitoring Costs ($114/month)	$684	650	$444,600
Total Costs ($189/month)	**$1,134**	**650**	**$737,100**
ROI			**541%**

Figure 2.10.1: Estimated CPRPM Program ROI

	EMS	LHIN	Total
CPRPM Cost Savings / Patient	$ 958	$ 6,316	$ 7,274
Overall Benefit Allocation	13%	87%	100%
6-month Cost Allocated ($189 Basic Service)	$ 147	$987	$ 1,134
Overall Cost Allocation	13%	87%	100%
Return on Investment (Basic Service)	**552%**	**540%**	**541%**
6-month Cost Allocated ($215 Extended Service)	$168	$1,122	$1,290
Return on Investment (Extended Services)	**470%**	**463%**	**464%**

Table 2.10.2: Recommended Funding Model

Chapter 3: Program Enrollment

3.1 Overall CPRPM Patient Enrollment

A total of 1109 patients across 14 Emergency Medical Services (EMSs) were enrolled in the program between April 2015 and December 2017. The overall enrollment trend (top line) by month is illustrated in Figure 3.1.1. On average, **29 patients were enrolled per month** (minimum 14 and maximum 56). The linear trend line shows an increase in patients enrolled/month over the lifecycle of the program.

As paramedic services joined throughout the program (started with 3 and increased to 14), the average number of patients enrolled (right axis) is also displayed in Figure 3.1.1 (bottom line). On average, services enrolled **4 patients/month**. There was an initial downward trend in patients/month due to large enrollments at the launch of the program. By October 2016, patient enrollment stabilized and an upward trend is evident from October 2016 to June 2017.

3.2 Emergency Medical Service (EMS) Enrollment

The program launched in April 2015 with three EMSs (Essex-Windsor, Grey County, and Renfrew County). Three additional services joined in 2015 Cochrane (June), Peterborough (July) and Parry Sound (September). Six services were added between April –November 2016. As of June 2017, eleven services remained on the program.

Only one service (Peterborough) left the program. They participated for 6 months (last patient enrolled November 10, 2015). An exit interview was conducted in April 2016, key points are summarized below.

- Overall, Peterborough felt the program was a success and this was communicated to local council in their final report;
- The County had only allotted funding for one paramedic for six months;
- The service communicated that their LHIN was told that on-going funding from OTN was conditional on no longer continuing with CPRPM;
    - It should be noted that this was not the understanding of the South Central Community Development Corporation (SCCDC), the Sponsor for CPRPM, or by Canada Health Infoway which fund both programs in Ontario. It was unclear how this information miscommunicated to Peterborough EMS or the LHIN;

Trends in enrollment were partly impacted by uncertainty surrounding annual Community Paramedicine funding from the Ministry. Due to lack of longer-term sustainable funding, some services had difficulty committing to the program given the longer-term requirements. This changed in February 2017 when the Ministry announced permanent LHIN funding to support Community Paramedicine programs going forward.

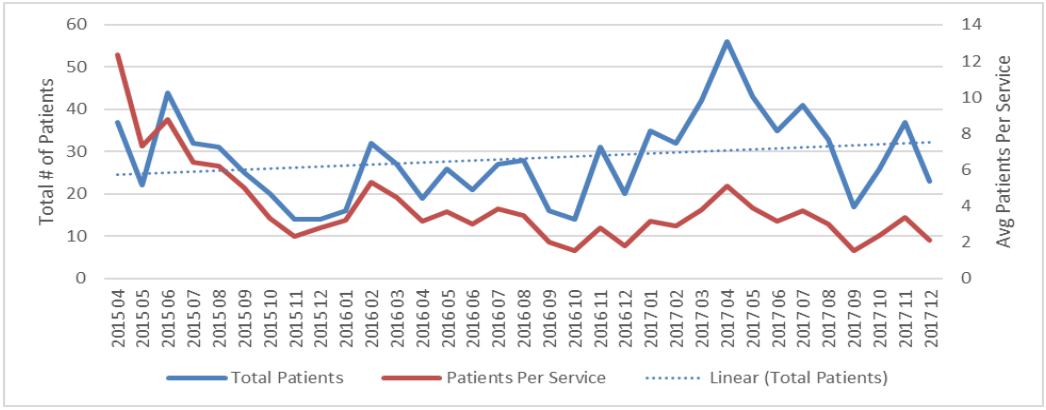

Figure 3.1.1: Total Enrollment by Month

- The patient portal feature of the program was not delivered during their participation, despite early intentions of it being up and running within six months of program start. They believed this contributed to lack of engagement from primary care providers;
- Despite the patient portal challenge, they thought the CPRPM program team's support was "top notch".

Figure 3.2.1 displays the total number of patients enrolled by each paramedic service as well as each services' monthly average enrollment (line graph). The numbers in brackets indicate the total number of months the service was on the CPRPM program.

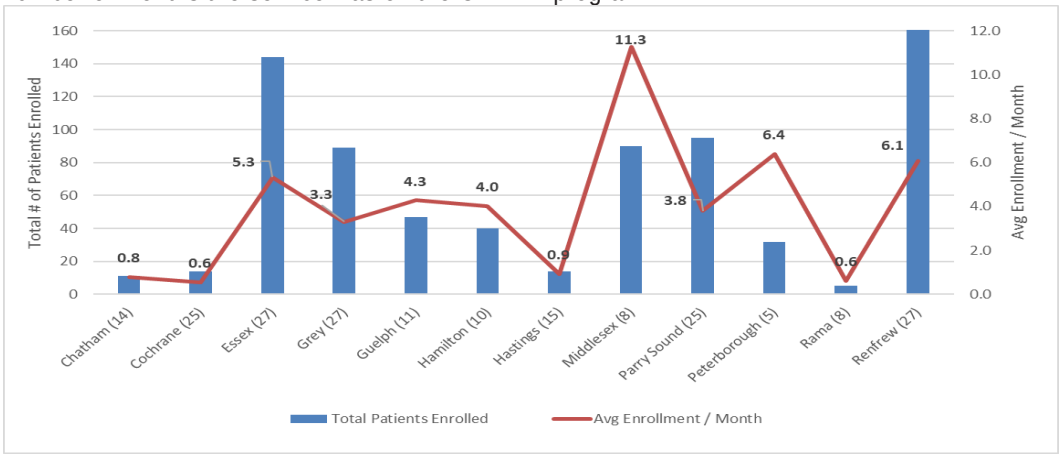

Figure 3.2.1: Enrollment by Paramedic Service

The bars on the graph show high enrollments achieved by Essex-Windsor, Grey County, Parry Sound, Middlesex-London and Renfrew County. The line graph shows services with above average enrollment per month include Essex-Windsor, Middlesex-London, Peterborough and Renfrew.

Services on the program longer tended to have higher monthly enrollments with some exceptions including Cochrane and Grey. EMS services on the program for long periods of time with low overall enrollment numbers consume significant resources (e.g., administration, support, etc.) and should be encouraged to increase average monthly enrollments moving forward.

3.3 Patient Retention

Eighty seven percent (87%) of the 745 patients **(650 total)** remained on the program for more than 3 months. There were five primary reasons patients left the program during the first three months:

- Non-compliant: 46 patients, 6%
  - Patients were not cognitive enough, had difficulty taking readings, or felt they did not need the program (zero alerts).
- Deceased within first 3 months on program: 22 patients, 3%
- No Longer Qualified (i.e., hospitalized, long-term care): 12 patients, 1.5%
- Refused Service: 12 patients, 1.5%
  - Patient felt the program was too much for them, they asked to be discharged early, and in some cases the patient had to leave CPRPM as a requirement of participating in OTN
- Technology issues: 3 patients, <1%
  - Devices would not connect due to access to network.

Overall, attrition is caused by patients not being cognitive enough, experiencing difficulty using the devices, being too sick to be on the program, or just refusing the service. These results suggest severity of patients' medical condition is an important enrollment consideration for the CPRPM program.

Demographic and diagnosis data for patients that did not complete the program are summarized in Table 3.3.1. Results were compared with patients that completed the program (Table 3.5.1). Although it seems patients with COPD and only one comorbidity have higher attrition rates, they also had higher enrollment rates so results were insignificant. One significant result is that female patients appear to be more challenging to retain on the program.

		Gender Summary		Diagnostic Summary			# of Comorbidities		
Years	**Total**	**Male**	**Female**	**CHF**	**COPD**	**Diabetes**	**1**	**2**	**3**
35-49	0								
50-64	13	7	6	8	6	3	8	3	1
65-74	22	8	14	13	15	3	20	4	1
75-84	32	15	17	19	10	4	18	6	1
85-94	24	8	16	16	20	2	22	5	2
95+	4	2	2	2	3		3	1	0
Total	**95**	40	55	58	54	12	71	19	5
Average	100%	42%	58%	61%	57%	13%	75%	20%	5%
Completed	100%	49.5%	50.5%	49.5%	69.5%	19%	66%	30%	4%
Avg Age	77.49	76.20	78.40	77.29	78.98	72.42	78.87	75.00	75.40
Completed	77.49	75.90	81.36	83.26	75.20	88.50	78.81	85.61	74.54

Table 3.3.1: Patient Demographic and Diagnostic Summary (Did Not Complete)

Table 3.3.2 summarizes retention rates across all paramedic services. A simple calculation (# Patients Completed/Total Enrolled) resulted in a **90%**[11] average retention rate ranging from 68% to 100%. These results raise some interesting questions such as did some EMSs do a better job screening patients? Why did some EMS services seem to do a better job keeping patients on the program? Did better retention rates correlate with better outcomes? The CPRPM program is encouraged to track retention rates across EMSs to identify potential issues with regard to training and set clear expectations to EMS services regarding patient retention results and the impact on program benefits and savings.

	Total Enrolled	Total Did Not Finish	Retention Rate	Months on Program
Chatham	11	2	82%	14
Cochrane	14	0	100%	25
Essex-Windsor	144	22 (8 Deceased)	90%	27
Grey	89	11 (4 Deceased)	92%	27
Guelph	47	5	89%	11
Hamilton	40	15 (2 Deceased)	68%	10
Hastings	14	1	93%	15
Middlesex London	90	7	92%	8
Parry Sound	95	12 (3 Deceased)	90%	25
Peterborough	32	4 (2 Deceased)	94%	5
Rama	5	0	100%	8
Renfrew	164	16 (3 Deceased)	92%	27
Total / Average	745	95 (22 Deceased)	90%	17

Table 3.3.2: Patient Enrollment and Attrition Rate by Paramedic Service

[11] Deceased patients were removed from the overall retention rate calculation.

3.4 Patient Time on Program (PTP)

Figure 3.4.1 categorizes the 650 patients who met the minimum 3 month retention period by the number of months they participated on the program. Throughout the evaluation, categorization of patients by the number of months they participated is referred to as 'Patient Time on Program' or PTP. Appendix D provides the data tables related to PTP analysis. The average PTP was **7.89 months** (> 6 month program target). Patients participated beyond the 6 month target for the following reasons:

- Paramedics found it difficult to take technology away from patients who really needed it; in fact, EMSs were willing to incur the expense beyond the 6 month funding period for patients that they felt needed the program;
- Patients felt the program provided value as many patients expressed an interest to stay on the program longer in the 'comment' section of the discharge survey.

Although there were clear patient benefits for staying on the program longer, a limitation was that equipment was not available to be redeployed and paramedics were continuing to devote time to patients that had already experienced the benefits of the program.

The line in Figure 3.4.1 illustrates the average number of alerts per month for each of the PTP categories. The average alerts/month increased the longer patients stayed on the program (i.e., longer PTP = more alerts/month). Most interesting is the increase in slope after 8 months on the program suggesting the patients paramedics kept on the program had higher needs and paramedics were responding to alerts to keep patients stay out of hospital.

Figure 3.4.2 illustrates patient time on program (PTP) analysis across EMSs. Averages range from 5 months (Peterborough) to 13 months (Chippewas of Rama First Nation). Illustrating the average PTP (dots) compared to the total number of patients that completed the program (bars) for each paramedic service highlights the challenges (i.e., limited funding, support) faced by some of the paramedic services in terms of implementing the CPRPM program. It is also recommended that services that have high average PTP but relatively few patients on the program (i.e., Hastings, The Chippewas of Rama First Nation, Cochrane) be monitored and encouraged to enroll more patients and discharge those who may not experience benefit beyond the targeted 6 months.

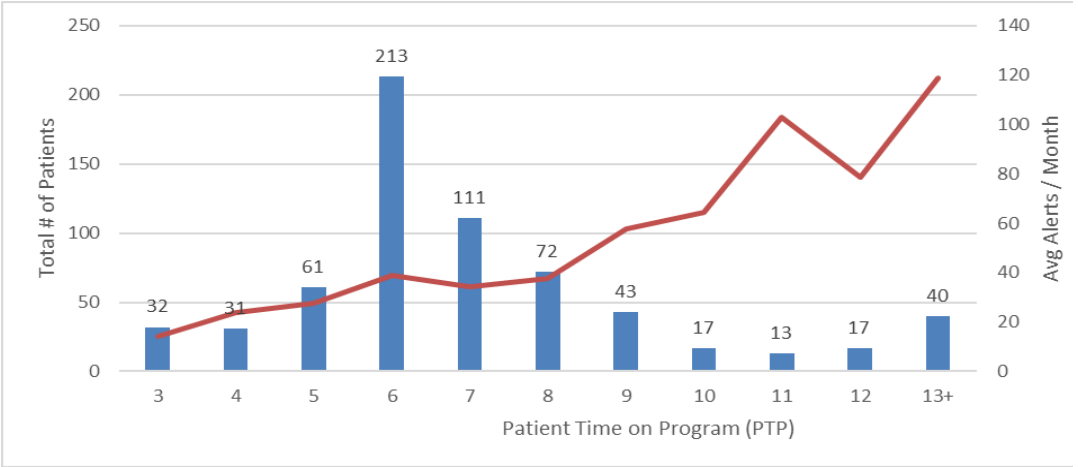

Figure 3.4.1: Total Patients by Patient Time on Program

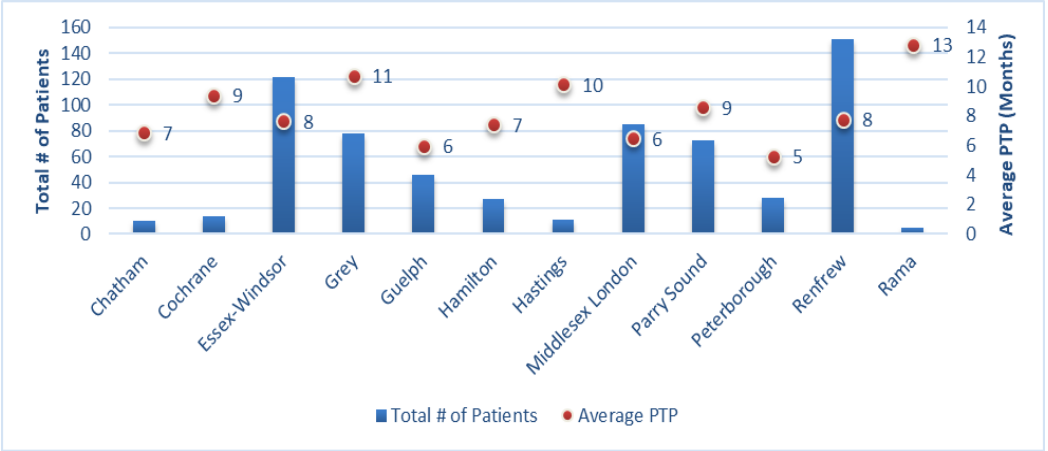

Figure 3.4.2: Total Patients and Average PTP by EMS

3.5 Patient Demographics

Males and females were equally represented in the overall patient population. The average age of the population was 77.49 years; with males on average 5.46 years younger than females (75.9 years vs. 81.3 years respectively). Data was analyzed by both disease type and total number of comorbidities (CHF, COPD, and Diabetes). Results include:

- COPD was the most common diagnosis (69.5%), followed by CHF (49.5%) and Diabetes (19%).
- Only four percent (4%) of the population were diagnosed with all three disease types;
- Of the 430 patients with one comorbidity, 274 (64%) had COPD, 152 (35%) had CHF, and 4 (1%) had Diabetes.

The Johns Hopkins Aggregated Diagnosis Groups (ADG) was used to analyze severity of patient condition. The ADG score is a weighted score representing the presence or absence of 32 ADG diagnosis groups[12] that have been used to predict mortality in a general adult population in Ontario[13]. Seventy eight percent (78%) of patients in this program had 10+ ADG, 19% between 5-9 and 3% between 1-4. These result show that compared to the average ADG of 3.2[14] in Ontario, **97% of the patients** involved in the CPRPM program had severe medical conditions.

Figure 3.5.2 displays the CPRPM patient population by socio-economic status (SES Quintile) and rurality. This data was extracted from ICES databases. SES quintile ranks patients from 1 (poor) to 5 (wealthy) based on ranges of mean household income (from Statistics Canada censes information), and grouped into five categories with each quintile assigned to approximately 20% of the population. Seventy eight percent (78%) of the CPRPM population is low-moderate income (Quintile 1-3). CPRPM patients were also more rural (37%) and suburban (34%) compared to the 2015 Ontario population (6.8% rural, 18.3% suburban)[15]. Only 29% of patients involved in this program were from urban regions compared to the 74.9% average in Ontario. In part, this finding was deliberate as the South Central Community Development Corporation (the Sponsor) was specifically trying to address the issues of more limited access to healthcare services in rural communities. Often these patients are also more difficult for EMS services to adequately support so providing patients in rural communities with an opportunity to monitor their condition using technology is a significant benefit of the CPRPM program.

		Gender Summary		Diagnostic Summary			# of Comorbidities		
Years	**Total**	**Male**	**Female**	**CHF**	**COPD**	**Diabetes**	**1**	**2**	**3**
18-34	1	1			1		1		
35-49	13	5	8	6	6	1	12	1	
50-64	87	41	46	32	61	25	60	23	4
65-74	175	91	84	76	134	39	107	62	6
75-84	227	121	106	114	168	44	143	67	17
85-94	134	61	73	87	75	11	96	37	1
95+	13	2	11	7	7	1	11	2	
Total	**650**	322	328	322	452	121	430	192	28
Average	100%	49.5%	50.5%	49.5%	69.5%	19%	66%	30%	4%
Avg Age	77.49	75.90	81.36	83.26	75.20	88.50	78.81	85.61	74.54

Table 3.5.1: Patient Demographics and Diagnosis (Program Completed)

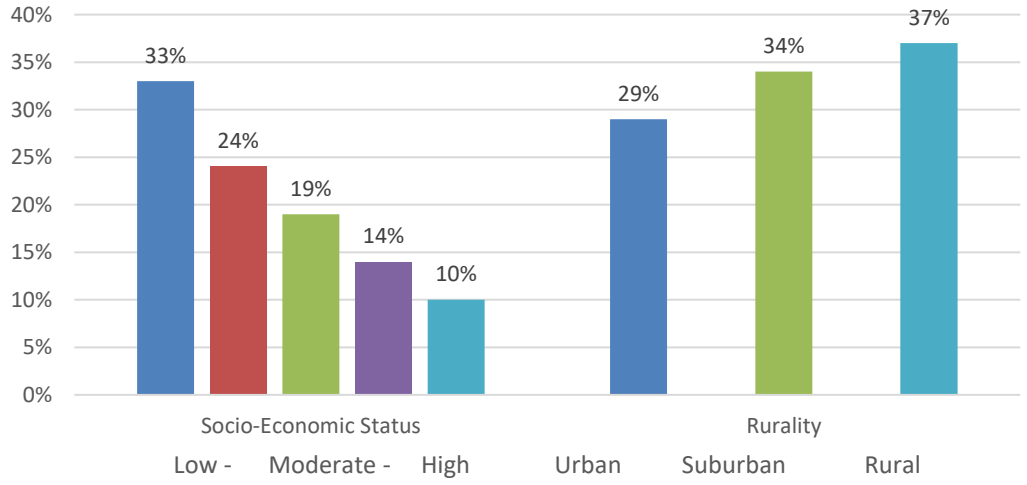

Figure 3.5.2: Patient Socio-Economic Status and Rurality

[12] ADG scores are available in the ICES Discharge Abstract Database (DAD) established in 1963. This database captures administrative, clinical and demographic information on hospital discharges (including deaths, sign-outs and transfers). The average ADG of 3.2

[13] Austin PC, van Walraven C, Wodchis WP, Newman A, Anderson GM. Using the Johns Hopkins Aggregated Diagnosis Groups (ADGs) to predict mortality in a general adult population cohort in Ontario, Canada. Medical care. 2011;49(10):932-939. doi:10.1097/MLR.0b013e318215d5e2.

[14] Mehta, N. K. A Kpelitse, R.A. Delvin, L. Li and S. Sarma, Primary Care Access and Emergency Department Utilization: Theory and Evidence in Canada, Canadian Centre for Health Economics, Working Paper Series (170005), June 21 2017.

[15] Urban, suburban and rural percentages provided by Institute for Clinical Evaluative Services (ICES).

3.6 Remote Monitoring Devices

The CPRPM program supported four remote monitoring devices: blood pressure (BP) manager, body manager (weight scale), SpO2 manager (pulse oximeter) and glucose-manager. A total of **1,922 devices** were assigned to 650 patients (Table 3.6.1). All patients were assigned an SpO2 Manager[16], over 96% assigned the BP manager, patients with diabetes were assigned glucose meters, and weight scales were assigned to patients mainly with CHF to help detect changes in body mass due to water retention which can signal pending cardiac difficulties.

Table 3.6.2 provides a complete list of how devices captured specific readings that triggered medical alerts. The table lists the alerts in priority of severity (low to high). During enrollment, clinical thresholds were established for each patient using the standard thresholds provided up front by the Clinical Advisory Committee. When a reading was outside the clinical threshold, a medical alert was generated[17]. The alert was categorized as low, medium, high, very high alert based on how the alert compared to the specific patient threshold.

Heart rate readings were taken by both the BP Manager and the SpO2 Manager; readings from the BP manager were associated with a high number of false alerts. **The CPRPM program is encouraged to capture heart rate readings exclusively using the SpO2 monitor moving forward.**

	# of Patients	BP Manager	Weight Scale	SpO2 Manager	Glucose Manager	Total Devices	% Device Category
1 Device	14			13	1	14	1%
2 Devices	203	194	6	202	4	406	21%
3 Devices	230	230	177	230	53	690	36%
4 Devices	203	203	203	203	203	812	42%
Total	650	627	386	648	261	1,922	100%
% / Device		96.5%	59.4%	99.7%	40.2%		

Table 3.6.1: Remote Monitoring Device Summary

SP02	Weight	Heart Rate	Glucose	Systolic	Diastolic
SpO2 less than 80 % for 1 consecutive reading(s) SpO2 less than 88 % for 2 consecutive readings SpO2 less than 88 % for 1 reading SpO2 less than 90 % SpO2 less than 94 % for 1 reading SpO2 greater than 95 %, SpO2 less than 92 % for 2 consecutive readings	Weight increase of 1 Kgs 1 Day Weight increase of 2 Kgs over 2 days Weight increase of 3 Kgs over 7 days.	Heart Rate greater than 130 bpm for 1 consecutive reading Heart Rate greater than 120 bpm for 2 consecutive readings Heart Rate greater than 110 bpm for 2 consecutive readings Heart Rate less than 50 bpm for 2 consecutive readings	Glucose greater than 30 mmol/l Glucose greater than 24 mmol/l Glucose in range between 3 and 4 mmol/L Glucose greater than 18 mmol/l over 3 readings Glucose in range between 24 and 30 mmol/L Glucose less than 4 mmol/l Glucose less than 3 mmol/L	Systolic greater than 180 mmHg for 2 consecutive readings Systolic greater than 140 mmHg for 2 consecutive readings Systolic less than 90 mmHg for 2 consecutive readings	Diastolic greater than 110 mmHg for 2 consecutive readings Diastolic greater than 90 mmHg for 2 consecutive readings

Figure 3.6.2: Description of Clinical Readings

[16] With the exception of two patients that did not have adequate perfusion.

[17] In a very few cases these thresholds were adjusted at the request of the patient's primary care provider and this was documented in the patient's record.

Chapter 4: Technology Usage

During the installation process, instructions were provided to the patient including a detailed set of standardized instructions for the proper use of each device (Table 4.1). These instructions included:

- An in-home demonstration with instruction card for the patient on how to use each device (see Appendix E);
- Advice for the patient to take measurements (blood pressure, pulse oximetry, and blood glucose) each morning an hour after taking medications, or subsequently at the time of symptom exacerbation;
- Taking weight readings first thing in the morning after voiding and prior to eating;
- Instructions to observe each device successfully transmitted the result before moving on to the next device;
- Observing patients taking readings on their own to demonstrate competence.

Weigh Scale	Blood Pressure Device	Glucose Manager	SpO2 Manager
• Flat even surface • Scale settings, voice, lb/kg • Patient must be able to stand independently • Scale is for patient only • Have patient take weight in morning after voiding, before breakfast, with about the same amount of clothing • Volume can be adjusted to accommodate patient • Voice can be set in French or English	• Cuff must fit properly (3 cuff sizes available). • 2 finger rule, should be able to slide 2 fingers between cuff and arm • Make sure patient is sitting, rested, and has arm resting on table at heart level while taking blood pressure. A message will be displayed each time patient turns device on: *"Please make sure you are sitting and have rested before taking your BP"* • If possible, have patient take a blood pressure independently to confirm they are able to take an accurate reading • Recommend instructing patient to take blood pressure at least 1 hour after taking medications	• Make sure patient is competent in taking blood glucose or has caregiver to assist • Have patient perform a repeat demonstration to assure they can take readings accurately • Test accuracy of device by taking test solution reading when a new bottle of strips is opened or if accuracy of reading is questioned • Check expiration date on bottle of strips. Discard if expired.	• Make sure SpO2 manager has a full charge, recommend instructing patient to charge nightly • Warm fingers • No nail polish • Make sure patient rests before taking a reading

Table 4.1: Instructions for Remote Monitoring Device Usage

4.1 Reading Compliance

A requirement of the CPRPM program was that patients take daily readings on all assigned devices every day they are on the program. One of the challenges related to monitoring the program is that some devices generate multiple readings (e.g., one BP reading generates a systolic, diastolic, and heart rate reading), so analyzing the total number of readings per day on program did not provide a clear measure of reading compliance. For example, a patient assigned a BP manager may use the device 3 days one week and because the device generates 9 readings, there is a risk this could be interpreted as 128% (9 readings/7 days) reading compliance. It is recommended that Ideal Life develop better reporting tools for calculating reading compliance.

To address this risk and limitation of the technology platform, a data analysis project was conducted in Summer 2016 to translate reading data into an adjusted measure of total readings that could be used to monitor and evaluate reading compliance. Reading compliance (0-100%) is defined as the *effort made by patients to take one good reading per device each day*. The analysis assessed the raw number of readings to create a single reading for each device per patient per day. Returning to the example above, use of a BP manager was reduced to one reading instead of three. Using this approach, a patient assigned two devices was expected to register 2 readings each day:

- A reading on both devices was 100% compliant;
- A reading on only one device (i.e., BP manager and not the scale) was 50% compliant;
- Multiple readings on one or both devices was greater than 100% compliant.

Using this data manipulation method, a total of 368,510 readings were registered across 650 patients on the program. Table 4.1.1 provides a summary of the calculated reading compliance rates categorized by number of devices. The 117% and 103% compliance rates for one and two devices respectively involved patients using the Sp02 monitor multiple times each day to regularly monitor oxygen saturation, taking multiple blood pressure readings in a single day, and/or diabetic patients using multiple test strips to monitor blood sugar. As such, compliance rates greater than 100% was deemed an appropriate protocol for remote monitoring in the CPRPM program. Beyond patients proactively monitoring their condition, paramedics also indicated they asked patients to take a subsequent reading if the first attempt produced a questionable alert to help patients learn how to take a good quality reading.

	# of Patients	Total Readings	Readings / Patient / Device	Avg Patient Time on Program	Avg Reading / Month	Avg Reading Compliance Rate
1 Device	14	4,299	307	8.76 months	35	117%
2 Devices	203	95,682	236	7.67 months	31	103%
3 Devices	230	144,252	209	8.28 months	25	83%
4 Devices	203	124,277	153	7.59 months	20	67%
Total	**650**	**368,510**	**100%**	**7.89 months**	**25**	

Table 4.1.1: Total Readings by Device

Categorizing compliance alert rates by number of devices also illustrates that assigning more devices decreases the reading compliance rate. The most plausible explanation for this result is that the routine of taking daily readings becomes more cumbersome as more devices are assigned. Two devices seems to be ideal for maximizing reading compliance and paramedics should be encouraged to minimize the number of devices assigned when possible (i.e., assigning more devices IS NOT better when it comes to reading compliance).

We also looked at reading compliance by device type to demonstrate significant variation in compliance rates by device type (Table 4.1.2). SpO2 manager had the highest compliance perhaps because taking a reading on this device is easy to do. BP Manager was next with 85% and is also relatively easy to use. The Glucose Manager was third at 72% and was likely lower in part because it requires patients to do a physical blood test (finger prick) and also because daily blood sugar testing is no longer a recommended daily requirement for all patients with Type 2 Diabetes. Finally is the weight scale at 58%. This is somewhat surprising as it is very easy to do, but presumably is has the lowest compliance as most people don't like taking their weight! Low weight scale compliance may also require more patient education as this is one of the most important clinical indicators of changes in patient health – particularly for CHF patients.

	BP Manager	Weight Scale	SpO2 Manager	Glucose Manager
Avg Reading Compliance Rate	85%	58%	99%	72%

Table 4.1.2: Compliance Rates by Device Type

Figure 4.1.3 shows reading compliance over patient time on program (PTP) for each device. It is important to note that this chart does not illustrate compliance over time, it illustrates patients that participate in the program for a longer period of time tend to be more compliant using SpO2 and glucose manager and less compliant using the weigh scale. Complete data is available in Appendix F.

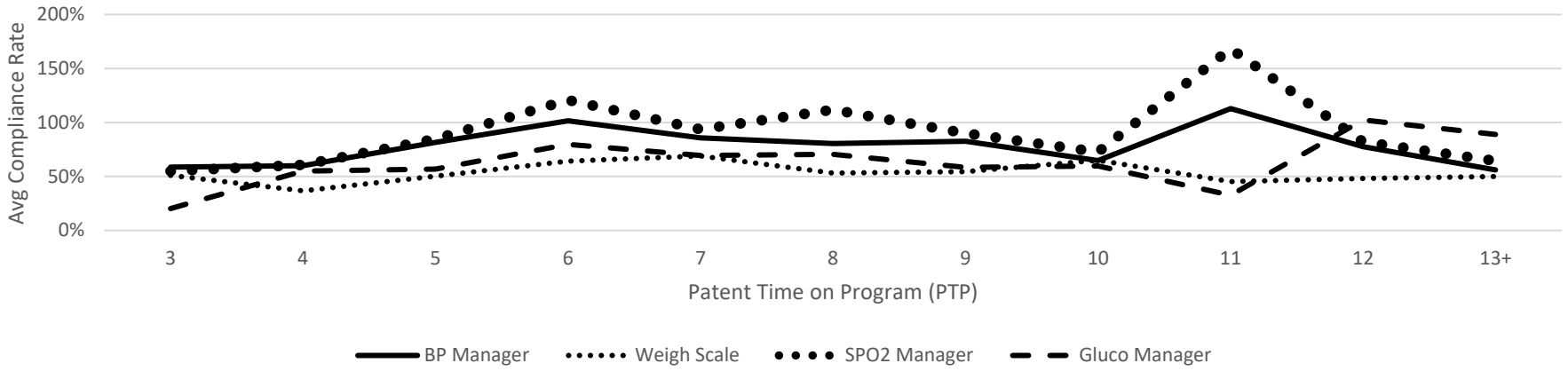

Figure 4.1.3: Device Reading Effort by PTP

4.2 Compliance by Paramedic Service & Patient

As illustrated in Table 4.2.1, the weighted average[18] reading compliance rate was 80% across paramedic services ranging from 99% (Grey) to 48% (Rama). In some cases, compliance issues may be due to technology issues (i.e., disturbance in connectivity with the pod) and in other cases the patient may be busy, travelling/away from home, pre-occupied or simply forgot to take their reading. The CPRPM system triggers a compliance alert when a patient fails to take readings within 24 hours and paramedics are instructed to follow-up with patients to remind them to take daily readings. The IdealLife system requires paramedics to check 'contacted patient' after the paramedic has spoken to the patient. This is then recorded in the notes repository (see further explanation provided in Chapter 6). Services with higher average reading compliance rates indicate better patient follow-up when patients stopped taking their daily readings.

Another observation from this analysis is that compliance rates decrease as the # of devices assigned increases. As such, if patients are apprehensive about using the devices, paramedics may consider assigning two devices to start (choose the 2 most applicable to their specific condition). A third device can be added later if appropriate. Similarly, if compliance rates for a patient are poor, paramedics may consider removing a device to see if compliance improves. If compliance issues continue, a patient may not be a suitable long-term candidate for the program. While following up on non-compliance alerts was a program expectation, it was not always done well. Future Health Services did impress upon the Paramedics the importance of this, particularly early on when a patient has first enrolled as it sets a clear expectation. If patients don't do their readings then the paramedics have no data to work with and can not intervene. While most readings (~90%) end up being within range, it is still important to reinforce the behavior change with patients so they get into the habit early.

	# of Patients	1 Device	2 Devices	3 Devices	4 Devices	Reading Compliance Rate
Chatham	10		73%	109%	70%	**89%**
Cochrane	14		99%	81%	47%	**79%**
Essex-Windsor	122	148%	114%	95%	58%	**98%**
Grey	78		131%	86%	94%	**99%**
Guelph	46		54%	131%	83%	**86%**
Hamilton	27		32%	53%	68%	**57%**
Hastings	11		85%	71%	34%	**72%**
Middlesex London	85	193%	93%	92%	61%	**76%**
Parry Sound	73	135%	88%	66%	62%	**74%**
Peterborough	28		101%	81%	86%	**94%**
Rama	5		123%	11%	47%	**48%**
Renfrew	151	85%	102%	96%	68%	**89%**
Compliance		**140%**	**91%**	**81%**	**65%**	**80%**

Table 4.2.1: Reading Compliance Rates by Paramedic Service

As illustrated in Table 4.2.2, reading compliance rates also vary according to patient demographics and condition diagnosis. Some general observations include males are more compliant on average than females and patients with 2 or 3 comorbidities are more compliant than patients with one comorbidity.

[18] Averages were weighted based on the number of patients in each category

	# of Patients	BP Manager	Weight Scale	SpO2 Manager	Glucose Manager	Average
Female	328	82%	61%	92%	76%	78%
Male	322	94%	61%	113%	73%	85%
Average Compliance		88%	61%	102%	84%	
18-34 Years	1	61%		62%		61%
35-49 Years	13	51%	38%	90%	106%	71%
50-64 Years	87	73%	40%	117%	90%	80%
65-74 Years	174	87%	54%	103%	73%	79%
75-84 Years	227	93%	68%	98%	76%	84%
85-94 Years	134	84%	66%	89%	58%	74%
95+ Years	13	209%	101%	235%	103%	162%
Average Compliance		**94%**	**62%**	**113%**	**83%**	
CHF	322	89%	74%	97%	83%	86%
COPD	452	92%	56%	112%	75%	84%
Diabetes	121	84%	64%	91%	108%	87%
1 Comorbidity	427	85%	50%	100%	38%	68%
2 Comorbidities	192	96%	75%	110%	102%	96%
3 Comorbidities	28	84%	79%	93%	110%	92%

Table 4.2.2: Average Reading Effort by Patient Demographics and Diagnosis

Chapter 5: Medical Alerts

5.1 Medical Alert Rate

A total of 28,703 medical alerts were generated from 368,510 readings; this equals 1 alert every 12.8 readings or an average alert activity of 7.8%. Medical alert activity is defined as the percentage of alerts compared to total readings. Figure 5.1.1 displays medical alert activity by patient time on program and illustrates that alert activity decreases between 4 and 7 months as expected and increases for patients that stay on the program longer than 9 months. These results support the conclusion that paramedics kept patients on the program that had higher health needs and therefore tended to generate more alerts (as the less acute patients were taken off the program after 6 months).

The alerts for these more acute patients helped paramedics monitor their condition and keep them out of hospital. These results also suggest that patients take some time to get comfortable with the technology and for benefits to start to appear from a clinical outcomes perspective (i.e., fewer readings out of range) as illustrated with the gradual reduction in months 4-8.

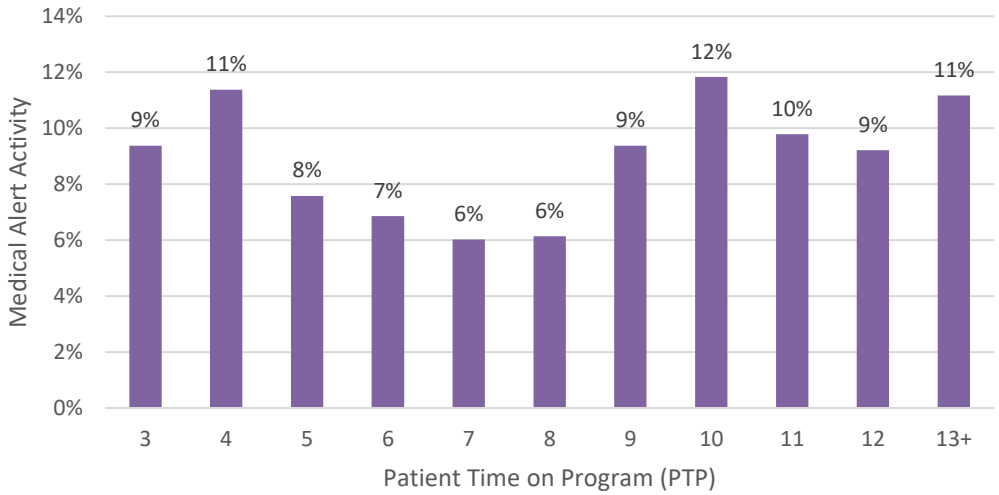

Figure 5.1.1: Medical Alert Activity by Patient Time on Program

5.2 Medical Alerts by Paramedic Service

Figure 5.2.1 illustrates the range of medical alert activity (lines) compared to total patients on the program (bars). As illustrated, services such as Grey and Chatham have high alert activity compared to services such as Middlesex-London and Parry Sound. It should be noted that some of the counties with very low patient volumes are fairly subject to random variation and these higher percentages may not be significant. This analysis raises a number of interesting questions. First, it is surprising to see the range of alerting given all programs used the same eligibility criteria. This may be because some counties (e.g., Grey, Renfrew) enrolled more acute patients while the others might have enrolled slightly less acute patients. Second, how did services with higher versus lower alert activity and higher versus lower number of patients use their resources? Finally, does the alert activity impact outcomes or net savings of the program?

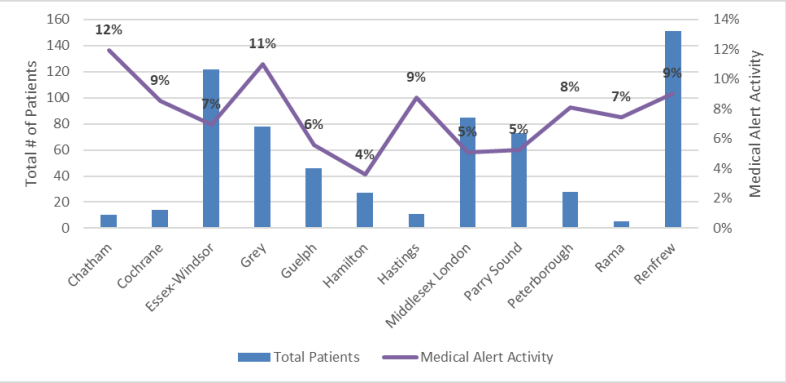

Figure 5.2.1: Alert Rates by Paramedic Service

Moving forward, it is recommended that paramedic services need to target enrolling a sufficient quantity of patients to make the program worthwhile. This is because it takes a critical mass of patients to be able to justify the Community Paramedic resource and training, and there needs to be enough work (and benefits) to justify the level of investment. Likely this means maintaining a minimum of about 40 patients at steady state, and requires onboarding about 5-6 patients a month, and discharging about the same. Services need to target the right patients. Typically you want to target those patients who struggling to manage their condition but are committed to self-management and want to stay in their homes. Patients who are already heavy users of the system will yield the highest ROI, but many other patients who may not yet be heavy users will end up there without early intervention. So programs need to be on the lookout for those patients who are "on the edge" of becoming heavy users of the health system. A common challenge experienced by several services was that they enrolled a lot of heavy users of the system that then required a lot of time for managing and stabilizing which made identifying and enrolling new patients, and discharging old patients more challenging.

The CPRPM program is also encouraged to monitor both medical alert activity and total number of patients on program as a way to help paramedic services better manage their resources. For example, a service with low alert activity may be encouraged to increase patient enrollments and a service with high alert activity may be encouraged to limit enrollment to make sure paramedics do not become overwhelmed with responsibility and lower the quality of service (i.e., alert response time, quality of feedback) as a result.

5.3 Medical Alerts by Patient Condition

Table 5.3.1 presents the medical alert activity by patient condition. Patients with CHF have the highest alert activity as a percentage of total readings suggesting CHF patients are more acute in terms of paramedic time and resources than patients with other conditions. There are no significant differences in program benefits across conditions so the added cost of CHF patients does not result in increased benefit for the program.

	Total Patients	Total # of Readings	Total Medical Alerts	Medical Alert Activity
CHF	322	209,882	20,058	10%
COPD	452	253,623	18,662	7%
Diabetes	121	88,426	6,513	7%
1 Comorbidity	427	206,196	13,886	7%
2 Comorbidities	192	137,490	12,942	9%
3 Comorbidities	28	23,585	1,821	8%

Table 5.3.1: Medical Alert Summary by Patient Condition

Alerts by patient condition were also analyzed by alert severity. Severity is defined as the distance a specific reading is away from the patient's clinical threshold that was established during the enrollment process. During enrollment, standard clinical thresholds were applied for each condition as recommended by the Clinical Advisory Committee. When a reading was outside a patient's clinical threshold, an alert was generated and the distance from the patient's threshold was recorded. The distance was used to categorize each alert as Low, Medium, High, and Very High to indicate the degree of alert severity (see Appendix G).

A summary of alert severity is provided in Table 5.3.2 and shows the majority of alerts (68%) were low severity. It also shows zero high and very high alerts for SpO2 suggesting clinical thresholds may be too low and need to be re-evaluated. If the point is to catch readings that are high (or low) and use them as 'teachable' moments to improve self-management, the program as structured may be missing significant opportunities. It is recommended the program broaden the clinical advisory committee to have further clinical discussion around chronic disease management, lifestyle and patient coaching (e.g., diabetes educators as an example).

	Alert Severity				Total	
Clinical Trigger	**Low**	**Med**	**High**	**Very High**	**Total**	**% of Total**
Heart Rate	4,232	772	409	67	5,480	19%
Glucose	962	568	146	49	1,725	6%
SpO2	11,688	50	0	0	11,739	41%
Systolic	739	643	201	42	1,625	6%
Diastolic	358	375	201	174	1,108	4%
Weight	1,409	4,769	779	69	7,026	24%
Total Alerts	**19,389**	**7,177**	**1,736**	**401**	**28,703**	**100%**
	68%	**25%**	**6%**	**1%**	**100%**	

Table 5.3.2: Alerts by Clinical Trigger and Severity

Figure 5.3.3 is a graphical illustration of alert severity that shows higher severity alerts were triggered by weight and blood pressure. SpO2 and Heart Rate had a high number of alerts but the majority of alerts were low in severity. This data reiterates the need to revisit and revise alert thresholds. Given the purpose of the program is to not only catch, but prevent high/low episodes, and to use low and moderate episodes to change behavior, perhaps there needs to be more follow up and coaching on the lower alert thresholds. Then again, these results may also indicate the relatively few number of "high" and "very high" alerts is proof that the program is working and preventing conditions from deteriorating.

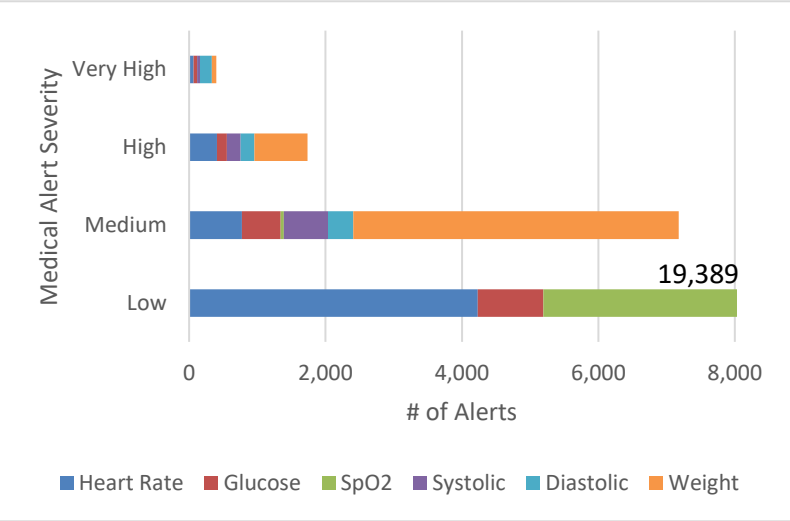

Figure 5.3.3: Alerts by Clinical Trigger and Severity

The CPRPM program is encouraged to seek clinical feedback to determine what opportunities exist to better manage low priority alerts moving forward. A review of the notes indicated that a common response to low priority alerts involved the paramedic continuing to monitor the patient's condition but no action was taken (or at least not documented). SCCDC is currently investigating the use of voice interaction technology (e.g., Amazon Echo devices) as a way to automate what the paramedic might do with a phone call. Providing simple automated "patient coaching" might allow the program to proactively follow up on all these high volume alerts, without significantly increasing the labour costs. Notes also indicated many low priority alerts were repeated and the paramedic would note 'this reading is normal for this patient' – indicating there was an effective change in the patient's clinical threshold. When a change in threshold was required, paramedics were encouraged to call the patient's physician and have the physician set an individualized alert threshold. Some services did not have a rapport with physicians and so the threshold was not adjusted. The result was a continuous stream of low priority alerts that increased risks related to paramedic alert fatigue. Moving forward, the CPRPM program is encouraged to revisit (and adjust if necessary) the process required to change a patient's clinical threshold as making a physician request and seeking approval proved to be challenging in many cases. Specifically, the patient portal could be a medium to help streamline this process.

5.4 Medical Alerts by Patient Demographics

Table 5.4.1 presents medical alert activity by patient demographics. There were no significant differences in medical alert activity across patient gender or age groups.

	Total Patients	Total # of Readings	Total Medical Alerts	Medical Alert Activity
Female	328	172,080	12,508	7%
Male	322	196,430	16,195	8%
18-34 Years	1	377	-	0%
35-49 Years	13	4,800	335	7%
50-64 Years	87	50,675	4,214	8%
65-74 Years	174	101,606	7,457	7%
75-84 Years	227	130,802	10363	8%
85-94 Years	134	66,120	5197	8%
95+ Years	13	13,319	1072	8%

Table 5.4.1: Medical Alert Summary by Patient Demographics

Chapter 6: Behavioral Adaptation

As CHF, COPD, diabetes and hypertension are all lifestyle induced chronic conditions, one of the key objectives of remote patient monitoring is to help patients learn how they can better manage their conditions through lifestyle changes – largely what they eat and what they do (e.g., exercise, medications). To better understand how CPRPM impacted patient behavior change, a comprehensive behavioral adaptation evaluation was conducted on a subset of patients (212 patients) enrolled between April 2015 to December 2016. Behavioral adaptation goes beyond patient compliance to take daily readings and alert response by paramedics; it involves active adjustments by both patients and paramedics. Specific needs of each individual patient require adjustments be made by both paramedics and patients to address different ways patients make an active role in self-managing their condition (i.e., medication, diet, exercise, etc.) and their specific motivation for doing so (e.g. feel safe and comfortable in the comfort of their home, decrease stress and anxiety etc.).

To explore the influence of the CPRPM program on behavioral adaptation, daily activity for a subset of patients (n=212) was analyzed. The subset of patients were those that were discharged and had completed at least 3 months prior to December 2016. A dataset of 38,160 rows (180 days of activity for 212 patients) was created that included daily readings, number of alerts (compliance and medical), validation of the alert (i.e., false alert), notes taken by the paramedic, the medium (call, home visit) and description of interaction activity (e.g., continue to monitor, seek help etc.). Daily rows were rolled up to a weekly sum for analysis. Table 6.1 describes the data set that included 5,274 weekly data points (approximately 26 weeks of data for 212 patients). Monitoring and feedback was provided by 71 paramedics across nine emergency medical services.

If all 212 patients took a daily reading on their assigned devices, the total number of readings is estimated to be 101,276 (see Appendix H: Table H1). As illustrated in Table 6.2, 68,833 readings (68% compliance) were actually taken and 23,915 compliance alerts were triggered. The remaining 8,528 compliance alerts (101,276 – 68,833 – 23,915) were likely overlooked when the program was initially designed to trigger a compliance alert after a 48-hour period. This was later changed to a 24-hour period in December 2015 as paramedics indicated daily monitoring of compliance alerts would be more effective in terms of encouraging reading compliance.

EMS Service	# of Patients	First Patient Enrolled	# of Paramedics	# of Weekly Data Points
Chatham	6	May 2016	4	156
Cochrane	9	June 2015	6	233
Essex-Windsor	81	April 2015	14	2034
Grey	33	April 2015	7	848
Guelph	5	August 2016	7	103
Hastings	6	April 2016	3	149
Parry Sound	9	October 2015	7	222
Peterborough	19	July 2015	3	421
Renfrew	44	April 2015	20	1108
Total	**212**		**71**	**5274**

Table 6.1: Alert Rates by Patient Demographics

The behavioral adaptation evaluation was limited to the first 6 months to coincide with the design of the reading alert plan (i.e., generation of a compliance alert when a patient fails to take a reading on a specific device within 24 hours). Patients remaining on the program longer than 6 months required a revised reading plan in order for compliance alerts to continue to be generated. If a revised reading plan was not processed, the Ideal Life platform would stop generating compliance alerts. The CPRPM program was encouraged to revisit this approach as the majority of patients are staying on the program for longer than 6 months and continuous compliance alerts are important for making sure patients continue to take their daily readings. This issue has since been corrected and will not be an issue going forward.

	# of Patients	# of Readings	# Comp Alerts	# Med Alerts	Total # Alerts
Chatham	6	2,626	704	466	1170
Cochrane	9	2,600	1,175	278	1453
Essex-Windsor	81	23,023	11,965	2648	14613
Grey	33	13,380	2,313	1863	4176
Guelph	5	1,437	140	61	201
Hastings	6	1,183	1,091	53	1144
Parry Sound	9	3,388	611	249	860
Peterborough	19	5,661	1,357	528	1885
Renfrew	44	15,535	4,559	2255	6814
Total	212	68,833	23,915	8,400	32,315

Table 6.2: Alerts, Interactions and Patient Adaptations

6.1 Alert Documentation (Notes)

When an alert was generated, paramedics were instructed to follow an alert documentation procedure. This procedure required them to make notes in the IdealLife® platform to capture details about the alert as well as any follow-up that occurred. The training required paramedics to document a note for each alert to describe what action (if any) was taken and if not why not. The reason for this was so the program could evaluate what responses were being taken and to what effect. The specific procedure varied depending on the type of alert:

- **Compliance Alert:** A check box 'contacted patient' is used to record when a paramedic contacts a patient after receiving a compliance alert to remind them of the importance of taking their daily readings. This check box is only to be used when a paramedic actually spoke with a patient, if the paramedic called and left a message they were instructed to make a note (i.e., left message) in system. There is no way to determine what in fact happened when paramedics checked 'patient contacted'. Although the intent of this feature was to 'check' when a patient had been contacted, it is possible paramedics used it if they attempted to call the patient or left a message. The CPRPM program is encouraged to evaluate how effectively this feature of the IdealLife system is being used, and how it might be modified to capture more detailed information while still providing paramedics with an efficient solution.

- **Medical Alert:** Documentation of medical alerts included an automated record that described the type of alert (e.g., high blood pressure) as well as a free-form noting feature that allowed the paramedic to document relevant details of the alert (i.e., false alert), details of the patient situation (i.e., patient feeling short of breath) and recommended actions (i.e., make an appointment with their doctor).

While 32,315 total alerts were generated (compliance and medical), unfortunately these generated a total of only 5,593 notes documented. Eighty-nine percent (4,986 notes) documented medical alerts and 11% (607 notes) documented compliance alerts. Adherence to the alert documentation procedure for medical alerts was 59% (4,986/8400 alerts) and 2.5% (607/23,915) for compliance alerts. Follow-up interviews with paramedics confirmed that notes were used primarily to document medical alerts (as opposed to compliance alerts). Paramedics noted that phone calls to remind patients to take readings were often made but rarely documented even though this was a program expectation. **Integrating the IdealLife system with a IP telephony solution may be a valuable enhancement to the system to make it easier and faster for paramedics to follow up and manage compliance alerts more efficiently.**

Notes were analyzed using standard guidelines for deductive qualitative coding (DQA) (Fereday and Muir-Cochrane 2006). Appendix H (Table H-2) lists the four-step qualitative coding design used to ensure reliability and validity of the qualitative study. Figure 6.1.1 decomposes the 4,986 medical alerts (8400-3,414 without notes) into four qualitative coding categories. Forty-one percent (3,414 medical alerts) did not have a note so no conclusion about feedback could be determined. Of the 4,986 notes remaining, **3,281 notes** related to patient-paramedic coaching interactions and 1,705 were generated by redundant alerts (same issue alerted on multiple devices) that provided paramedics with additional information related to the patient's condition. For example, a patient with a heart-related issue might trigger a heart rate alert and systolic blood pressure alert and receive one follow-up phone call from a paramedic. The note on the phone call was coded as a coaching interaction and the second alert coded as additional alert information. **This is also a recommended enhancement to the IdealLife RPM back end system – streamlining multiple alerts from the same reading encounter into one "event" and not requiring the paramedic to have to document their interventions in multiple places.**

One of the limitations of the IdealLife system was how it managed alerts. Sometimes one reading (e.g., blood pressue) could trigger multiple alerts (e.g., heart rate, systolic and diastolic pressures). IdealLife recorded each alert separately which created additional follow-up activity for paramedics. Furthermore, the proper way to take a blood pressure reading is really to take it a number of times and then take an average of the readings which collectively should be viewed as "one result". Unfortunately this was not how the IdealLife system managed multiple device readings. It would have been better if the platform provided a more intuitive way of managing multiple alerts for the same patient rather than treating each reading result separately.

Self-Management Coaching (20%): 1022 Coaching Interactions	Paramedic provided feedback to help patients take a more active role in self-managing their condition. Examples include breathing techniques, supplemental oxygen, healthy eating, exercise, laying down, elevating feet etc. This coaching helped patients understand what to do when their readings were out of range (i.e., low oxygen) and encouraged patients to take a subsequent readings to determine whether or not the issue was addressed.
Device Coaching (31%): 1551 Coaching Interactions	Paramedic provided feedback to help patients take good quality readings. Examples include warming their finger before taking an SpO2 reading, take readings at a specific time of day etc. This coaching helped patients improve the quality of their readings and lowered the risk of false alerts.
Seek Help Coaching (14%): 708 Coaching Interactions	Paramedic provided feedback to address patient concerns related to whether or not they needed to seek help (i.e., call 911, visit doctor etc.). This coaching not only decreased stress and anxiety by reassuring patients their condition was being monitored, it also helped patients understand when it was appropriate to call 911.
Additional Alert Information (34%): 1,705 Points of Reference	A medical issue often triggers an alert on multiple devices (e.g., high heart rate, high blood pressure). Although multiple alerts for the same device is redundant, the information is used by the paramedic to understand the patient's condition and construct appropriate feedback. that only required one interaction.

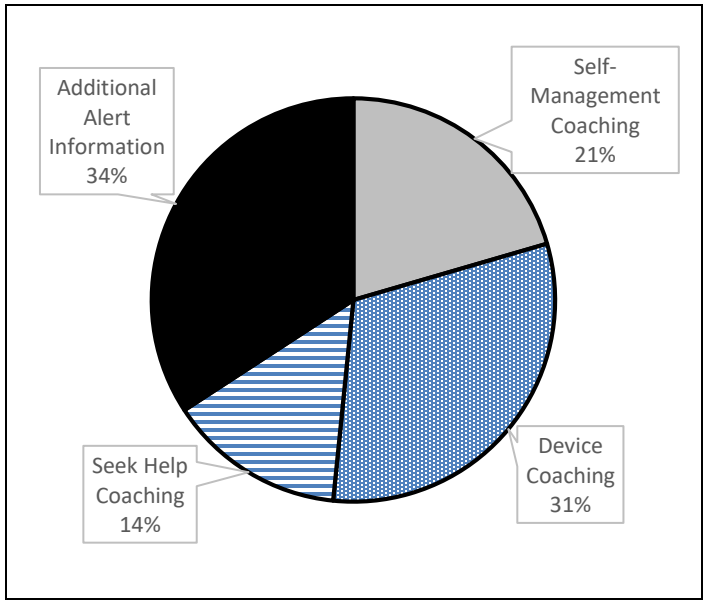

Figure 6.1.1: Medical Alert Response Description

6.2 Medical Alert Documentation Across EMSs

Medical alert documentation rates (notes taken / # of medical alerts) were calculated for all paramedic services (dots in Figure 6.2.1). The expectation, as set out in the training, was that all medical alerts would have some documentation of how the alert was resolved. Without proper documentation explaining what was done, the default is that "nothing was done" which is why documentation is so important. Although the average documentation rate for medical alerts was 59%, the weighted average[19] documentation rate across services was 70% (ranged from 29% to 180%) as there was significant differences across paramedic services. (Note: Documentation rates greater than 100% indicates paramedics documenting notes for compliance alerts and and/or checking in with a patient without an alert being triggered.)

The bars in Figure 6.2.1 illustrate the total number of patients participating as well as the number of paramedics involved in each of the paramedic services. It was difficult for the CPPRM to manage and monitor documentation rates as the reporting tools provided by IdealLife were limited from a program management perspective and did not make this sort of detail available. So, an 83% documentation rate in Essex-Windsor with 81 patients on the program is very impressive. The combination of low enrollments and low documentation rates (i.e., Hastings, Parry Sound) should be monitored a potential risk to the CPRPM program.

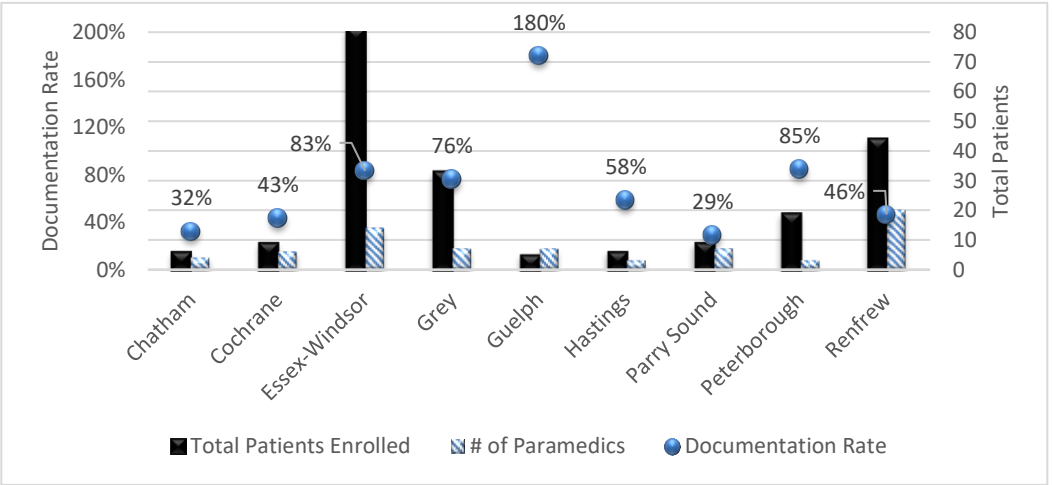

Figure 6.2.1: Documentation Rates by Paramedic Service

[19] Weighted average adjusted the average documentation rate by the total number of patients on program. For example, a service that had 69/212 patients achieved a documentation rate of 86% their rate would influence 32.5% of the weighted average total.

Paramedic interviews were conducted to examine the variance in documentation rates across services. Services with low documentation rates explained they perceived notes to be of little value; more specifically, they had relationships with the patients and were aware of their issues, concerns and activity so making notes felt unnecessary. This demonstrates a clear lack of understanding of the importance of this step and highlights that additional training and reinforcement may be needed. Services with high documentation rates explained they used notes to keep track of patient alerts and feedback as well as notes were important when more than one paramedic was involved in supporting patients. Again, this was evident in Essex-Windsor as 14 paramedics were involved in the program; however, 20 paramedics in Renfrew with a 46% documentation rate raises the concern that patient information is not being shared resulting in patients having to repeat their concerns to different paramedics and/or paramedics being less informed when responding to alerts.

Given that in the future, these notes will be more accessible to the patients, family members, and others involved in the care of the patient, note detail is going to be even more important. Going forward the CPRPM Program may need to provide more training and will require better tools to monitor and manage patient feedback and documentation. As noted above, the addition of the Amazon Echo devices and automated patient interactions will also greatly help in this respect without placing additional workload on paramedics.

6.3 Patient Coaching Summary

Table 6.3.1 summarizes the data that shows 68,833 readings, triggered 8,400 medical alerts, and generated 3,281 patient-paramedic interactions. Appendix B provides detail showing 88% of interactions were phone calls and 12% home visits. Home visits were most common when paramedics were providing device coaching (i.e., reminding patients how to use the technology, coaching patients on how to take a good reading) as well as after a series of alerts had occurred and paramedics wanted to more carefully assess the patient's condition and living situation.

The ideal outcome of patient feedback and coaching is a recognized adaptation in patient behavior as premised on feedback intervention theory (Kluger and DeNisi 1996). According to the theory, when patients perceive a discrepancy between their desired goals for participating in the program and their actual progression toward achieving such goals, they are motivated to adapt their behavior to reduce the discrepancy. For example, a patient that desires improved self-management of their chronic condition leverages feedback from a low SpO2 reading and feedback from paramedic that helps them understand when and how to supplement oxygen. They learn the symptoms of low oxygen and what they need to do to feel better. Research on goal setting has demonstrated that when individuals are committed to specific, clear, and challenging goals, and are provided with feedback on their goal progression, the most common response to negative discrepancies is to adapt and regulate behavior (e.g., work harder or smarter) to attain the goal (Erez 1977; Locke and Latham 1990). Feedback invention theory also states that reducing a negative discrepancy can also lower the goal standard or cause a patient to abandon the goal altogether (i.e., patient resistance).

				Interactions		Documentation	
	# of Patients	# of Readings	# of Alerts	Interactions	Rate	Notes Taken	Rate
Chatham	6	2,626	466	70	15%	149	32%
Cochrane	9	2,600	278	56	20%	120	43%
Essex-Windsor	81	23,023	2,648	1,269	48%	2,203	83%
Grey	33	13,380	1,863	839	45%	1,415	76%
Guelph	5	1,437	61	54	89%	110	180%
Hastings	6	1,183	53	12	23%	31	58%
Parry Sound	9	3,388	249	43	17%	72	29%
Peterborough	19	5,661	528	301	57%	447	85%
Renfrew	44	15,535	2,255	637	28%	1,046	46%
Total	**212**	**68,833**	**8,400**	**3,281**	**39%**	**5,593**	**67%**

Figure 6.3.1: Patient Coaching Activity

Table 6.3.2 defines specific *patient adaptations* and *patient resistance* extracted from the notes repository. Types of adaptation and resistance were coded according to the three types of feedback defined in Section 6.1.

Table 6.3.3 provides a summary of patient adaptions and patient resistance across the 3,281 patient interactions. It is important to note during the 6 month period, a single patient can experience multiple adaptations. For example, one patient from Essex-Windsor had experienced two self-management adaptations; they learned to proactively seek help but resisted feedback related to device usage as they continued to generate false alerts on one specific device.

On average, the patient adaptation rate was 180% higher than the patient resistance rate for the CPRM program. A total of 14% of interactions (455 adaptations / 3,281 interactions) resulted in positive patient adaptations that included learning how to self manage their chronic disease, learning how to use their device, and/or learning when it is appropriate to seek help. Paramedics made note of only 5% of interactions that despite encouragement to change behavior, patients either refused to listen or reverted back to prior habits. A regression analysis was completed to test the relationship between documentation rates and patient adaptations and results were highly significant ($p<.001$). This reiterates the importance of improving the documentation rates as notes provide paramedics with history about the patient condition making their interactions more meaningful as well as enabling patient information to be shared across paramedics.

Although this analysis supports the positive influence of the CPRPM program on changing patient behavior, the data also shows that the vast majority of interactions did not reflect either. This may be explained in part by the fact that there is general lack of good documentation for deeper analysis. It may also reflect the impact of limited patient feedback provided by the IdealLife system. While patient's will start to learn what "normal" readings are, the IdealLife system does not provide specific feedback which could be helpful with behavior changes.

Behavior modification is a specialized skill set and required additional training and focus for CPs to be successful. Table 6.3.3 shows that Parry Sound and Renfrew had equal *resistance rates* compared to patient adaptation rates. Both these services also had low documentation rates providing further evidence that weak documentation procedures are preventing the capture and sharing of information and increasing patient resistance to feedback over time. Again this is something the Sponsor plans to address in the future by adding Amazon Echo devices that can provide automated real-time feedback to patients to reinforce compliance and behavior changes (when appropriate), all with minimal or no paramedic involvement.

Type of Feedback	Patient Adaptation	Patient Resistance
Self-Management Adaptation	Evidence that patients took an active role in self-managing their condition. In all cases, paramedic noted the patient took appropriate steps to manage their condition on their own initiative.	Evidence that patients repeated ignored prior feedback related to self-managing their condition. Paramedics either noted patient resistance or feedback was repeatedly provided but similar alerts generated.
Device Adaptation	Evidence that patients learned how to take a good quality reading. These adaptations were coded when paramedics provided feedback related to a series of false alerts and the false alerts were eliminated over time.	Evidence that patients continued to generate false alerts and ignored paramedic feedback. False alerts caused by faulty equipment were coded separately as a technology replacement/repair (discussed below).
Seek Help Adaptation	Evidence that patients learned when it was appropriate to seek help (i.e., call 911, go to clinic). These adaptations were coded when paramedics either encouraged a patient to seek help or explained why a 911 call was perhaps unnecessary. When faced with a similar situation, patient adhered to the desired behavior indicated by the paramedic.	Evidence that patients resisted paramedic feedback related to seeking help. They either did not seek help when needed or called 911 when help was not necessarily needed or necessary.

Table 6.3.2: Description of Patient Adaptations and Resistance

			Patient Adaptations				Patient Resistance			
	Patients	# Interactions	Self Manage	Device	Seek Help	Patient Adaptation Rate	Self Manage	Device	Seek Help	Patient Resistance Rate
Chatham	6	70	7	2		**13%**	0	0	0	**0%**
Cochrane	9	56	2	3	2	**13%**	1	3	0	**7%**
Essex-Windsor	81	1,269	100	51	55	**16%**	20	16	11	**4%**
Grey	33	839	60	34	30	**15%**	13	11	8	**4%**
Guelph	5	54	7	1	1	**17%**	0	0	0	**0%**
Hastings	6	12	1	1		**17%**	1	0	0	**8%**
Parry Sound	9	43	4		1	**12%**	1	2	2	**12%**
Peterborough	19	301	16	20	12	**16%**	10	6	7	**8%**
Renfrew	44	637	16	12	17	**7%**	14	13	17	**7%**
Total	212	3,281	213	124	118	**14%**	60	51	45	**5%**

Table 6.3.3: Patient Adaptations and Resistance by Paramedic Service

6.4 EMS Adaptation

Community Paramedicine (CP) is a new and evolving model of community-based health care in which paramedics function outside their customary reactive emergency response and transport roles in ways that facilitate more proactive and appropriate use of emergency care resources. The challenge with this evolving model is resourcing day-to-day EMS requirements with this new proactive and preventative role. During the majority of the CPRPM program the Ontario Ministry of Health and Long Term Care (MOHLTC) was providing annual funding to some communities to support Community Paramedicine pilot projects. However, because this was annual funding, it was uncertain whether it would continue to following years. Fortunately, the CP funding ($6M annually) was renewed three times. However, in February 2017 permanent Community Paramedicine funding was provided by the MOHLTC to the Local Health Integration Networks (LHINs) to support CP programs on an ongoing basis.

Semi-structured interviews were conducted with eighteen participants from six of the nine paramedic services to evaluate adaptation approaches across paramedic services. All paramedic services were invited to participate in this component of the evaluation but only six agreed. Despite ethics approval that clearly stated EMSs would not be named in the results, the three services that denied participation were either not comfortable sharing their experiences or did not have time to participant in the interviews. In each service, a senior decision maker (e.g., paramedic chief) and one or more paramedics were interviewed. CPRPM program managers responsible for implementing the program were also interviewed as they provided important information and insights related to the day-to-day operations of the project including procuring technology, recruiting paramedic services, and supporting project rollouts.

Interviews were transcribed and coded to explore three categories related to paramedic service adaptation:

- *Strength of organizational routines:* Degree to which paramedic services adhere to a regular set of behaviors and recurring actions. Stronger organizational routines can make it difficult for adaptations to occur.
- *Business model innovation:* Paramedic service's ability to develop new modes of operation by drawing on new innovative technologies and practices;
- *Adaptation mechanisms:* Capabilities of the paramedic service to sustain the integration of new modes of operation into existing routines. Three capabilities were most common in this study:
  - **Leadership:** Engagement of leadership to commit to the technology as well as their ability to remove bias and barriers related to previous experience to advocate for change. Leadership support in terms of advocating for funding, placing importance and priority on the CPRPM program, as well as commitment to transformative change.
  - **Organization:** Ability to define an enhanced scope of practice, foster integration across partner organizations such as other health (i.e., family health teams, LHIN-support) partners and effective management of resources.
  - **Technology:** Desire and confidence to experiment with new technologies as well as the ability to integrate technology into existing business processes.

A pre-interview survey (64 questions) used a pre-validated instrument[20] to triangulate results. Interviews were used to interpret results and provide further insight into paramedic service adaptation. Table 6.4.1 displays the results from paramedic service adaptation study. Each of the six paramedic services was categorized as either High, Moderate or Low based on the strength of their organizational routines, business model innovation and adaptation mechanisms.

		Strength of Organizational Routines	Business Model Innovation	Adaptation Mechanisms
Service Adaptation	High	Low	Very Strong	High
	Moderate	Very Strong	Strong	Moderate
	Low	Moderate	Moderate	Low

Table 6.4.1: Paramedic Service Adaptation

High Service Adaption (2 Services): Two services clearly understood the benefits of community paramedicine and its potential benefits (i.e., business model innovation) and were able to sustain CPRPM operations with a combination of a clearly defined enhanced scope of practice and understanding of how to embed technology and new work routines into existing day-to-day service routines. Both services also had a strong advocacy for change and specifically, the CPRPM program. High adaptation was enabled by low organizational routines that made it easier for the service to adapt to new ways of doing things; the presence of highly structured and rigid routines make it more difficult to absorb change.

Moderate Service Adaptation (1 Service): This service also had a strong understanding of the benefits of related to the CPRPM program but their adaptation mechanisms (i.e., leadership advocacy, organizational resources, and confidence with technology) were only moderately strong. Most evident in this service was the highly structured nature of the day-to-day routines that made it difficult for the CPRPM program to compete for time and resources. A significant change occurred in the fall of 2016 that addressed some of the issues (specifically resourcing) and attempted to relax existing rules and policies (i..e, organizational routines) in an attempt to improve the overall adaptation of the service to support CPRPM.

Low Service Adaptation (3 Services): Although the specific challenges

[20] Brohman, M.K., E. Brown, J. McSheffrey, "SHIFT: A New Mindset for Sustainable Execution", University of Toronto Press, forthcoming 2018.

varied, three services struggled with regard to adapting to the new CPRPM service model. All of these services had evidence of lower commitment (i.e., lower enrollments, longer patient time on program, and lower documentation rates) in other components of the evaluation. These services had a moderate understanding of the potential benefits of the community paramedicine (i..e, business model innovation) and faced less resistance from strong organizational routines, the key issue was they low adaptation mechanisms. Specifically, they had lower commitment from senior leadership, fewer resources to support the implementation of the CPRPM program, less investment in the development and use of standardized procedures such as documentation and follow-up, and lower desire and confidence in experimenting with the technology and integrating remote monitoring into day-to-day routines.

Finally, it is important to note that all services identified a number of important barriers that need to be addressed moving forward including (but not limited to):

- Municipal funding models are not linked to LHIN/Ministry;
- Paramedics are not recognized as a member of the health system circle of care (as they are not regulated healthcare professionals in Ontario);
- Lack of investment in routinizing community paramedicine models of care;
- No full-time investment in community paramedic staff to manage and deliver the program.

These findings suggest that as CPRPM is expanded, there may need to be more program support to help the services learn how to properly set up the program, staff it, manage it, etc. It may also be important to debrief further with the two High Service Adapters to uncover specific best practices that helped their colleagues capture the full benefits of the program.

Chapter 7: Lessons Learned

The CPRPM Program has done many things well and has also learned many important lessons along the way. This section of the report groups these lessons learned into the following headings:

1. Governance/Program Management
2. Financials
3. EMS On-Board Process
4. CPRPM Program Set Up
5. Community Paramedic Selection Process
6. CP Training
7. CPRPM Program Marketing
8. Patient Identification
9. Patient Recruitment
10. Patient Enrolling
11. Circle of Care (Patient Portal) Setup
12. Patient Monitoring
13. Equipment Functioning
14. Clinical System
15. Behavior Change & Outcomes
16. Program Reporting and Outcomes
17. Patient Discharge
18. Other Observations and Insights

7.1 Governance/Program Management

- Having the South Central Community Development Corporation (SCCDC) as the single sponsor for the project (vs having to deal with multiple services separately) was a big benefit. SCCDC played the role of service provider hosting the program and was able to then provision the service to each EMS Service which was the legal Health Information Custodian for the data.
- It is recommended that a more consistent set of clinical guidelines be established for CP programs focusing on the 3 main areas of CP (Remote Monitoring, Clinics, and Home visits).
- In retrospect there was likely too much room for local variation to the program which did weaken some of the outcomes that otherwise might have been even stronger.
- Community Paramedicine needs to be recognized at the provincial level as a new type of paramedic service with their own unique skill set and training program.

7.2 Financials

- CPRPM should receive consistent FTE equivalent base funding to support the program on an ongoing basis to ensure the success of the program. It should be staffed with full time and properly trained staff, vs having a rotation of different people coming through every 1-2 weeks. Stable staffing is important to establish a relationship with the patients being monitored.
- The current EMS funding model (50/50 municipality and MOH) makes it difficult for paramedic services to properly invest in the CPRPM business model as the benefits do not accrue equally to the municipality and health system. Working closely with the LHINs to share the CPRPM business case will be essential to long term success.
- The business case for CPRPM clearly showed that the healthcare benefits do not accrue equally to EMS services and the health system at large and highlights why a more equitable funding model is needed.

7.3 EMS On-Board Process

- Some services and municipalities took a long time to get the MOUs approved and signed through municipal political and legal processes. This significantly reduced the number of services participating in the CPRPM program from what was initially planned and this impacted cash flow and ultimately achieving adoption targets. Unfortunately the project ended up getting about 1100 of the planned 1500 patients by Dec 2017.
- Having a standard MOU template made the on-boarding process much easier as the project evolved.
- Furthermore the approved Ministry funding to the LHINs for Community Paramedicine has helped with EMS onboarding more recently. While it is unfortunate that it was so late in the program (Feb 2017) this has helped signal to other EMS services that there is value in the program. Unfortunately this funding does not extend to all municipalities and EMS Services so there are still some funding gaps that limit broader expansion.

7.4 CPRPM Program Set Up

- After initial program development, the replication process for establishing new services became simple. Each EMS service had its own hosted and managed environment.
- The training program was adapted through the project to add learnings from early adopters. While there was an attempt made to create a standard program, there was a lot of flexibility that led variation between services. This was both an advantage (being adaptable and flexible) and a limitation (leading to significant program variation and impact on outcomes).

7.5 Community Paramedicine (CP) Selection Process

- Staffing consistency is key. Some services assigned paramedics who were recovering from an injury or illness rather than full time CP staff. This resulted in a lot of turnover and less consistency than in other services who staffed one or two lead CPs to run the program. The latter produced much better outcomes and staff clearly felt ownership of the program. The dedicated staffing model is highly recommended going forward.
- Selecting the right staff member(s) for the CP program is equally important. Not every paramedic is equipped to do the CP role. It takes a special type of paramedic who believes in behavior change, can establish a relationship with the patient, help identify the goals and motivations, and who believes in coaching and behavior change. It also requires someone who is diligent and detail oriented. Selecting and training the CPs is critical.

7.6 CP Training

- During the program, training was inconsistent across paramedic services. Some did little to no training while others invested significantly in training and continuing medical education. In order to gain the respect of healthcare colleagues (e.g., physicians and other community partners), the CP must be able to understand and communicate with other clinicians. Even Advanced Care Paramedics require training for this new role.
- Community Paramedics will benefit from specialized training/education. A consistent training program across the province will allow paramedics and management to have a grasp on what is required to be a CP. Some work is taking place to develop more training consistency in partnership with various community colleges in Ontario.

7.7 CPRPM Program Marketing

- The CPRPM program management team is important to the adaptation of the health care system and embracing the benefits of CPRPM. This team is needed for program advocacy, effective governance, daily operations, and data management. Some services also found that having a third party do recruitment, troubleshooting, equipment and battery replacement deliveries to be quite helpful.
- The SCCDC really played an important role in consolidating the evaluation work, helping market the program, manage media, engage with the ministry and OTN, the LHINs, Primary Care, etc.

7.8 Patient Identification

- The initial plan for patient enrolment was to use Interdev data to run reports of patients who had the identified conditions so they could be telephoned and invited to join the program. Unfortunately, most EMS services do not use the iMedic system to record patient phone numbers and as a result, the project team had to revert to mailings as the only way to contact patients. These proved to be ineffective as most patients did not respond to multiple attempts. Direct paramedic referrals to the program worked much better but took much more time.
- Identifying patients proved to be more difficult than originally thought when the program was designed due to:
  - Data quality issues from Interdev
  - Physician buy in (from primary care)
  - Cold calls and letters sent to pts identified by the 911 query was not very successful
- Matching patient records was not easy. Capturing the patient`s Health Card Number (HCN) became the 'gold standard'. This was a challenge for services where Paramedics did not routinely record HCN but became much easier as the program evolved (i.e., paramedics began capturing the HCN).
- The community needs to identify needs/gaps that a CP can fill. Once this is established, the CP programs can solicit the various community partners for referrals including: hospitals, discharge planners, ED, GEMS staff, internists, Respiratory therapists, OT/PT staff, family health teams, LHIN, CMHA, and the many other community partners who support individuals in the home.

7.9 Patient Recruitment

- Buy-in from Family Health Teams (FHT), hospital discharge coordinators and other community-based physicians is important to identifying potential patients for the program. This was more difficult at the start of the program due to other competing programs.
- As a result of this project, some paramedic services are developing an 'automated' process for finding patients that may be helped by RPM.
- Encouraging front line staff such as rapid response nurses and local heart clinics to send referrals for CPRPM is starting to yield more patients.
- Some services are marketing the CPRPM with local pharmacies and medical offices.
- With support from community partners, the patients will begin to learn about how valuable the CPs are and the additional care that they can receive in their home.

7.10 Patient Enrolling

- The process of bringing the equipment into the home is important to encourage daily reading compliance and technology acceptance. Important components of the process include:
  - Explaining when to take daily readings and how taking readings at the wrong time of day can cause false alerts;
  - Demonstrating how to use the technology and training the patient on how to properly take readings (i.e., walking them through the daily process);
  - Providing clear instructions with regard to batteries, maintenance etc.
- A really important thing that the program did well up front was to develop a consent form that was granular – patients could sign up for the program and opt out of the clinical evaluation, or participate in to both. Having an express consent from patients helped greatly in getting access to their ICES data. What would have been helpful for future projects was to have more engagement with ICES at the time the forms were developed to ensure it include appropriate wording.
- Fear of technology may have deterred some patients, however when the paramedic brought the equipment into the home and explained the process demonstrating how easy it is to use, patients were less anxious.
- Some services found it helpful to have a third party do installs, however the draw back was that the paramedics were not able to build a relationship with the patient. In this case having a third party do the discharge was more advantageous.
- In many cases the patients were just getting comfortable with the program when the equipment was scheduled to be removed.
- Extending the reading plans beyond the minimum 6 months to one year or more so compliance alerts continue to be generated for patients that stay on the program is a must.

7.11 Circle of Care (Patient Portal) Set Up

- The Circle of Care (or Patient Portal) was intended to allow patients to include their loved ones (e.g., family or friends) to participate in their care. The setup was implemented during the project registration by gathering necessary contact information from the patient including email addresses and phone numbers if available. Unfortunately, many times patients did not have this information readily available which made inviting other care members to the program difficult.
- The initial Patient Portal (from HQIC based on Microsoft Yammer) turned out to be difficult to use and for patients to navigate. There were also some privacy & security concerns raised as the solution was hosted in the US making compliance with Ontario Privacy Laws more challenging. SCCDC migrated to the IdealLife Patient Portal which was not available at the beginning of the project. SCCDC worked closely with IdealLife to adapt the solution, including the on-boarding process, to ensure it complied with privacy and security best practices. This was quite successful in the end but took much longer than planned to get up and running. This negatively impacted the scope of deployment for this part of the solution.
- One challenge with the Patient Portal is that it does not integrate with the primary care clinician's EMR solution. This means that clinicians need to log into the portal to get updates on their patients. Most clinicians do not have the time to do this for all the various types of solutions and portals in use. One of the work-arounds for this was that the IdealLife Clinical Portal could be set up to automatically fax monthly reports to the Primary Care Providers (PCPs) so they receive updates on the progress of their patients. These reports were designed with input from the Clinical Advisory Committee to ensure they provided the right amount of clinical detail. Paramedics were also instructed to contact PCPs by phone if there was an urgent problem requiring their attention. The portal was **not used** as a channel to communicate critical information.
- The Patient Portal developed for family members and Circle of Care providers proved to be very helpful. For family members it gave them the ability to follow their loved one's progress as well as print reading data for medical appointments. For care providers it allowed them to view patient data as well as communicate with each other about patient progress and appointments. Further development of this feature will be very helpful in encouraging behavioral adaptation with regard to people managing their condition, learning how to use telemonitoring devices, and determine when they need to seek help.
- One of the future considerations is to leverage OntarioMD's Health Report Manager (HRM) solution which delivers clinical reports right into the EMR. It is felt this will be a positive enhancement to the RPM solution rather than developing this capability for each different EMR solution. The one disadvantage is that this solution is only available in Ontario currently.
- A further planned enhancement going forward is to explore integration with Sunnybrook's MyChart Personal Health Record solution. This is being deployed broadly in Ontario and provides patients with a comprehensive view of their Electronic Health Record and this could include RPM data. Discussions are underway to explore integration of MyChart in the future.

7.12 Patient Monitoring

- It was identified during the program that there needs to be a more consistent processes and procedures for ensuring patient compliance, and for documenting actions following a non-compliance or reading alert. Not all services did these things the same way and this introduced considerable variation between services which impacted the clinical benefits and outcomes.
- Some services found it helpful to have a third party (Future Health Services) provide technical support for equipment issues, battery replacements, discharges, etc. This would allow paramedics to focus on clinical and patient aspects of the program. It is unclear to what extent this impact had on outcomes and opens up another opportunity for further study. This said, it is believed that personal connection between patients and paramedicst is key to supporting the necessary behaviour and lifestyle changes.
- Patients assigned two or three devices and stay on the program longer (i.e., 8, 9, 11 and 12 months) are more compliant in taking their daily readings. It seems when too few devices (e.g., one) are assigned, it doesn't become a part of daily routines and assigning four may become overwhelming. Two to three devices seem to be the optimal level – at least to start.
- There is a feature in IdealLife called "combined Alerts". Paramedics were instructed to use this feature to handle multiple alerts all at once. Enter one note and click complete – attaches one note and completes all alerts for that patient to assist in efficiency and workflow. There is a risk this feature is skewing the data as it still records the alert and increases the overall alert activity (see Section 5.1). In general the reporting capabilities of the IdealLife system were quite limited. On a positive note, we were able to get raw data extracts which could then be analyzed in Excel or using other third party tools.

7.13 Equipment Functioning

- There were significant problems early on with the equipment such as:
  - Battery issues – batteries tended to burn out and needed to be replaced frequently. We found this to mainly be a result of communication issues between the device and POD often due to placement issues. The devices kept trying to send the signal until it is successfully transmitted and this used a lot of power and killed the battery. Better device and POD placement improved this issue considerably.
  - Inaccurate readings – Early on there were concerns from some services with specific devices (mainly SPO2) and their accuracy. While all devices were Health Canada certified there were questions being raised. These have since been addressed
  - Connectivity issues were experienced for some installations. While cellular networks were used for most patients, there were some patients who had poor or non-existent cellular coverage and then needed a phone or ethernet connection to transmit data.
  - IdealLife's backend solution lacked tools to perform research analysis such as compliance rate, patient improvement, alert analysis, etc. While this was a limitation, they did have good tools to extract most if not all the data so it could be analyzed externally. SCCDC did a lot of development to configure the data into usable research information during the program and is now able to use the reading data to understand patient behavior.
- These issues were taken very seriously and the Sponsor and IdealLife worked closely to ensure these issues were documented, escalated and resolved in a timely manner. While it did take longer than we would have liked to resolve some of these issues the main ones have been successfully resolved.

7.14 Clinical System

- The IdealLife Clinical Portal was the main clinical system used by the EMS Services to support the RPM program. In general, this system worked quite well and was where paramedics spent most of their time. The dashboard provided a clear list of alerts in order of priority (severity) and also the tools and protocols for paramedics to follow up with patients. The system did treat compliance alerts separately from reading alerts. There was also limited ability to configure all the various parameters of the system for each service and to make some things mandatory. Having more ability to configure the system centrally could help support better program consistency.
- One of the main benefits with the IdealLife system was the ability to get all the raw clinical data for analysis. Not all vendor solutions allow this and it was noted as a major benefit for the project team.
- Several services did not offer weekend or after hour coverage. Several noted that this meant the number of alerts could become overwhelming on Monday mornings. From a program perspective this is concerning as the whole point of the program was to proactively monitor patients to prevent an emergency and this can just as easily happen on a weekend as a weekday. It might be worth exploring providing a central after hours coverage model for services who can not justify a dedicated resource on evenings or weekend or holidays.
- Some services established a program to respond via phone over weekend, with visits to patient's homes during weekdays. This made the patients feel more comfortable as well as reduced the alert workload on Monday mornings. We did not analyze whether there were more weekend calls vs weekday calls while on the program, but this might be something to look at more closely and evaluate across services who did offer weekend coverage.
- The quality and access to data is a major benefit of this program. The behavioral adaptation study highlights the importance of clinical documentation (e.g., alert notes). There was a large variance in noting quality across paramedic services. These program issues need to be addressed in the new program going forward to ensure better outcomes and greater consistency.

7.15 Behavior Change and Outcomes

- Type 2 Diabetes, and Hypertension are largely lifestyle conditions. While monitoring can help catch or prevent exacerbations, effective management means that patients need to learn how to better manage their conditions themselves and need to make lifestyle changes (diet, exercise, medications, etc.). This really involves behavior change – making changes to how one lives and what one does. This is why coaching is an important aspect of this program. It is not just about catching things before they go from bad to worse, it is also about helping prevent them from going bad in the first place. That requires getting to know the person (patient), understanding their motivations and goals, and then setting realistic targets and objectives that will help them achieve their overall goals.
- While CPRPM managed the biometric aspects, it did not manage the other aspects of patient management, e.g., medications, nutrition, etc. Exploring other applications or solutions that can capture these aspects of Chronic Disease Management would be worth exploring further.
- In many cases patients built a strong relationship and a trust with their paramedics and did not want to be discharged.
- Many previous programs have targeted up to 6 months and that was Infoway's goal for this project. However, there is limited literature that suggested that this is the right amount of time. Given CHF and COPD are chronic conditions that will not go away – even with good management – it is unclear whether RPM becomes redundant after some period of time. This said, we do believe there are different types of patients, with different needs, and therefore there may need to be different durations and types of programs. While 6 months was good for some patients who demonstrated significant improvement, perhaps after 6 months they could move to a "step down" program that is less intensive but still has someone paying attention. Other patients may not come off the intensive program but this may help keep them in their homes and out of hospital for the last few months of their lives. Others may find that 6 months is enough and they can then come off the program altogether. We believe more research is needed to better identify these different populations and how to identify them early.
- There were several cases where paramedics intercepted a patient who was on a deteriorating trajectory and were able to identify a condition to the doctor to remedy the situation before it became more serious.
  - In one case a patient had an increase in weight alert, the paramedic phoned and based on the patients self-reported symptoms, the paramedic advised them to go see their doctor. The patient was hesitant, but finally agreed. The patient went to the doctor and was sent for chest x-rays, which showed fluid beginning to build up in the patients lungs. His medications were adjusted, and he was able to stay at home. The doctor said that this patient would have ended up in the hospital had it not been caught so early.
  - In another case a paramedic called a patient with COPD/CHF on home oxygen based on declining oxygen saturation readings over a few days. The patient described the beginning of what the paramedic believed to be a COPD exacerbation. A long weekend was approaching, so the paramedic took a summary report to his doctor's office showing the change in readings and got him a doctor's appointment for that day. The patient was able to get his prednisone treatment and stay out of hospital. Following this, the paramedic received the kindest message from his family who had been away on vacation that it was amazing what the paramedic had done for him and that the program is excellent. They are confident he would have ended up in hospital had the paramedic not intervened.
  - Finally, a patient with known atrial fibrillation had been having very irregular heart rate readings. The paramedic was concerned about her heart rate being over 100 bpm with her cardiac history so a summary report was send to the Doctor. Based on this data the doctor put her on a beta-blocker.

7.16 Program Reporting and Outcomes

- A key limitation with the IdealLife system, is that it did not provide a mechanism to provide patient feedback directly into the system. In response, SCCDC implemented Infoway's System & Use Survey separately to report on patient satisfaction and self-reported outcomes. It would have been better if this could have been integrated with the IdealLife system in some way. They do support patient interaction using a tablet but the cost of these devices increased the technology cost which the program was trying to minimize. This is something we hope to address in a future project using the Orbita voice interaction (e.g., Amazon Echo) devices which will then integrate survey data with the RPM data.
- As noted above, one of the key benefits of the IdealLife system was that we were able to get full access to all RPM data. Not all programs we have spoken to were able to get this level of data access. Most had to rely on reports provided by the vendor. While this was a big benefit, a limitation was with some of the rather limited reporting capabilities within IdealLife. For example, there were not great tools to calculate and report on actual patient compliance (i.e., taking at least one reading per device per day). Similarly, if a reading triggers an alert the current system does not notify the patient to take another reading. Some patients know to do this but not all. If a new reading is taken and normal, this should automatically over-ride the previous alert but does not today. These are little things that really should be addressed to make the system and program work better and more efficiently for paramedics.
- Through this project benefits evaluation we were able to study patient compliance, reading and alert data, and emergency service utilization data for analysis purposes. We were also able to complement this with a Health System Utilization Analysis using ICES data for those patients who consented to participate in this evaluation component. It would have been helpful if the program received outcome data monthly rather than waiting for the quarterly/yearly reports from ICES. Unfortunately the ICES NACRS and DAD data are only available semi-annually.

7.17 Patient Discharge

- The original plan was that patients would be on the RPM program for a minimum of 3 months and a maximum of 6 months. However, one of the problems the program did experience was difficulty getting patients off the program at the end of the 6 month period. Patient's built a relationship and a trust with their paramedics, and many did not want to be discharged. Similarly, many paramedics felt that the patients were not necessarily stable and ready to be discharged from the program so they felt uncomfortable removing the technology. Many paramedics felt that 6 months was too short a duration for many of these patients given their complex health issues and lack of support in the home. In fact, many of these patients require participation in the program for the duration of their life to live independently.
- In some other cases, patients were being discharged prior to three months but with no reason given as per the training protocol. While SCCDC did receive an adoption payment for the initial go-live, if patients were discharged prior to the 3 month minimum SCCDC did not receive the 3-month "active use" payment. The set-up costs (i.e., installation, training etc.) need to be considered and policies with regard to minimum time on program need to be evaluated. This may have to do with inadequate screening and patient identification procedures up front for some services. Fortunately, the number of patients in this situation was relatively few.
- Paramedic services who focused on coaching and teaching the patients about their disease and its effective self-management, had an 'easier' time discharging patients after 6 months, with a few exceptions. One service in particular made this known to their patients at the outset, that the goal was for the patient to learn how to self-manage within the 6 month period.

7.18 Other Observations and Insights

In summary the CPRPM program was very successful in giving patients with chronic conditions the tools and education to safely stay in the comfort of their own homes. This said there were a number of other questions or ideas that should be looked at for the future:

- One common theme was whether the program should be broadened to other clinical conditions and uses such as fall detection/alerting/prevention, mental health, palliative care, diabetes and hypertension (as primary conditions vs co-morbidities), etc. The other groups identified were frail elderly people (regardless of medical condition) and those who are socially isolated. The feeling among the community paramedics was that these other groups could also benefit. This may require further analysis to better understand the business case for other conditions and patient populations.
- Another question that arose was whether patients should be discharged from the program if they haven't had any alerts after 3 months. One argument is that the patient is already doing something to manage their condition and the program is not providing benefit. Another school of thought is that the patient corrects unhealthy behaviors because they know they are being monitored but over time problems will likely occur. The consensus was that in general it is likely appropriate to remove the patient from monitoring, however there should be room for flexibility if it is felt the technology is having a beneficial impact e.g., reducing anxiety, supporting patients who are on their own, etc.
- A real challenge most services reported was difficulty engaging primary care in the RPM process. Most primary care providers have patients they could refer to the program and once on it, they can be kept informed on their patient's progress. This did start to improve as the program progressed, but more work is needed to engage primary care in the process, make them aware of the benefits, and effectively engage them as part of the care team. This will likely require regular integration and communication. We also need answers to questions like: What should be the collaboration approach and reporting frequency? What billing codes are available for primary care to support such virtual care initiatives?
- More research is needed into the optimal staff model for RPM for both regular hours as well as evening and weekend coverage. Some EMS services had dedicated CP resources, while other services utilized CPs as first responders and were often interrupted for 911 calls. It was clear that the dedicated CP model worked best. However, most services could not afford to run these programs over the evenings and weekends. It may be appropriate to have on call community paramedics that can respond to alerts but depending on their assessment may not visit the patient until the weekday. Also using an SCCDC trained technical support staff would allow paramedics to focus on the clinical work with equipment issues left to SCCDC. This is something we hope to finalize over the next year as part of the Scale & Spread project.
- Finally, a key strategic priority for the program is solidifying long term funding from the LHINs. The LHINs ultimately are going to be responsible for funding RPM programs. On a positive note, the CPRPM program has a very compelling value proposition based on its net ROI. Long term sustainability will require support from the Ministry, LHINs, Primary Care Practices (e.g., FHTs), municipalities, specialist groups, and other community partners.

Chapter 8: Conclusion

While there was quite a bit of variation in terms of how the CPRPM program was implemented by different EMS services, overall it provides a very compelling business case with an average return on investment in excess of 500%! This has been supported using actual health system utilization data from ICES for our specific patient population. We believe this is the first study of its kind to do so including looking at post-program health system utilization. Also, unique to this evaluation is the in-depth behavioral adaptation study that uses quantitative and qualitative methods that not only evaluate the benefits of patient adaptation, but explain how patient adaptation occurs. Specifically, change in behavior depends on the patient's willingness to take daily readings and paramedic's commitment to providing coaching, feedback, and documenting notes to help the patient achieve their goals.

This evaluation also uncovered specific insights about the role of the community paramedic (CP) in influencing behavioral change. There were over 70 CPs involved in this program and significant variance with regard to their alert response time, competence in coaching, and commitment to documenting patient information to retain knowledge and share information. As the patient-paramedic relationship is not one-to-one (i.e., multiple CPs are supporting the CPRPM program in most EMSs), a commitment to patient coaching and documenting interactions is crucial to driving benefits from this program. Clear expectations for documentation need to be established, incentives designed to maintain documentation quality, and finally technology platform improvements are essential to deliver and analyze feedback in a more efficient and effective way. Integration of analytics tools will expand the feedback system to become more intelligent and embedding tools on the patient portal would further empower patients and their families to identify ways they can work toward the patient's goals.

In conclusion, access to care, particularly in rural communities, is a major challenge. With a rapidly aging population and more and more seniors living at home in their own communities, they need better supports to remain at home safely. CPRPM is an innovation in care that not only pays for itself, but provides a compelling net return on investment. This said, it does require bringing the system stakeholders together. LHINs, primary care, EMS services, hospitals and community providers need to work together to provide the right services, to the right people at the right time. Implementing CPRPM requires significant change to integrate RPM into day-to-day activity for paramedics. Strong buy-in is needed from all stakeholders so the management of CPRPM is effective. Formal sources of funding, clearly defined work routines, and clearly defined roles and responsibilities are essential.

This evaluation provides a clear and compelling business case to support on-going investment and expansion in the CPRPM program. The business case includes tangible cost and benefit data and shows how these accrue to different stakeholders. Recommendations are made as to how costs should be funded based on benefits realized over the long-term. Finally, this report outlines a number of promising future opportunities that may further reduce program costs, and suggests several opportunities for expansion to more regions, patient populations, and possibly longer RPM durations to sustain greater system benefits.

Appendix A: System Benefits by EMS

		911 Calls			ED Visits			Transport Rate		
	Total Patients	**Pre**	**Post**	**Reduction**	**Pre**	**Post**	**Reduction**	**Pre**	**Post**	**Reduction**
Chatham	9	66	17	74%	64	33	48%	97%	198%	-101%
Cochrane	6	30	23	22%	29	23	20%	97%	100%	-3%
Essex	102	576	428	26%	436	263	40%	76%	61%	14%
Grey	34	113	92	19%	100	86	14%	89%	94%	-5%
Guelph	24	127	105	17%	118	94	20%	93%	89%	3%
Hamilton	18	92	59	36%	83	49	40%	90%	83%	7%
Hastings	7	33	26	22%	33	26	22%	100%	100%	0%
Middlesex-London	49	239	211	12%	184	160	13%	77%	76%	1%
Parry Sound	23	102	79	23%	90	82	9%	88%	104%	-16%
Peterborough	19	119	64	46%	108	60	44%	91%	94%	-3%
Rama	3	9	2	73%	7	1	83%	78%	50%	28%
Renfrew	52	239	183	24%	229	142	38%	96%	78%	18%
Total Average	**346**	**1744**	**1289**	**26%**	**1481**	**1021**	**31%**	**89%**	**94%**	**-5%**

			Total Coaching Time						Total Documentation Time				Total Paramedic Client Time (PCT)			
			12%	88%	30 min	5 min				2 min						$175/ Hour
	# of Patients	# of Interactions	12% Home Visits	88% Phone Calls	Home Visit (Hours)	Phone (Hours)	Total Interaction Time (Hours)	Time / Patient	Notes Taken	Note Time	Total Doc Time	Time / Patient	Total Time / Patient	Average Patient Time on Program	Time / Month (Hours)	Monthly Cost
Chatham	6	82	10	72	5	6	10.9	1.82	149	5	16	2.65	4.47	6.86	0.65	114
Cochrane	9	68	8	60	4	5	9.1	1.01	120	4	13	1.45	2.46	9.43	0.26	46
Essex-Windsor	81	1314	158	1156	79	96	175.2	2.16	2203	73	249	3.07	5.23	7.67	0.68	119
Grey	33	850	102	748	51	62	113.3	3.43	1415	47	161	4.86	8.30	10.74	0.77	135
Guelph	5	66	8	58	4	5	8.8	1.76	110	4	12	2.49	4.25	5.97	0.71	125
Hastings	6	18	2	16	1	1	2.4	0.40	31	1	3	0.57	0.97	10.15	0.10	17
Parry Sound	9	43	5	38	3	3	5.7	0.64	72	2	8	0.90	1.54	8.60	0.18	31
Peterborough	19	312	37	275	19	23	41.6	2.19	447	15	57	2.97	5.16	5.28	0.98	171
Renfrew	44	635	76	559	38	47	84.7	1.92	1046	35	120	2.72	4.64	7.77	0.60	104
Total / Average	**212**	**3,388**	**407**	**2,981**	**203**	**248**	**451.7**	**1.70**	**5,593**	**186**	**638**	**2.41**	**4.11**	**8.08**	**0.65**	**114**

Appendix B: Paramedic Client Time (PCT) Data Table

			Total Coaching Time						Total Documentation Time				Total Paramedic Client Time (PCT)			
			12%	88%	30 min	5 min				2 min						$175/ Hour
	# of Patients	# of Interactions	12% Home Visits	88% Phone Calls	Home Visit (Hours)	Phone (Hours)	Total Interaction Time (Hours)	Time / Patient	Notes Taken	Note Time	Total Doc Time	Time / Patient	Total Time / Patient	Average Patient Time on Program	Time / Month (Hours)	Monthly Cost
Chatham	6	82	10	72	5	6	10.9	1.82	149	5	16	2.65	4.47	6.86	0.65	114
Cochrane	9	68	8	60	4	5	9.1	1.01	120	4	13	1.45	2.46	9.43	0.26	46
Essex-Windsor	81	1314	158	1156	79	96	175.2	2.16	2203	73	249	3.07	5.23	7.67	0.68	119
Grey	33	850	102	748	51	62	113.3	3.43	1415	47	161	4.86	8.30	10.74	0.77	135
Guelph	5	66	8	58	4	5	8.8	1.76	110	4	12	2.49	4.25	5.97	0.71	125
Hastings	6	18	2	16	1	1	2.4	0.40	31	1	3	0.57	0.97	10.15	0.10	17
Parry Sound	9	43	5	38	3	3	5.7	0.64	72	2	8	0.90	1.54	8.60	0.18	31
Peterborough	19	312	37	275	19	23	41.6	2.19	447	15	57	2.97	5.16	5.28	0.98	171
Renfrew	44	635	76	559	38	47	84.7	1.92	1046	35	120	2.72	4.64	7.77	0.60	104
Total / Average	**212**	**3,388**	**407**	**2,981**	**203**	**248**	**451.7**	**1.70**	**5,593**	**186**	**638**	**2.41**	**4.11**	**8.08**	**0.65**	**114**

		Total 911 Calls				Total 911 Call with Transports				Total 911 Call Only (No Transport)			Reallocated Service Hours			Paramedic Savings			
	Total # Patients	Pre	Post	Total Calls Reduced	Call Reduction	Pre	Post	Total Calls Reduced	Transport Reduction	Pre	Post	Reduction	911 & Transport	911 Only	Total Time Saved	Cost Savings	Month on Program	Savings / Month	Savings / Month / Patient
													100 minutes	30 minutes		$ 434			
Chatham	9	66	17	49	74%	64	33	31	48%	2	(17)	19	51	9	60.15	26,103	7.27	$ 3,590	$ 399
Cochrane	6	30	23	7	22%	29	23	6	20%	1	-	1	10	1	10	4,348	6.87	$ 633	$ 105
Essex-Windsor	102	575	428	147	25%	436	263	173	40%	139	165	(26)	288	(13)	275	119,450	7.55	$ 15,824	$ 155
Grey	34	113	92	21	19%	100	86	14	14%	12	5	7	23	3	27	11,661	11.84	$ 985	$ 29
Guelph	24	127	105	22	17%	118	94	24	20%	9	11	(2)	40	(1)	39	16,736	5.81	$ 2,883	$ 120
Hamilton	18	92	59	33	36%	83	49	33	40%	9	10	(1)	56	(0)	55	23,985	7.25	$ 3,309	$ 184
Hastings	7	33	26	7	22%	33	26	7	22%	-	-	-	12	-	12	5,308	11.12	$ 477	$ 68
Middlesex London	49	238	211	27	12%	184	160	24	13%	54	50	4	39	2	41	17,878	6.50	$ 2,750	$ 56
Parry Sound	23	102	79	23	23%	90	82	8	9%	12	(3)	15	13	8	21	9,047	7.99	$ 1,132	$ 49
Peterborough	19	119	64	55	46%	108	60	48	44%	11	4	7	80	4	83	36,045	5.32	$ 6,774	$ 357
Rama	3	9	2	7	73%	7	1	6	83%	2	1	1	10	0	10	4,369	12.56	$ 348	$ 116
Renfrew	52	239	183	56	24%	229	142	87	38%	10	41	(31)	146	(16)	130	56,535	8.30	$ 6,811	$ 131
	346	1,742	1,289	453	33%	1481	1021	460	33%	261	268	(7)	767	(4)	764	$ 331,899		**$ 7,111**	**$ 132**

Appendix C: Supplementary ICES Analysis (Length of Stay)

	On Program			
	Pre-Program	**On Program**	**Savings**	**Reduction**
ED Visits	1,780	1,313	467	26%
Admissions	535	365	170	32%
% of ED Visits Admitted	30%	28%	2%	8%
# of Readmissions (7 Days)	52	34	18	35%
% of Admissions Readmitted (7 Days)	10%	9%	1%	5%
# of Readmissions (30 Days)	143	84	59	41%
% of Admissions Readmitted (30 Days)	27%	23%	4%	14%
Hospital Days (Actual)	2,452	2,049	403	16%
Average Length of Stay (Actual)	4.9	5.8	(1.00)	-21%
Total Hospital Cost - ED ($655 Estimate)	$ 1,165,900	$ 859,884	$ 306,016	26%
Total Hospital Cost - Hospital Days ($954/day Estimate)	2,339,208.00	1,954,746.00	384,462	16%
Total Hospital Savings	**3,505,108.00**	**2,814,630.00**	**690,478**	**20%**
Total Savings / Patient (294 patients)			**$ 2,349**	

Appendix D: Patient Time on Program (PTP)

	Months on Program												
	3	4	5	6	7	8	9	10	11	12	13+	Total	**Average**
	3.42	4.5	5.57	6.43	7.43	8.43	9.45	10.40	11.48	12.39	19.83		
Chatham	1	1			6	2						10	**6.86**
Cochrane		1	1	3	3	2	1	1		1	1	14	**9.43**
Essex-Windsor	5	7	16	26	28	12	15	3	2	4	4	122	**7.67**
Grey	2	2	4	11	12	10	10	2	5	2	18	78	**10.74**
Guelph	2	1	7	35	1							46	**5.97**
Hamilton		2	2	8	5	9				1		27	**7.42**
Hastings				1	2	3	1	1	1	1	1	11	**10.15**
Middlesex London	5		13	47	12	4	2	1	1			85	**6.49**
Parry Sound	5		4	31	14	5	3	1		2	8	73	**8.60**
Peterborough	5	7	7	7	2							28	**5.28**
Rama								1		1	3	5	**12.86**
Renfrew	7	10	7	44	26	25	11	7	4	5	5	151	**7.77**
Total	**32**	**31**	**61**	**213**	**111**	**72**	**43**	**17**	**13**	**17**	**40**	**650**	
Average Time	5%	5%	9%	33%	17%	11%	7%	3%	2%	3%	6%	100%	**7.89**

Appendix E: Remote Monitoring Instruction Cards

Community Paramedic Remote Patient Monitoring (CPRPM)

STEP-BY-STEP GUIDE for CHF Patients

VERY IMPORTANT: *You must wait for each device to finish transmitting & shut off before using the next one.*

Please sit and rest for 5-10 minutes before taking Blood Pressure & Pulse Oximeter Readings

TRANSMITTER

This device is vital to ensure your readings are shared with your Community Paramedic. While you should not have to pay too much attention to it, there are a few things to keep in mind:

- If your other devices are behaving strangely (lights are flashing, turning off and on at odd times) it COULD be that they are having trouble connecting to the transmitter.
- To reset the transmitter simply unplug it (pull the plug from the back of the machine) and plug it back in.
- If your Community Paramedic calls to say you missed a few readings and you know you did them – a simple reset may fix the problem.
- If you have a power outage – even a short one, the transmitter will need to be reset by unplugging it and plugging it back in.
- The transmitter needs to stay in a spot in your residence that provides a good cell connection. At least 2 bars on the device usually ensures the connection and your Community Paramedic set this device up in the best spot in your residence to provide a good connection.

BLOOD PRESSURE

1. Pull the cuff onto the left upper arm.
a. Place the red strip in the crease of the elbow with the tube on the thumb side of your arm.
b. The cuff has been adjusted for you to slip on and off. If the cuff's Velcro has become unfastened, it will need to be re-fitted: please call # below.
2. Press the ROUND button TWICE, with a small pause in between, the cuff will now inflate.
a. If the screen changes to "Reminder to be rested..." push the button on the RIGHT once.
3. The machine will "Beep" when the reading has been taken. The screen will show "you may now remove the cuff"
4. The screen will then go through a series of changes:
   a. A flashing blue light means the device is connecting to the transmitter. When connected the light will be a steady blue and the message "Transmitting" will show up along the bottom of the screen.
   b. "Information Transmitted" will appear when the transmission is complete. The light will turn off.
   c. "Goodbye" ****The machine will shut itself off****

PULSE OXIMETER (Finger Clip)

1. Press the small round button on the top of the machine
2. Open the machine and insert a finger, nail-side facing up, until the finger hits the ledge at the back
3. Machine will switch from only showing lines to showing numbers that will fluctuate for a few seconds.
4. Machine will "BEEP" after 20-60seconds and the numbers will now be showing the patient's results
   a. A flashing blue light means the device is connecting to the transmitter. When connected the light will be a steady blue and the message "Transmitting" will show up along the bottom of the screen.
   b. "Information Transmitted" will appear when the transmission is complete. The light will turn off.
   c. "Ideal Life" ****The machine will shut itself off****

SCALE

Weight is to be taken in the morning, after using the washroom & before eating or drinking

1. Make sure the scale is on a firm flat surface (Hardwood, linoleum, tiles etc. NOT Carpet, towel etc.)
2. Carefully step onto the scale with your feet in the middle of the pads.
3. Stand as still as possible, without holding onto anything, and looking straight ahead
4. Once reading has been taken, the scale will say out loud:
   a. Your Weight (Ex: 174.2lbs→ One hundred, seventy-four point two pounds)
   b. "You may now step off the scale"
5. In 20-60 seconds it will then say "Information Transmitted"
6. ****The machine will shut itself off**** Once it has turned off, the scale can be moved.

IF A MACHINE GIVES YOU A READING THAT SEEMS CONFUSING AND YOU FEEL OK, PLEASE SIT AND REST FOR 5-10 MINUTES AND TAKE THE READING AGAIN

If a machine is not working properly, you are on your last set of batteries, or you need assistance with the machines: Please call your Community Paramedics at 519-776-6441 ext. 2655

YOUR DISCHARGE DATE FROM THE CPRPM PROGRAM IS:

Community Paramedic Remote Patient Monitoring (CPRPM)

STEP-BY-STEP GUIDE for COPD Patients

VERY IMPORTANT: *You must wait for each device to finish transmitting & shut off before using the next one.*

Please sit and rest for 5-10 minutes before taking Blood Pressure & Pulse Oximeter Readings

TRANSMITTER

This device is vital to ensure your readings are shared with your Community Paramedic. While you should not have to pay too much attention to it, there are a few things to keep in mind:

- If your other devices are behaving strangely (lights are flashing, turning off and on at odd times) it COULD be that they are having trouble connecting to the transmitter.
- To reset the transmitter simply unplug it (pull the plug from the back of the machine) and plug it back in.
- If your Community Paramedic calls to say you missed a few readings and you know you did them – a simple reset may fix the problem.
- If you have a power outage – even a short one, the transmitter will need to be reset by unplugging it and plugging it back in.
- The transmitter needs to stay in a spot in your residence that provides a good cell connection. At least 2 bars on the device usually ensures the connection and your Community Paramedic set this device up in the best spot in your residence to provide a good connection.

BLOOD PRESSURE

1. Pull the cuff onto the left upper arm.
a. Place the red strip in the crease of the elbow with the tube on the thumb side of your arm.
b. The cuff has been adjusted for you to slip on and off. If the cuff's Velcro has become unfastened, it will need to be re-fitted: please call # below.
2. Press the ROUND button TWICE, with a small pause in between, the cuff will now inflate.
a. If the screen changes to "Reminder to be rested..." push the button on the RIGHT once.
3. The machine will "Beep" when the reading has been taken. The screen will show "you may now remove the cuff"
4. The screen will then go through a series of changes:
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b. "Information Transmitted" will appear when the transmission is complete. The light will turn off.
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1. Press the small round button on the top of the machine
2. Open the machine and insert a finger, nail-side facing up, until the finger hits the ledge at the back
3. Machine will switch from only showing lines to showing numbers that will fluctuate for a few seconds.
4. Machine will "BEEP" after 20-60seconds and the numbers will now be showing the patient's results
a. A flashing blue light means the device is connecting to the transmitter. When connected the light will be a steady blue and the message "Transmitting" will show up along the bottom of the screen.
b. "Information Transmitted" will appear when the transmission is complete. The light will turn off.
c. "Ideal Life" ****The machine will shut itself off****

IF A MACHINE GIVES YOU A READING THAT SEEMS CONFUSING AND YOU FEEL OK, PLEASE SIT AND REST FOR 5-10 MINUTES AND TAKE THE READING AGAIN

If a machine is not working properly, you are on your last set of batteries, or you need assistance with the machines: Please call your Community Paramedic at 519-776-6441 ext. 2655

YOUR DISCHARGE DATE FROM THE CPRPM PROGRAM IS:

Appendix F: Reading Compliance Rates by Device

	3	4	5	6	7	8	9	10	11	12	13+	Total	Average
Average Patient Time on Program (PTP)	3.42	4.50	5.57	6.43	7.43	8.43	9.45	10.40	11.48	12.39	19.83		
# of BP Devices	31	30	58	205	109	69	41	16	12	17	39	627	
# of BP Readings	1862	2429	7897	40148	20794	14030	9588	3234	4663	4896	13001	122,542	
Weighted Average BP Reading Days	17.59	17.98	24.44	30.45	25.69	24.13	24.75	19.44	33.86	23.24	16.81		25.51
BP Reading Effort	**59%**	**60%**	**81%**	**101%**	**86%**	**80%**	**83%**	**65%**	**113%**	**77%**	**56%**		**78%**
% of BP Population (Weighted Average)	5%	5%	9%	33%	17%	11%	7%	3%	2%	3%	6%		**85%**
Weigh Scale	21	16	38	126	73	34	27	8	8	12	23	386	
# of Weigh Scale Readings	1100	792	3190	15567	11212	4568	4168	1620	1246	2148	6844	52,455	
Weighted Average Weigh Scale	15.34	10.99	15.07	19.21	20.68	15.94	16.34	19.47	13.57	14.44	15.01		17.53
Weigh Scale Reading Effort	**51%**	**37%**	**50%**	**64%**	**69%**	**53%**	**54%**	**65%**	**45%**	**48%**	**50%**		**53%**
% of Weigh Population (Weighted Average)	5%	4%	10%	33%	19%	9%	7%	2%	2%	3%	6%		**58%**
SP02 Manager	32	31	61	211	111	72	43	17	13	17	40	648	
# of SP02 Readings	1801	2542	8620	49123	23130	20335	10966	3844	7533	5190	15310	148,394	
Weighted Average SP02 Reading Days	16.48	18.20	25.37	36.20	28.06	33.51	26.99	21.75	50.49	24.64	19.30		29.60
SP02 Manager Reading Effort	**55%**	**61%**	**85%**	**121%**	**94%**	**112%**	**90%**	**72%**	**168%**	**82%**	**64%**		**91%**
% of SP02 Population (Weighted Average)	5%	5%	9%	33%	17%	11%	7%	3%	2%	3%	6%		**99%**
Gluco Manager	7	10	24	105	52	29	9	3	2	6	14	261	
# of Gluco Readings	145	744	2275	16123	8056	5174	1486	558	224	2282	7409	44,476	
Weighted Average Gluco Reading Days	6.06	16.52	17.02	23.87	20.86	21.17	17.48	17.89	9.76	30.69	26.69		21.49
Gluco Manager Reading Effort	**20%**	**55%**	**57%**	**80%**	**70%**	**71%**	**58%**	**60%**	**33%**	**102%**	**89%**		**63%**
% of Gluco Population (Weighted Average)	3%	4%	9%	40%	20%	11%	3%	1%	1%	2%	5%		**72%**

Appendix G: Medical Alert Rates by Patient Time on Program

		Alert Severity				Total	
		Low	Medium	High	Very High	Total	% of Total
Heart Rate	> 110 bpm for 2 consecutive	2,004	772	409	67	3,252	**11%**
Heart Rate	> 120 bpm for 2 consecutive	1	0	0	0	1	**0%**
Heart Rate	> 130 bpm for 1 consecutive	8	0	0	0	8	**0%**
Heart Rate	< 50 bpm for 2 consecutive	2,219	0	0	0	2,219	**8%**
Diastolic	> 90 mmHg for 2 consecutive readings	6	2	1	0	9	**0%**
Diastolic	> 110 mmHg for 2 consecutive readings	352	373	200	174	1,099	**4%**
Glucose	Glucose greater than 18 mmol/l over 3 readings	115	195	107	49	466	**2%**
Glucose	Glucose greater than 24 mmol/l	87	35	0	0	122	**0%**
Glucose	Glucose greater than 30 mmol/l	31	3	0	0	34	**0%**
Glucose	Glucose in range between 24 and 30 mmol/L	251	150	0	0	402	**1%**
Glucose	Glucose in range between 3 and 4 mmol/L	92	185	39	0	316	**1%**
Glucose	Glucose less than 3 mmol/l	255	0	0	0	255	**1%**
Glucose	Glucose less than 4 mmol/l	130	0	0	0	130	**0%**
SPO2	SpO2 greater than 95 %	166	50	0	0	216	**1%**
SPO2	SpO2 less than 80 % for 1 consecutive reading(s)	63	0	0	0	63	**0%**
SPO2	SpO2 less than 88 % for 2 reading	711	0	0	0	711	**2%**
SPO2	SpO2 less than 88 % for 1 consecutive readings	3,872	0	0	0	3,872	**13%**
SPO2	SpO2 less than 90 %	913	0	0	0	913	**3%**
SPO2	SpO2 less than 92 % for 2 reading	4,136	0	0	0	4,136	**14%**
SPO2	SpO2 less than 92 % for 1 consecutive readings	1,754	0	0	0	1,754	**6%**
SPO2	SpO2 less than 94 %	74	0	0	0	74	**0%**
Systolic	> 140 mmHg for 2 consecutive readings	4	3	0	0	7	**0%**
Systolic	> 180 mmHg for 2 consecutive readings	68	640	201	42	951	**3%**
Systolic	< 90 mmHg for 1 consecutive reading	0	0	0	0	0	**0%**
Systolic	< 90 mmHg for 2 consecutive readings	668	0	0	0	668	**2%**
Weight	Weight increase of 1 Kgs 1 Day	1,408	3,103	5	0	4,517	**16%**
Weight	Weight increase of 2 Kgs over 2 days	1	1,373	216	10	1,600	**6%**
Weight	Weight increase of 3 Kgs over 7 days	0	292	559	59	910	**3%**
Total		**19,389**	**7,177**	**1,736**	**401**	**28,703**	**100%**

Appendix H: Behavioral Adaptation

H-1: Description of Behavioral Adaptation Dataset

	# of Patients	# of Weeks	Avg # Devices	# of Ideal Readings	# of Readings	# Compliance Alerts	Compliance Alert Rate
Chatham	6	156	3.33	3,640	2,626	704	19%
Cochrane	9	233	2.55	4,165	2,600	1,175	28%
Essex-Windsor	81	2034	2.69	38,325	23,023	11,965	31%
Grey	33	848	2.91	17,262	13,380	2,313	13%
Guelph	5	103	2.41	1,736	1,437	140	8%
Hastings	6	149	2.52	2,632	1,183	1,091	41%
Parry Sound	9	222	2.79	4,340	3,388	611	14%
Peterborough	19	421	2.55	7,511	5,661	1,357	18%
Renfrew	44	1108	2.79	21,665	15,535	4,559	21%
Total	212	5,274		101,276	68,833	23,915	24%

H-2: Four-Step Qualitative Coding Design

Step	Description of Qualitative Coding Approach
1	Two researchers coded notes (186 notes) for 5 randomly chosen patients. Both researchers reviewed literature on patient coaching to develop a working knowledge of possible coaching types prior to coding notes for the first 5 patients.
2	A three-hour meeting to compare codes and define specific coaching dimensions (i.e., self-management, device, and seek help). Coders also recognized multiple alerts were being generated for single patient issues and added the code 'additional alert information'.
3	Two researchers coded notes (726 notes) for 12 randomly chosen patients. To validate coding accuracy, inter-rater reliabilities were calculated for all dimensions of coaching feedback (Inter-rater reliability 92%).
4	One research coded the remaining 4,681 notes.

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