Examining the potential for information and communication technology to support patients with cardiovascular disease

by

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Ethics Statement

Abstract

The overall goal of this work was to investigate the potential of information and communication technology (ICT) to support patients with cardiovascular disease (CVD). There were two specific aims: (1) to determine access to and willingness to use technology for health-related information in patients with CVD; and (2) to develop and pilot test a text-messaging intervention to support patients with acute coronary syndrome (ACS) following discharge from the hospital.

The first aim was done with a cross-sectional survey (n=169). ICT ownership was common, as 98% of participants owned at least one ICT device. Computers were the most commonly owned device (88%), the device most commonly used for health information (74% of computer owners), and the device participants had the most interest in using for health information (72% of computer owners). Participants with lower incomes and education levels were less interested in receiving health information on at least one of their devices.

The second aim was done with a mixed-methods, assessor-blinded, pilot randomized controlled trial (n=76). An advisory committee composed of patients, researchers, and clinicians developed 48 one-way text messages to send over 60 days to patients with ACS. There were no statistically significant differences between the intervention and usual care groups for self-management domains, medication adherence, health-related quality of life, self-efficacy, and healthcare resource use except for one self-efficacy domain. The study protocol was feasible, except recruitment took longer than anticipated. Ninety-three percent reported they were satisfied with the text messages. In the semi-structured interviews, many participants reported the program made them feel normal, perceived the program to be a source of social support, reinforced they were on the right track, and reminded them of their condition. However, some participants felt they did not need the messages, wished for a more tailored experience, or did not change their behaviours as a result. Learnings from the pilot study should be addressed prior to proceeding to a larger trial.

Overall, these two studies indicate that ICT can be acceptable to patients with CVD. Further work needs to be done to determine how to best use ICT to support patients.

Keywords: acute coronary syndrome; cardiovascular disease; text messaging; mobile health; self-management

Dedication

This dissertation is dedicated to my parents, David and Bobbie Ross, for their constant support of all my educational endeavours and for instilling in me an appreciation of learning from a young age that continues today.

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List of Acronyms

ACE	Angiotensin-converting-enzyme
ACEI	Angiotensin-converting-enzyme inhibitor
ACS	Acute coronary syndrome
AMI	Acute myocardial infarction
ANCOVA	Analysis of covariance
ARB	Angiotensin II receptor blockers
ASA	Acetylsalicylic acid
CA	Census agglomeration
CI	Confidence interval
CMA	Census metropolitan area
CONSORT	Consolidated Standards of Reporting Trials
CSE	Cardiac Self-Efficacy Scale
CVD	Cardiovascular disease
EQ VAS	EQ Visual Analogue Scale
heiQ	Health Education Impact Questionnaire
ICT	Information and communication technology
MI	Myocardial infarction
MMAS	Morisky Medication Adherence Scale
MOST	Multiphase Optimization Strategy
NSTE-ACS	Non-ST-segment elevation acute coronary syndrome
NSTEMI	Non-ST-elevation myocardial infarction
SD	Standard deviation
SMART	Sequential Multiple Assignment Randomized Trial
SMS	Short message service
STEMI	ST-elevation myocardial infraction

Chapter 1.

Introduction

1.1. Burden of Cardiovascular Disease

While cardiovascular disease (CVD) mortality rates have decreased in recent decades, CVD is still the second leading cause of mortality in Canada and the leading cause of mortality globally [1,2]. High mortality rates are primarily due to a type of CVD called ischemic heart disease [2], which results in reduced blood supply to the heart [3]. This is most often due to a build-up of plaque in the coronary arteries (known as coronary heart disease or coronary artery disease) [3]. Myocardial infarction (MI; “heart attack”) occurs when reduced blood flow causes heart muscle cells to die due to a lack of oxygen [4]. This most commonly happens when arterial plaque ruptures. Bleeding at the rupture site causes a clot that can occlude the flow of blood in the artery [4]. There are two types of acute MIs, ST-elevation MI (STEMI) and non-ST-elevation MI (NSTEMI). Both types of MIs along with the related condition called unstable angina are categorized more broadly as acute coronary syndrome (ACS). In 2017, approximately 71,000 Canadians had their first acute MI [5], making MI the third leading cause of hospitalization (excluding giving birth) [5].

In addition to high rates of hospitalization for index ACS events, readmission rates are a concern. In Canada, 11.5% of patients with an MI have an urgent readmission to the hospital within 30 days [6]. One Alberta-based study found that approximately 34% of patients with ACS had an emergency department visit or were readmitted within 30 days of discharge [7]. Furthermore, the median days until readmission was 23 (interquartile range: 5 to 41 days) [7]. A study conducted in the United States reported that MI patients’ daily change in risk of readmission had declined by 95% by day 38 post-discharge [8], showing that the initial period following discharge is a high-risk time for readmission. Readmissions are of concern because they may indicate a worsening of the patient’s condition [9] or complications from the initial care [10,11] as well as impact patients’ quality of life [12]. These readmissions contribute to the already high costs of providing care to patients with CVD [13,14], which in Canada is approximately $7.6 billion per year in direct costs such as hospitalizations, medications, and physician visits [15].

1.2. Challenges Faced by Patients with Cardiovascular Disease

Patients with ACS may experience challenges, including when they are in the hospital receiving treatment for their cardiac event. At this time, patients often have several emotional reactions such as fear and anxiety about having experienced a life-threatening event [16], surprise [16], vulnerability [17], and uncertainty about what life will be like [16]. Patients commonly search for a reason why--including potentially blaming themselves [16,18]. On the other hand, some patients may not appreciate the severity of an acute MI [19]. Overall, patients are trying to process what has happened to them [19,20].

Complicating matters is that the length of stay in the hospital has markedly declined over the past several decades [21,22]. The reduction in length of stay has several benefits, but it may require hospital staff to prepare the patient to be ready for discharge soon after admission. In the United States, 45% of patients with unstable angina were discharged within one day while patients with an MI stayed for an average of three days [23,24]. European guidelines suggest patients with a STEMI who have no complications and thorough follow-up care can be discharged within 48-72 hours [25]. These reductions in length of hospital stay reduce the amount of time available to deliver inpatient programs, including patient education. Twenty-eight percent of Norwegian patients with an acute MI reported they felt they were missing information at the time of discharge [26]. Additionally, as their time in the hospital can be busy and overwhelming, patients may have difficulty remembering everything they are told [19]. Many patients experience mild cognitive impairment while in the hospital, which can also make learning more difficult [27,28]. Therefore, while the time and treatment in the hospital are undeniably important, we must also consider what assistance patients require after they have been discharged.

One area that patients with ACS often need support with after discharge is regarding health behaviours aimed at secondary prevention. Guidelines promote the following health behaviours: smoking cessation, eating a healthy diet, being physically active, joining an exercise-based cardiac rehabilitation program, and adhering to medication regimens [25]. Weight control and blood pressure control, which are influenced by the above behaviours, are also recommended [25]. Many patients with CVD often have difficulties making and maintaining these lifestyle changes [29], particularly those of lower socioeconomic status [30]. In one study, 30 days after discharge, 35% of smokers continued to smoke, and 29% of patients did not adhere to physical activity and diet recommendations [31]. This non-adherence to smoking, diet, and exercise behavioural recommendations was associated with a 3.8-fold increased risk of MI, stroke, or death at six months post-discharge [31]. Enrolment in cardiac rehabilitation also remains low [32]. Another study reported that within the first seven days after discharge, 23% of cardiac medication prescriptions were not filled, despite the association between medication adherence and reduced mortality and hospitalizations [33,34]. Health behaviours are important to patients' outcomes, but we are not achieving optimal levels of adherence. Therefore, we must continue to help patients with ACS make the recommended lifestyle changes.

The period after discharge may be an especially important time to encourage behaviour change. Previous research reported that patients who made improvements to their behaviours made them within 6 months after their ACS event [35]. Patients may be motivated to make changes due to their gratitude for surviving or as a way to regain some control over their disease [36–38]. However, some patients report that they tried to make too many lifestyle changes at once after their MI, which was unsustainable [39]. Additionally, patients can experience psychosocial challenges in this post-discharge period that can impede making lifestyle changes. These challenges include being uncertain [40], feeling alone with setbacks [40], losing confidence [19], needing to adapt routines [41,42], dealing with the fear of a repeat cardiac event [16,43], and managing physical symptoms, such as breathlessness, fatigue and chest pain [42–44]. The healthcare system needs to consider the psychosocial challenges patients with ACS may experience, including the process of arriving at a "new normal" and coping with an unfamiliar self [36], as we support them in the period following a cardiac event.

The challenges patients face with behaviour change can be exacerbated by a lack of knowledge. Patients do not always know where to start when changing their behaviours, as their knowledge about personal risk factors, risk of future MIs, and heart disease in general can be low [45–47]. For example, in one study, less than half of the participants could give the exact name of their heart event [46]. Recall rates for instructions about diet, smoking cessation, physical activity, and cardiac rehabilitation ranged from 54-67% [46]. One-fifth of patients felt they were missing information [26], and they particularly wanted information to identify and manage physical symptoms and risk factors as well as psychosocial information (especially regarding social support) [48–50]. However, patients do not always have opportunities to ask healthcare providers their questions soon after they are discharged. Around half of patients with an MI do not see their physician within seven days [51]. This can be problematic, as getting information can help make patients feel reassured [41,52]. Therefore, in many instances, patients need and desire more information so they can understand how to navigate and manage their recovery and prevent additional cardiac events.

In addition to challenges making lifestyle changes and accessing information, patients may also have difficulties with their mental health. Approximately 20% of patients with ACS experience depression after their cardiac event [53]. Co-morbid depression is associated with increased mortality and decreased quality of life as well as decreased adherence to secondary prevention behaviours such as smoking cessation, medication adherence, exercise, and cardiac rehabilitation attendance [53–55]. Social isolation, which is often interlinked with depression, also appears to be associated with morbidity and mortality [56]. Furthermore, approximately a third of patients with ACS have anxiety at the time of their event and half of these patients continue to have anxiety at one-year post-event [57], although the link between anxiety and mortality is not as strong as depression [58]. Overall, there are many complex psychosocial challenges that patients experience, especially soon after their ACS event.

1.3. Theory of Self-management and Previous Self-Management Interventions for Patients with CVD

Many of the above challenges regarding changing behaviours and managing psychosocial and mental well-being require patients to engage in self-management. While a number of researchers have proposed definitions of self-management, including foundational work by Corbin and Straus [59] and Lorig et al. [60], a qualitative meta-synthesis suggests that self-management has three categories: focusing on illness needs, activating resources, and living with a chronic illness [61]. Each category has associated tasks and skills. For example, within focusing on illness needs, there is the process of learning, which has the task ‘learning about condition and health’ and the skill of ‘acquiring information’ [61]. Another important concept related to self-management is self-efficacy. Self-efficacy, which was introduced by Albert Bandura in 1997, is the belief in one’s capacity to perform a specific behaviour [62]. Self-efficacy may predict behaviours related to medication adherence, exercise, stress and diet [63–65], be connected with resilience [66,67], and is considered to be a mediator between self-management and health outcomes. These concepts of self-management and self-efficacy can be used to support patients with CVD as they transition from an acute event, such as ACS, to everyday life with a chronic illness.

Many self-management interventions have been developed to help patients with chronic illnesses, including CVD. While heterogeneous in content and design, self-management programs promote the adoption of healthy behaviours with strategies like patient education and goal setting [68]. In a scoping review of self-management programs for ACS, the majority of studies reported improvements in behavioural outcomes like physical activity, as well as reduced angina symptoms [42]. About half of the studies observed reductions in anxiety and depression as well as improvements in quality of life in the self-management group compared to the usual care group [42]. Self-management programs may also reduce costs and healthcare visits [69,70].

Programs for home-based cardiac rehabilitation or other secondary prevention support (e.g., with manuals, telephone calls, home visits, or a combination) also often include self-management principles. While these program designs vary, there have been some promising results in outcomes, including physical activity levels, smoking cessation, quality of life, blood pressure, cholesterol, anxiety, and depression [71–73]. Programs that focused on psychosocial aspects appear in particular to influence quality of life, while multi-modal and exercise-based interventions have the most impact on mortality [74,75]. Combining both psychosocial and exercise elements can improve psychological distress, systolic blood pressure and cholesterol as well as reduce mortality and recurrent cardiac events [76]. This type of program can have some limitations though, which include requiring staff time and its associated costs, as well as requiring scheduling between the patient and provider, which may not always be convenient. Programs may also not be geographically accessible to everyone who could benefit from joining. Therefore, alternative or supplementary programs could further benefit patients.

1.4. Potential Role for Information and Communication Technology

1.4.1. Information and Communication Technology Prevalence

Information and communication technology (ICT) covers a range of tools, such as computers, the internet, and mobile phones, that are used to transmit, store, or exchange information [77]. ICT ownership and use has increased substantially over the past fifteen years [78]. For example, mobile phone ownership has increased from 65% in 2004 to 96% in 2019 in the United States [78]. While mobile phone ownership is higher among younger people, 91% of American adults ages 65 years or older owned a mobile phone and 53% owned a smartphone [78]. Recent data from industry and government surveys found that Canadians also have high levels of ICT ownership, with 87% having an internet subscription, 86% of households owning a smartphone, and 75% owning a laptop [79,80].

1.4.2. Potential of Information and Communication Technology for Health Purposes

As the prevalence of ICT increases, so has the interest in using these technologies for health purposes. So far, studies targeting the prevention and management of CVD have used web-based strategies, email, mobile applications, monitoring sensors, and text messages [81]. The majority of these studies did not specifically target the hospital-to-home transition period though. Before designing interventions that use elaborate and expensive technologies, simpler ICTs, such as text messages, are an attractive starting point. Text messages, in general, have generated a lot of interest in their potential applications for health purposes [82–84], likely due to their simplicity and high market penetration. Eighty percent of American adults report using their mobile phones to send text messages (short message service; SMS], making text-messaging one of the most commonly used features [85]. Marketers report that text messages have an open rate of 85-99% [86,87]. This may be because text messages are perceived to be dual communication that has a human element versus, for example, a pop-up notification on an app [88]. They also have other potentially beneficial features. Messages can include reminders and prompts to engage in recommended behaviours. They are inexpensive to send and receive, and automated delivery systems do not require a significant amount of staff time to maintain. Users can store messages on their device to re-access and can access the messages when it is convenient for them, unlike a standard telephone call. Text messages also have a wide geographic reach. This can be important in countries like Canada, which have health disparities between urban and rural areas [89]. For example, patients with CVD in northern regions of Canada have higher readmission rates, are less likely to have access to specialist care, and are less likely to see a cardiologist post-cardiac event compared to those who live in more southern (i.e., urban) regions [90]. ICT may be able to help fill some of the care gaps for these patients.

As with any technology though, it is important to consider whether the target population has access to the technology and for what purposes they are willing to use it. While technology ownership at a population level is generally high [78,91], variations exist among demographic groups [92]. Text messages appear to be acceptable from previous studies conducted in patients with CVD [93,94]; however, since study participants were often required to own a mobile phone to participate, it is unclear how acceptable text messages and other types of technologies are to the general cardiac population. Overall, ICT, especially text messages, have many features that are appealing to use in health situations, although it remains important to ensure whether the chosen ICT is acceptable for the target population.

1.4.3. Previous Work Using Text Messages in a Cardiovascular Disease Population

One of the first studies examining text-messaging for health purposes was published in 2002 [95]. Since then, a systematic review of reviews from 2015 found 89 unique text-messaging intervention studies that measured health outcomes ranging from smoking cessation, physical activity, weight loss and chronic disease self-management (particularly diabetes self-management) [96]. As part of the broader interest in text-messaging for health purposes, several text-messaging interventions have been developed to support patients with CVD. One of the most researched topics within this area is whether text messages can support medication adherence. Medication adherence is an appealing target because it is important for improving mortality and hospitalization outcomes, but adherence among patients with CVD remains sub-optimal [33,34]. Of seven medication adherence studies included in a 2017 systematic review, most involved text-message reminders, which were often sent daily and customized to the patients' prescriptions. Several of the interventions also included supplemental phone calls, additional health information sent via text message, or a requirement for participants to text back [97]. The majority of systematic reviews reported positive effects of text-messaging on medication adherence [97–99], which indicates the potential of text-messaging in this population.

There have been a small number of text-messaging-only studies that target multiple health behaviours and risk factors in patients with CVD. It is more common for interventions to have additional technology components on top of text-messaging, including websites, phone calls, apps, and emails [100–107]. The multiple components make it difficult to tease out which factors contribute to or lessen the effectiveness and whether text-messaging by itself is sufficient. Text messages may be an important factor though, as there has previously been higher adherence to the text-message components compared to the internet/website components [105]. Two large studies (n > 700) have evaluated the effect of a text-messaging-only program on health behaviours and risk factors in patients with CVD. Chow et al. found positive effects on LDL cholesterol, blood pressure, body mass index, physical activity, and smoking cessation [93]. Zheng et al. incorporated elements of Chow et al.'s study in a Chinese population, but did not find the same positive effects for blood pressure, cholesterol, or smoking cessation; however, participants were more likely to have met three or more of the guideline-based goals [94]. So far, text-messaging seems to be a promising application of ICT for a CVD population, but there have only been a few studies targeting multiple health behaviours. Additionally, these studies did not specifically target the hospital-to-home transition period after an ACS event. Therefore, more work needs to be done to evaluate the effectiveness of text-messaging programs, particularly whether they are suitable to address multiple health behaviours in the post-discharge period for patients with ACS.

1.5. Rationale

Given previous studies in the CVD population, ICT-supported self-management has the potential to improve patients' experiences and outcomes. Of the various types of ICT, text messages are attractive due to their accessibility and simplicity. Early studies show text-messaging's potential and support exploratory work on an intervention designed to support the multiple self-management behaviours required in the period after discharge. Prior to undertaking this work, to increase uptake, an assessment is needed to ensure that such a program would be accessible and acceptable to the target population.

1.6. Thesis Aims and Objectives

For this thesis, I investigated the potential of ICT to support patients with CVD. Within this overall goal, there were two specific aims:

1. To determine access to and willingness to use technology for health-related information in patients with CVD (Chapter 2).
2. To develop and pilot test a text-messaging intervention that supports patients with ACS following discharge (Chapters 3, 4, and 5).

1.6.1. Aim 1

This aim was assessed through a cross-sectional survey of cardiac inpatients. Within this first aim, the main objectives were to 1) describe access to and use of ICT in patients with CVD, 2) describe patients' use and interest to use ICT for health information, and 3) identify factors associated with patients' interest. All objectives of this aim are reported in Chapter 2.

1.6.2. Aim 2

This aim was assessed through a pilot, randomized controlled trial in 76 patients to evaluate a 60-day post-discharge text-messaging program. Within this second aim, the main objectives were to 1) develop the text-messaging program (Chapter 3), 2) assess the effect of the text-messaging intervention on self-management, quality of life, self-efficacy and medication adherence, and healthcare resource use (Chapter 4), 3) assess the feasibility of the study protocol (Chapter 4), and 4) assess the acceptability of the text-messaging intervention program (Chapter 5).

These two studies will help inform how technology can be applied in health care services by providing important formative information about technology use and preferences for patients with CVD as well as by applying this technology in a novel, high-need context.

Chapter 2.

Access to and Willingness to Use Information and Communication Technology for Health Purposes Among Patients with Cardiovascular Disease

2.1. Introduction

Cardiovascular disease (CVD) is one of the leading causes of morbidity and mortality in Western countries and results in high direct healthcare costs—approximately $193.1 billion per year in the United States and over $11 billion per year in Canada [15,108,109]. Outcomes for patients with CVD can be improved through follow-up by a healthcare provider as well as with appropriate self-management practices, such as monitoring one's condition and maintaining healthy lifestyle behaviours [110,111]. However, self-management can be difficult for many patients, and they may be unable to overcome challenges on their own [31]. Patient programs are typically delivered in-person [75], but patients may experience barriers using these services, such as transportation problems [112], and therefore may be a higher risk for secondary events due to unmet health needs. We need alternative solutions to reach and support patients, particularly as the number of people living with CVD and CVD-associated costs are projected to increase [113].

Patients with CVD can use information and communication technology (ICT), which includes devices such as mobile phones and computers, to access or receive health information. The use of ICT for health purposes has rapidly increased, with over 250,000 health apps now available commercially [114] and over 500 published research studies evaluating mobile ICT health interventions [83]. These technologies have several advantages over traditional methods of healthcare delivery, including timeliness, convenience, and reach to patients regardless of their geographic location, which minimizes travel needs. In the past decade, several studies have demonstrated the potential of ICT for health purposes. These studies include a meta-analysis that found reduced CVD hospitalization and mortality [81] and a systematic review that reported reduced heart failure readmissions [115]. In a systematic review of qualitative studies, patients who used ICT reported feeling involved in their care and better informed to make decisions [116]. Additionally, as many of these technologies are low cost, they may be cost-effective to implement, although there are currently few studies published in this area [117–119]. While more work needs to be done to determine what features of programs are effective, preliminary results indicate the potential of these technologies.

Key to the success of interventions delivered using ICT is patients' access and willingness to use ICTs for health purposes. ICT ownership has increased over the last decade [91], but ownership does not necessarily mean individuals are ready or willing to use ICT for health purposes or have been consulted in the development of ICT interventions [120]. This is reflected in a 2013 report that found 50% of health apps are downloaded fewer than 500 times [121]. Additionally, there are variations in ICT ownership among demographic groups. For example, in the United States, internet use among the general population is associated with higher education, younger age, higher income, and urban dwelling [92]. These may not be the demographic characteristics of target users for ICT health programs. Therefore, information about ICT ownership and willingness to use ICT for health information is important to ensure digital health interventions are appropriate and acceptable to patients with CVD, especially as patients with CVD are often older [122]. The objectives of this descriptive study were to 1) describe patients with CVD's access to and use of ICT, 2) describe patient use and interest to use ICT for health information, and 3) identify factors associated with patient interest.

2.2. Methods

2.2.1. Study Design, Sample, and Recruitment

In this cross-sectional survey, we recruited in-patients from the cardiac units of a tertiary-quaternary care hospital in Vancouver, British Columbia, Canada. The cardiac units at this hospital serve as a provincial heart centre for patients from rural and urban areas across the province and have over 2,700 inpatient discharges per year. Patients were eligible to participate if they spoke English, were above the age of majority (19 years or older), and were able to provide informed consent. They did not need to own or use any type of ICT to participate. Nurses on the cardiac in-patient units screened patients to determine if they were interested in learning more about the project. Patients who were eligible and interested were then invited to participate in the study by the research team. After providing informed consent, participants completed an in-person structured survey with a research assistant while in the hospital. Surveys were administered in-person to minimize missing data, to allow those who were feeling too fatigued to fill out a survey on their own or who had to remain lying down to still participate, and to minimize confusion about the question branching. Participants were recruited between June 2014 and December 2014. The sample size was based on recruitment feasibility during this time period. The study was approved by the University of British Columbia/Providence Health Care and Simon Fraser University Research Ethics Boards.

2.2.2. Survey Design

The survey (Appendix A) used in this study was adapted from a previous survey used by Lear et al [123]. Our survey included three components:

Demographic and Clinical Information

Self-reported demographic information included: sex, marital status, education level, employment status, household income, and geographic location of residence (city or town). Geographic location was categorized based on Statistics Canada's definitions [124]: a census metropolitan area (CMA) with an urban core population greater than 100,000, a census agglomeration area (CA) with an urban core population of 10,000-99,999, or a rural area. Clinical information was obtained through the participants' medical charts and included reason for admission, co-morbidities, previous cardiac events, and smoking status.

Ownership, Access, and Frequency of ICT Devices and Methods

ICT was categorized into two categories: devices (i.e., the hardware, such as a computer or tablet) and methods (i.e., the ways people might use ICT, such as emails or text messaging, which can cross over several devices).

For devices, participants were asked if they owned any of the following: computer (desktop or laptop computer ownership), landline phone, smartphone, non-smart mobile phone, tablet, smart TV, and gaming consoles (yes/no). If they owned a device, they were asked about their frequency of use (daily, more than once a week, once a week, monthly or never) and if they needed help using the device for regular tasks (yes/no).

For methods, participants were also asked if they had access to the following: internet, answering machine/voicemail, text messaging, emails, and apps (yes/no). If they had access to the internet, text messaging, emails, or apps, they were asked how frequently they used each one using the same frequency options as the device questions.

Use, Preference and Interest to Use ICT for Health Information

Health information was defined broadly as any information about health and was not specific to only patient-provider communication. For each device a participant used, the participant was asked whether they used that device for the access or exchange of health information. If yes, they were asked if they preferred to use that device health for information. From these responses, a unique variable was created to categorize participants' interest to use each of their devices for the access or exchange of health information. Participants were categorized as interested if they either a) were currently using their device for health information and preferred using this device, or b) were willing to use their device in the future for health information. Participants were then categorized for a derived variable that indicates (yes/no) whether they are interested in using at least one of their ICT devices to access or exchange health information. The same process was done for ICT methods.

2.2.3. Statistical Analysis

For the descriptive statistics, categorical variables are reported as frequency counts and percentages, and continuous variables are reported as means with standard deviations (SD). Chi-square tests and independent t-tests were used to test for between-group differences among device owners and method users on their interest to use ICT for health information based on age, sex, geographic region, income, employment status, and education. Multiple logistic regression was used to predict demographic factors associated with interest to use at least one device or ICT method to receive health information using age, income, education, and sex as covariates. All covariates were entered into the model. The following assumptions were assessed: linearity between continuous predictors and the logit of the outcome variable, independence of errors, multicollinearity, overdispersion, and whether any outliers had an influential impact. Statistical significance was set at *P* < .05. All analyses were performed using SPSS 24.0.

2.3. Results

One hundred and sixty-nine participants consented (Figure 2.1).

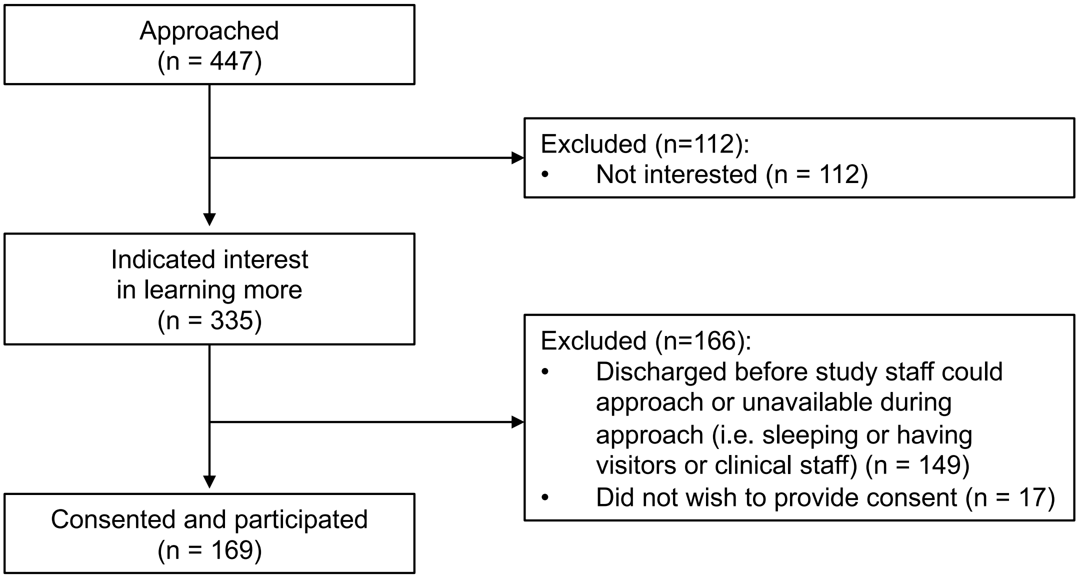


Figure 2.1. Flow diagram of study participants.

The mean age of the participants was 64 (SD: 11), the majority were men (73%), and two-thirds had at least some post-secondary education (66%). A total of 38% resided outside the Vancouver metropolitan area. Sample characteristics are further detailed in Table 2.1.

Table 2.1. Characteristics of the survey population (n=169).

Characteristic	N (%)
Men, n (%)	123 (73)
Age, years, mean (SD)	64 (11)
Annual household income, n (%)	
<$20,000	17 (10)
$20,000 – $39,999	24 (14)
$40,000 – $59,000	35 (21)
>$60,000	75 (44)
Refused	18 (11)
Education, n (%)	
Less than high school	20 (12)
High school	38 (23)
Any post-secondary	111 (66)
Married/common law, n (%)	126 (75)
Primary reason admission, n (%)	
Coronary artery disease	73 (43)
Heart failure	15 (9)
Arrhythmia	44 (26)
Other	37 (22)
Geographic location, n (%)	
Rural	21 (12)
Census agglomeration area	38 (23)
Census metropolitan area	110 (65)
Region, n (%)	
Greater Vancouver	105 (62)
Other	64 (38)
Smoking status, n (%)	
Never	76 (45)
Former	81 (48)
Current	11 (7)
Employment, n (%)	
Retired	81 (48)
Full-time	53 (31)
Other	35 (21)
Co-morbidities, n (%)	
Hypertension	82 (49)
Diabetes	40 (24)
Renal disease	23 (14)
Previous cardiovascular event, n (%)	109 (65)

Abbreviations: SD = standard deviation

2.3.1. Device Ownership and ICT Method Access

The devices most frequently owned were computers (88%), landline phone (86%), and mobile phones (83%) (Table 2.2). Two participants did not own any devices. Among device owners, computers (77%), landlines (77%), and smart mobile phones (88%) were the devices most frequently used at least daily (Table 2.2). The most common devices that device owners needed help with were computers (19%), tablets (18%), and mobile phones (16%) (Table 2.2).

Table 2.2. Ownership, daily use and help required for ICT device owners

ICT Device	Ownership, n (%)	Daily Use, n (% of device owners)	Require Help, n (% of device owners)
Any computer	149 (88)	115 (77)	29 (19)
Landline phone	145 (86)	111 (77)	1 (0.7)
Any mobile phone	140 (83)	111 (79)	22 (16)
Smart mobile phone	101 (60)	89 (88)	15 (15)
Tablet	96 (57)	61 (64)	17 (18)
Smart television	54 (32)	33 (61)	4 (7)
Non-smart mobile phone	46 (27)	23 (50)	8 (17)
Gaming console	37 (22)	4 (11)	1 (3)

Abbreviations: ICT = information and communication technology.

The ICT methods that participants had the most access to were voicemail and/or an answering machine (96%), internet (89%), and email (88%) (Table 2.3). Internet (89%), email (80%), and applications (72%) were the methods most frequently used at least daily among those with access to the ICT method (Table 2.3).

Table 2.3. Access to and daily use of ICT methods.

ICT Method	Access to Use, n (%)	Daily Use, n (% of method users)
Phone voicemail	163 (96)	Not asked
Internet	151 (89)	134 (89)
Email	148 (88)	118 (80)
Text messaging	117 (69)	59 (50)
Applications	92 (54)	66 (72)

Abbreviations: ICT = information and communication technology.

2.3.2. Access to and Interest in Using ICT for Health Information

Computers were the most used device to access or exchange health information in terms of both the absolute number of participants (110 participants) as well as when represented as a percentage of those who owned each device (74% of computer owners). Computers were also the device that participants had the most interest in using for health information (108 participants, 72% of computer owners) (Table 2.4). In total, 88% percent of participants were willing to use at least one of their devices to access or exchange health information.

Table 2.4. Participants using or interested in using their ICT device for health information.

ICT Devices	Owners, n	Currently use to access health information, n (% of owners)	Interest in using to access health information, n (% of owners)
Any computer	149	110 (74)	108 (72)
Landline phone	145	38 (26)	24 (17)
Smart mobile phone	101	50 (49)	42 (42)
Tablet	96	43 (45)	43 (45)
Smart television	54	1 (2)	1 (2)
Non-smart mobile phone	46	4 (9)	5 (11)
Gaming console	37	0 (0)	0 (0)

Abbreviations: ICT = information and communication technology.

Email was the most used ICT method to access or exchange health information in terms of both the absolute number of participants (67 participants) as well as when represented as a percentage of those who used each ICT method (45% of email users). Emails were also the method participants had the most interest in using for health information (111 participants, 75% of email users) (Table 2.5). In total, 83% percent of participants were willing to use at least one of their ICT methods to access or exchange health information.

Table 2.5. Participants using or interested in using their ICT method for health information.

ICT Method	Users, n	Currently use to access health information, n (% of users)	Interest in using to access health information, n (% of users)
Phone	167	51 (31%)	35 (21%)
Email	148	67 (45%)	111 (75%)
Text messaging	117	6 (5%)	27 (23%)
Applications	92	31 (34%)	43 (47%)

Abbreviations: ICT = information and communication technology.

2.3.3. Factors Associated with Interest in Using ICT For Health Information

Participants who were younger, (t = 2.6 *P* = .011), had a higher household income (chi-square = 15.8, *P* = .001), were working full-time (chi-square = 19.5, *P* = .005), and had at least some post-secondary education (chi-square = 19.1, *P* < .001) were more likely to be interested in accessing or exchanging health information on at least one device that they owned, compared with those who did not want to use any of their ICT devices for health information. There were no associations with sex or geographic region. In a multiple logistic regression with covariates age, income, education, and sex, only income and education remained significantly associated with participants' interest to receive health information on at least one of their devices, such that having less than a high school education and a household income of less than $20,000 per year were predictive of less interest in using ICT devices for health information (Table 2.6).

Table 2.6. Multiple logistic regression determinants for participant's interest in using at least one of their devices or at least one of their ICT methods for the access or exchange of health information.

Characteristic	Interest in using at least one device owned for health information, OR (95% CI) (n = 146)	*P*	Interest in using at least one ICT method for health information, OR (95% CI) (n = 146)	*P*
Age (per one-year increase)	0.95 (0.89 – 1.01)	.12	0.97 (0.92 –1.02)	.23
Education				
Less than high school	0.14 (0.03 – 0.69)	.02	0.15 (0.04 – 0.52)	.003
High school	0.30 (0.06 – 1.42)	.13	0.77 (0.21 – 2.83)	.70
Any post-secondary	1 (reference)		1 (reference)	
Income				
Less than $20,000	0.11 (0.02 – 0.66)	.02	0.39 (0.08 – 1.89)	.24
$20,000 - $59,000	0.72 (0.15 – 3.46)	.68	0.67 (0.21 – 2.13)	.50
Greater than $60,000	1 (reference)		1 (reference)	
Sex				
Male	0.93 (0.22 – 4.0)	.92	0.54 (0.14 – 1.99)	.35
Female	1 (reference)		1 (reference)	

Abbreviations: CI = confidence interval; ICT = information and communication technology; OR = odds ratio.

With regards to ICT methods, participants who were younger, (t = 2.7 *P* = .007), had a higher household income, (chi-square = 9.9, *P* = .019), were working full-time (chi-square = 10.4, *P* = .005), and had at least some post-secondary education (chi-square = 17.3, *P* < .001) were more likely to be interested in accessing or exchanging health information on at least one of their ICT methods compared with those who did not want to use any of their ICT methods for health information. In a multiple logistic regression with covariates age, income, education, and sex, only education remained significantly associated with participants' interest to use at least one method for health information, such that having less than a high school education was predictive of less interest in using their ICT methods for health information (Table 2.6).

2.4. Discussion

The objectives of this study were to describe ICT ownership and use, and interest in using ICT for health information in a CVD population as well as to identify factors associated with this interest. ICT ownership was high as over 80% of participants owned a computer, landline phone, or mobile phone, and over 85% used voicemail, internet or email. Overall interest in using ICT for health information was high, as 88% of participants who owned ICT devices were willing to use at least one device for health information and 83% of participants who used an ICT method were willing to use at least one ICT method for health information. However, participants were not consistently interested in using ICT devices and methods for health information across all their devices. Participants were most interested in using computers and email and less interested in landline phones and text messages. Additionally, those with lower levels of education and lower household income levels were less likely to be interested in using ICT for health information.

Over the past decade, ICT ownership and use have increased dramatically in the general population in the United States and elsewhere, such as Great Britain [125,126]. In a patient sample, a 2012 survey of Canadians with chronic conditions reported that 76% of participants had a computer with internet access at home and 74% had a mobile phone [127]. Eighty-nine percent of our participants had a computer with internet access at home and 83% had a mobile phone, which indicates increasing ownership in a chronic disease population as well. Additionally, more participants in the current study had internet access compared to a similar survey conducted by our research group in 2006 (89% versus 66%) [123]. Compared to 2016 Canadian census data, our participants owned fewer smartphones (60% versus 76%), more non-smart mobile phones (27% versus 16%), and had slightly lower rates of internet use (89% versus 92%) [128]. It is interesting to note, that for some devices, ownership may be plateauing—in the US, mobile phone and smartphone ownership has remained around 95% and 77% respectively between 2016 and 2018 [78]. As ICT has become more prevalent, it is valuable to examine its potential for implementation for health purposes.

While interest in using at least one device or method to access or exchange health information was quite high (i.e., 88% and 83% respectively), there were variations in interest depending on the specific device. Computers and email use had strong interest, while other devices and methods, such as non-smart mobile phones and text messaging, were not as popular. These results are similar to another Canadian study where text messaging was the least popular method for communicating with a health professional [127]. Additionally, a study of a sample derived from the general US population reported that only 9% of mobile phone owners receive text updates about medical issues, despite 80% of mobile phone owners texting, and less than 20% of a nationally representative panel in the US were willing to communicate with their doctor through text messaging [129,130]. While the underlying reasons for this are not known, it may be due to factors such as (1) few programs being offered by text messages, meaning participants may not be familiar with the possibilities, (2) email being used more frequently than text messaging by people with chronic diseases, or (3) having the ability to have longer messages in emails. However, if the low interest is, in fact, due to text messaging being unacceptable, then this should be considered in the design of interventions.

We may also need to better align the ICT options provided to patients' preferences as there were discrepancies between current use and willingness to use, particularly with email (45% currently use while 75% are interested in using) and telephones (31% currently use while only 21% are interested in using). The willingness may be content dependent; past studies have reported some participants were concerned about receiving test results or diagnostic information via a mobile device while general health tips and reminders were fine [131,132]. Participants were also more likely to be willing to exchange health information if they trusted the information from their health professionals and if they had previously used text messaging or apps in the past year [132]. Future studies should explore what factors are associated with interest for specific technologies (e.g., perception that a method is not as private, needs technical assistance in using the device, perceived value and ease-of-use, preference for written information versus audio, perceived ease or convenience of using a device or method, active versus passive use), and target populations should continue to be consulted during the development of programs.

Lower levels of education and income were associated with less interest in using ICT for the access or exchange of health information. In earlier studies, education was a stronger predictor of using technology to access health information and services than other socioeconomic factors [133,134]. The difference in interest in using ICT for access or exchange of health information between education levels may be due to health or technology literacy levels as those with lower health literacy levels may be less engaged in ICT interventions, such as patient portals [135]. Strategies to make ICT interventions more accessible to those with low health literacy levels, such as adding video or verbal narrative, presenting essential information first or by itself, and using simple designs should be considered [136,137]. In contrast to our findings, other studies have found age to be an important predictor of technology use for health purposes, including an

Australian survey of patients with CVD [138,139]. The Australian survey focused specifically on mobile device technology, which older adults may not use as often or be as comfortable with. Our outcome regarding participants' interest included telephone calls, which may be more acceptable to older adults. It will continue to be important to ensure that ICT interventions do not exclude certain demographic groups, especially those with lower levels of education and income, and that they are designed to be acceptable and appropriate for the target population.

2.4.1. Limitations

This study has some limitations to consider. While all eligible patients were invited to participate, regardless of their use of ICT, the sample may include those who are more likely to use ICT. Approximately 3% of Americans do not own any type of phone [140], while the percent of our study population who did not own any technology was around 1% (n=2). Patients may have chosen not to participate if they wished to rest, had visitors, or were having medical tests or procedures done. We do not have data on patients who did not wish to participate in the survey so we cannot assess if there was selection bias. The clinical nurse leader identified all eligible patients each day for nurses to approach and a research team member made frequent presentations at nursing rounds to remind nurses of the study, its inclusion criteria, and its recruiting system. Additionally, we excluded people who did not speak English, and those who do not speak English are less likely to use ICT [141,142]. In Metro Vancouver, 26% of the population speaks a non-English language at home although 93% of residents know how to speak English [143]. We also did not collect ethnicity data, so we cannot determine how representative our sample is of the broader cardiac inpatient population and whether there were differences in technology use between ethnic backgrounds.

As this is a cross-sectional survey, we are unable to make any statements about causality for the results of the logistic regression. We also did not do an a priori power analysis for the multiple logistic regression. While there are disagreements about what constitutes an adequate sample size for logistic regressions [144,145], our sample size is relatively small (n=146). Because many participants indicated they were interested in using their devices or methods for health purposes, the number of events per predictor variable (i.e., the number of participants in the smaller of two outcome groups relative to the number of regression coefficients estimated) was small. This could result in imprecise estimates or overestimated associations [144]. Additionally, the ICT method and device questions did not specifically ask about using the internet in general, health trackers, or social media for health purposes, so we cannot comment on this in our findings. Finally, participants were questioned about their interest to use ICT for the broad purpose of “health information.” The results could be different if participants were presented with more specific purposes (e.g., peer-to-peer support, health-practitioner-to-patient communication, seeking additional information about a health condition, or self-management). Nevertheless, we believe our results provide insight into the general attitudes of patients in regards to their interest in the access or exchange of health information through ICT.

2.4.2. Conclusion

Since CVD inpatients have high ICT ownership and 88% indicated an interest in using at least one of their devices for health information, there is a demonstrated readiness and likelihood for uptake for ICT health projects among this population. When designing projects using ICT, it is important to consult the target patient population to inform the use of certain devices and/or methods, as there are differences in preferences at a device or method level. Due to the potential of ICT in a health context, more work is required to determine which aspects of ICT appeal to patients in order to increase the acceptability of future programs.

Chapter 3.

Development of the Txt2Prevent Program and Study Protocol

A modified version of this work has been published in JMIR Research Protocols. Ross ES, Sakakibara BM, Mackay MH, Whitehurst DG, Singer J, Toma M, Corbett KK, Van Spall HG, Rutherford K, Gheorghiu B, Code J, Lear SA. The use of text messaging to improve the hospital-to-community transition in acute coronary syndrome patients (Txt2Prevent): intervention development and pilot randomized controlled trial protocol. JMIR Res Protoc. 2017;6(5):e91.

3.1. Introduction

3.1.1. Background

Cardiovascular disease (CVD) is one of the leading causes of hospitalization and death in Western countries [15,146]. Acute coronary syndrome (ACS) includes the diagnoses of acute myocardial infarction (AMI) and unstable angina. AMIs are the second most common reason for inpatient admissions in Canada (excluding giving birth), with over 60,000 cases while ACS was the primary or secondary cause of over 1.1 million unique hospital admissions in the United States in 2010 [108,147]. Approximately 60% of these admissions were due to AMIs, making AMIs a leading cause for inpatient admissions [108,148]. The initial period following discharge is the highest risk for readmission, with 14% of AMI patients having an urgent readmission within 15 days of discharge, and 20% of patients being readmitted by 30 days [10]. In the United States, Dharmarajan et al. found that AMI patients' daily change in risk of readmission has declined by 95% by day 38 post-discharge [8]. In Canada, the median days until readmission in patients with ACS was 23 (interquartile range: 5 to 41 days) [7]. Readmissions are of concern because of the impact on patients' quality of life [12] and the cost to the healthcare system, which has been estimated at $1 billion in the United States in 2013 [13,14].

Patients have several challenges during the transition period after discharge that can influence readmissions, including lack of support, potentially preventable adverse events, and difficulties performing self-management behaviours [31,52,149]. During the transition period, patients report feeling overwhelmed, uncertain, and alone with physical or mental setbacks [40,52]. Patients may be confused about the information they received in the hospital [40] and may want more information once they are home because being informed often provides reassurance [52]. Additionally, up to 23% of patients may experience adverse events after discharge, such as adverse drug events or therapeutic error, of which half may be preventable or ameliorable [149]. Having better transitional care could help to identify or prevent these errors.

Following hospital discharge, patients with ACS also must become independent with new self-management responsibilities [52,150]. Self-management is the concept that people with chronic illness, such as CVD, must live with and manage their disease on a daily basis, which includes engaging in healthy behaviours to control or reduce the impact of their disease, communicating effectively with health professionals and caregivers, and managing physical and emotional challenges [151]. Meta-analyses have found chronic disease self-management programs have been associated with reduced hospital use [70], improvements in health behaviours [152], improvements in health outcomes [153,154], and increased quality of life and self-efficacy [153,155]. Self-management for patients with ACS includes recommended behavioural changes (e.g., smoking cessation, exercise, and/or adhering to a healthy diet), and taking their medications as prescribed. Despite this knowledge, research shows that many patients continue with unhealthy behaviours. In one study, thirty days after discharge, 35% of smokers continued to smoke, and 29% of patients do not adhere to physical activity and diet recommendations [31]. The authors found non-adherence to smoking, diet, and exercise behavioural recommendations is associated with a 3.8-fold increased risk of AMI, stroke, or death at six months post-discharge [31]. Another study reported that within the first seven days after discharge, 23% of cardiac medication prescriptions were not filled, despite the association between medication adherence and reduced mortality [33]. Therefore, providing continuing support following discharge from hospital has the potential to affect several key factors of post-ACS management, including medication adherence and lifestyle changes, which in turn can impact patients' experiences and outcomes.

Text messaging technology presents an opportunity to help support patients during the hospital-to-home transition. Mobile phone ownership has increased from 65% in 2004 to 92% in 2015 in the United States [91]. While mobile phone ownership is higher in younger demographics, 78% of adults ages 65 and older own a mobile phone [91]. Eighty percent of mobile phone owners send or receive text messages making it one of the most commonly used features [156]. Text messages can provide information to patients in a manageable amount at the appropriate time-point in their recovery. Messages can include reminders and prompts to engage in the recommended post-discharge behaviours. Messages are inexpensive to send and receive, and automated delivery systems do not require a significant amount of staff time to maintain. Additional benefits are that messages may be stored on the device to be accessed multiple times, do not require both the sender and the receiver to be available at the same time, such as with a standard phone call, can be received without effort by the recipient, and have a wide geographic reach--ensuring that patients do not have to travel to receive the information. In previous text messaging studies with patients with or at risk for CVD, there have been improvements in self-management behaviours, such as medication adherence [157], and increased leisure, physical activity and walking [103]. Text message interventions have also contributed to improvements in cardiac risk factors including lowering LDL cholesterol and systolic blood pressure [93]. Additionally, a systematic review of text messaging studies in diabetes patients found improved scores on measures for self-management capacity [158]. The studies in a CVD population do not target multiple aspects of the hospital-to-community transition period for patients with ACS, so it is worth investigating the potential for text messaging to support patients with CVD as they transition from hospital to home.

3.1.2. Study Objectives

The aim of this pilot study is to test a one-way text-messaging intervention program (Txt2Prevent) composed of 48 messages that supports patients with ACS for 60 days after their hospital discharge in an assessor-blinded randomized controlled trial. The objectives are:

1. To compare self-management between participants receiving usual care versus participants receiving usual care plus the Txt2Prevent program as measured by the Health Education Impact Questionnaire

(heiQ). The heiQ assesses proximal outcomes of self-management and patient education programs [159].

2. To compare health-related quality of life, medication adherence, self-efficacy, all-cause and cardiovascular-related hospital readmissions, and healthcare resource use between participants receiving usual care versus those receiving usual care plus the Txt2Prevent program.
3. To assess the acceptability of the text messaging intervention program according to patient-participants and the feasibility of the study protocol.

We hypothesize that the Txt2Prevent group will have improved self-management compared with usual care. This paper describes the development of the Txt2Prevent program and the research protocol for the pilot study (Clinicaltrials.gov identifier: NCT02336919), in accordance with the CONSORT-EHEALTH checklist [160].

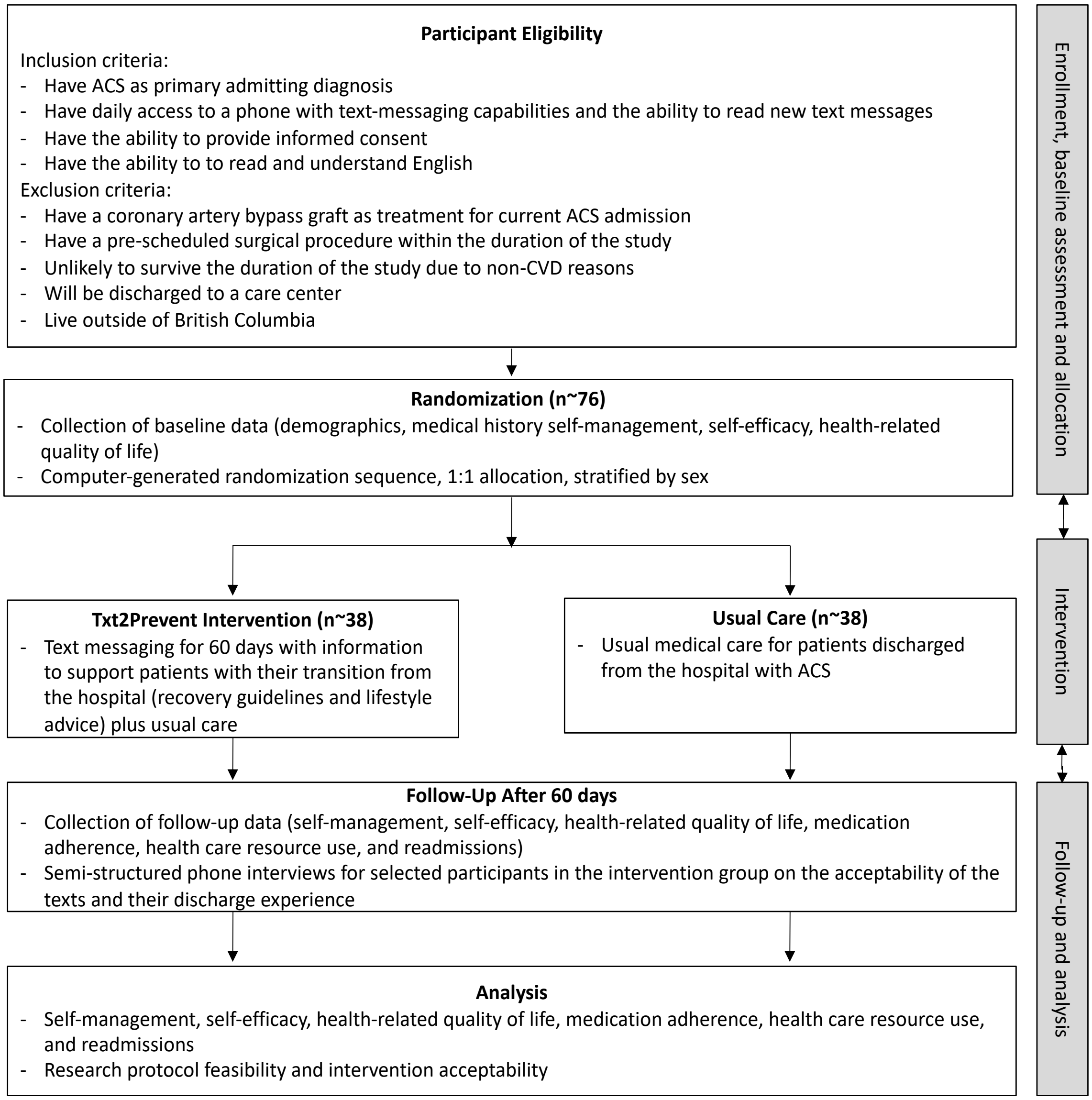
3.2. Methods

3.2.1. Overview of Study Design

The Txt2Prevent project is a mixed methods, assessor-blinded randomized controlled trial with a parallel group design. Participants will be randomized to receive either usual care or usual care plus one-way text messaging for the first 60 days following discharge from the hospital (Txt2Prevent).

3.2.2. Setting, Participants, and Recruitment

Participants will be recruited from the provincial heart centre located in a tertiary care hospital in Vancouver, British Columbia, Canada. This hospital serves patients from across the province, including the local metropolitan area as well as urban and rural areas. Consecutive patients admitted for ACS, as identified by clinical staff, will be screened for eligibility (see Figure 3.1). Patients with ACS whose treatment is a coronary artery bypass graft will be excluded as they have different recovery guidelines than medical management or percutaneous coronary intervention patients due to the more invasive nature of the procedure. Those who are eligible and interested will provide written, informed consent. The consent process will occur in-person at the hospital. If the patient is discharged before the research assistant can complete the written consent process, the patient may provide their phone number to study staff so they can complete an oral consent process over the phone within seven days of discharge. The research assistant will also give the participant a one-page sheet outlining the study process and study contact information while the participant is still in the hospital or over the phone (including sending a copy through email or mail).



Participant Eligibility

Inclusion criteria:
- Have ACS as primary admitting diagnosis
- Have daily access to a phone with text-messaging capabilities and the ability to read new text messages
- Have the ability to provide informed consent
- Have the ability to to read and understand English

Exclusion criteria:
- Have a coronary artery bypass graft as treatment for current ACS admission
- Have a pre-scheduled surgical procedure within the duration of the study
- Unlikely to survive the duration of the study due to non-CVD reasons
- Will be discharged to a care center
- Live outside of British Columbia

Randomization (n~76)
- Collection of baseline data (demographics, medical history self-management, self-efficacy, health-related quality of life)
- Computer-generated randomization sequence, 1:1 allocation, stratified by sex

Txt2Prevent Intervention (n~38)
- Text messaging for 60 days with information to support patients with their transition from the hospital (recovery guidelines and lifestyle advice) plus usual care

Usual Care (n~38)
- Usual medical care for patients discharged from the hospital with ACS

Follow-Up After 60 days
- Collection of follow-up data (self-management, self-efficacy, health-related quality of life, medication adherence, health care resource use, and readmissions)
- Semi-structured phone interviews for selected participants in the intervention group on the acceptability of the texts and their discharge experience

Analysis
- Self-management, self-efficacy, health-related quality of life, medication adherence, health care resource use, and readmissions
- Research protocol feasibility and intervention acceptability

Figure 3.1. Study design and flow.
Abbreviations: ACS = acute coronary syndrome. CVD = cardiovascular disease.

3.2.3. Sample Size

A convenience sample of 76 participants will be enrolled in the study. This sample size is based on the feasibility of recruitment over six months and is not determined in order to be able to detect between-group differences. Approximately 750 unique patients with ACS were discharged from the target hospital during the 2012/2013 fiscal year. In a preliminary feasibility survey of patients, 14 of 28 had mobile phones with texting capabilities. Assuming 40% are eligible and 50% agree to participate [161], we expect approximately 76 patients will agree to participate over 6 months of recruiting.

3.2.4. Randomization

After discharge and once the baseline assessment has been completed, participants will be randomized to receive either usual care or usual care plus the 60-day text messaging program (Txt2Prevent), using a 1:1 allocation ratio. To minimize bias, randomization will be conducted by a research assistant who is not involved in either the recruitment or data collection phases. This research assistant will use a web-based randomization service developed through an independent research centre. To ensure balance between the groups, the randomization will be stratified by sex and use block randomization with variable block sizes. The randomization research assistant will register participants for the TxT2Prevent intervention, where appropriate, and then contact all participants by phone to inform them of their group assignment. The start date for participants in the Txt2Prevent program will be documented. A letter will also be sent to all study participants' primary care providers informing them that their patient has been enrolled in the study. Primary care providers will be identified by the participant. The primary care providers' addresses will be obtained online from the registry maintained by the provincial licensing and regulatory body for physicians. Participants will be told to contact the research assistant who performs the randomization if they have any questions during the study period. Participants will be aware that the text messaging program is the intervention of interest as it is being compared to usual care.

3.2.5. Intervention

Intervention

The intervention group will receive a total of 48 unique health-related text messages; one per day for the first 36 days, then one every other day for days 37 to 60 (Table 3.1; Appendix B). The text messaging program will begin the day after the participant is discharged from the hospital or, if the participant has already been discharged, immediately after the baseline questionnaires are complete. Some of the messages are time-sensitive regarding their recovery (e.g., the recommended timeframe to see their primary care provider after discharge), while others are general healthy living texts. Participants randomized to the intervention group will be registered through our secured, password-protected text messaging administrative website. We will input what time of day to send the message based on the participant's preference and indicate whether they should be in the smoking ('current smoker' or 'quit within the past six months') or non-smoking stream. These streams have two different text messages where current smokers are provided with cessation information while non-smokers are encouraged to remain smoke-free and to avoid second-hand smoke. The text message delivery will be automated, and each text message will cost $0.0075 to send.

We will be able to confirm if the text message is delivered but not whether the text messages were opened and read. Some of the text messages contain URL links and phone numbers for resources that are accessible province-wide. The URL links are converted to a bit.ly link to make them shorter and to allow us to monitor how many times the links were accessed. After the initial sign-up, study staff involvement will only be required if the participant is readmitted to the hospital. Participants who are readmitted will have their text messages paused until discharge for all readmissions. Those participants readmitted for ACS will be restarted from the day one text message when discharged. Participants are instructed about the process to inform us of any re-admittances at the time of consent, when we inform them of their group assignment, and through three text messages throughout the text messaging program. The text message is a one-way communication; if a participant responds to the text, they will receive an automated message saying that incoming text messages are not monitored regularly. Participants receive a one-page information sheet with instructions about the text messaging program. Participants will be able to request to stop receiving the text messages by speaking to the randomization assistant over the phone.

An advisory committee (consisting of cardiologists, a general practitioner, a community pharmacist, a cardiac nurse specialist, two people with lived experience of CVD, a programmer, a benefits evaluation specialist from a federally funded, non-profit digital health organization, and academic researchers) developed the messages based on six guiding principles. Messages had to be: 1) based on clinical-evidence, 2) consistent with the hospital's current discharge instructions, 3) general enough to apply to a range of patients with the target condition, 4) within a 160-character limit to be compatible with older mobile phones, 5) at a grade 8 reading level, and 6) co-created with patients to be acceptable. The advisory committee identified important themes to include, such as the timing of the standard appointments (all patients with ACS discharged from the recruitment hospital are recommended to visit their general practitioner within two weeks and cardiologist within six weeks), psychosocial needs (including depression, stress, anger and social support), diet, physical activity, medication information and recovery guidelines (e.g., returning to work, driving and resuming sexual activity). The intervention incorporates social marketing principles, such as formative research about the target audience's perspective, and emphasis on appropriate communication channels and messages [162]. Instead of conforming to a single one of the many 'branded' theories of behaviour change, the intervention reflects a set of cross-cutting theoretical domains; the themes in the messages relate to concerns about knowledge, skills, roles and identity, beliefs about capabilities (e.g., self-efficacy), beliefs about consequences, motivation, attention and decision processes (e.g., cues to action such as reminders), environmental context and resources, social influences, emotion, and action plans [163].

The advisory committee drafted and revised messages based on the guiding principles, the identified themes, current discharge materials, and interviews conducted with four discharged patients with CVD (one man and three women; ages 36-71). Revisions addressed the wording, timing and the order of the messages, as well as reviewing and including any absent topics were believed to be important based on the advisory committee's experiences. After the advisory committee approved the messages, two focus groups (totalling seven participants with coronary artery disease; five women and two men) were held with participants of a cardiac rehabilitation program to assess the appropriateness and acceptability of the messages. After further minor revisions to address the findings from the focus groups, the patient members of the clinical advisory committee pilot-tested the text messages by receiving them for 60 days.

Table 3.1. Examples of the text messages developed. All messages start with 'T2P:' to indicate the source.

Topic	Example Text Message
Appointment Reminders	T2P: Make an appointment to see your family doctor within 2 weeks of leaving the hospital. If you need a doctor, try the tool at: http://bit.ly/findaMD (Day 2)
Smoking Cessation	T2P: Not smoking is one of the most important things you can do for your health. For quitting resources, check out: http://bit.ly/quitnow.bc (Day 8)
Recovery Guidelines	T2P: Resuming sex: A general guide is that if you can go up a flight of stairs without symptoms, it is probably safe to restart sexual activities. (Day 14)
Psychosocial	T2P: It is common to feel sad or depressed after a heart attack or being in the hospital. If you feel this way for 2+ weeks, contact your doctor. (Day 16)
Physical Activity	T2P: Have you done something physically active today? If you have questions, call the Physical Activity Line at 1-877-725-1149 or talk to your doctor (Day 21)
Medication Reminders	T2P: Bring a list of your medications to your appointment when you see your doctor. You can get copies from your pharmacist. (Day 9)

Usual Care

The usual care group will not receive text messages. During hospitalization, these participants will typically receive an education session from a nurse prior to discharge as well as be provided with printed educational materials. The participant is informed that they should see their general practitioner within 2 weeks, their cardiologist within 6 weeks, and are recommended to join a cardiac rehabilitation program. The follow-up appointment with the cardiologist and the referral to cardiac rehabilitation may be scheduled while the participant is in the hospital, but they generally have to schedule the appointment with their general practitioner themselves. If they wish to join any additional programs, they must seek these out or learn about them from their healthcare professionals.

3.2.6. Study Outcomes

The primary outcome will be the follow-up scores (controlled for baseline) of the self-management domains measured by the heiQ. The heiQ comprises 40 questions and measures eight domains that are indicators of effective self-management programs: positive and active engagement in life (five questions), health-directed behaviour (four questions), skill and technique acquisition (four questions), constructive attitudes and approaches (five questions), self-monitoring and insight (six questions), health service navigation (five questions), social integration and support (five questions), and emotional distress (six questions). Items are scored on a Likert scale from one to four, with higher scores being desirable except for the emotional distress domain. The heiQ was developed using item response theory and structural equation modeling, and the subscales have ‘acceptable’ to ‘high’ internal consistency (Cronbach’s alphas ranging from 0.70-0.86, depending on the domain) [159]. The heiQ has been used in a broad range of patient education programs, including those using technology and with patients with CVD [164]. The heiQ will be measured at both the baseline and follow-up sessions.

Secondary outcomes are health-related quality of life, cardiac self-efficacy, medication adherence, healthcare resource use, and hospital readmissions. Health-related quality of life will be measured by the EQ-5D-5L, a measure of health status developed by the EuroQol Group, which comprises five dimensions (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression; one item per dimension), with each item having five levels of response [165]. The Canadian EQ-5D-5L scoring algorithm will be used to value the health state descriptions reported by study participants [166]. Quality of life will also be assessed with the EQ visual analogue scale (EQ VAS), which is a 0-100 visual analogue scale with anchors defined as ‘the best health you can imagine’ (100) and ‘the worst health you can imagine’ (0) [167]. Cardiac self-efficacy will be measured through a modified Sullivan Cardiac Self-Efficacy (CSE) scale. The original scale has 13 items and is composed of two factors, control symptoms and maintain function. Responses are on a 5-point Likert scale where a higher number indicates more confidence. It has high internal consistency (Cronbach’s alphas of 0.90 and 0.87 for the two scales, respectively), and good convergent and discriminant validity when compared with other distress and disability scales [168]. The modified version combines two questions about symptoms and adds additional questions about diet and emotional distress. We calculated scores for the modified control symptoms scale, and the maintain function scale as well as a total score (includes the modified control symptom and maintain function scale), and a total plus score (includes all questions in the total score plus the additional diet and emotional distress questions). Cronbach's alphas were 0.71, 0.76, 0.79, and 0.82 respectively although we did not do further validation testing on the modifications. Medication adherence will be measured with the 8-item medication adherence scale (MMAS) developed by Morisky et al [169–171][1]. This 8-item medication adherence scale has good internal consistency (Cronbach's alpha = 0.83) and reliability when assessed in a hypertensive population [169]. It has good sensitivity (93%) and moderate specificity (53%) [169]. Healthcare resource use over the 60-day follow-up period (i.e., visits to healthcare practitioners, visits to a hospital, use of phone health services, cardiac rehabilitation program participation, and medication use) will be self-reported by all study participants in a structured format using a questionnaire developed by the research team. Self-report resource use questionnaires provide an efficient method of collecting information in the absence of routine data sources [172,173]. Although reliance on self-reported health care resource use may be regarded as a limitation, the 60-day follow-up period in this study is significantly shorter than timeframes that have been used extensively in economic evaluations performed alongside clinical trials. Hospital readmissions will be assessed through self-report via the healthcare resource use questionnaire and confirmed medical records. The EQ-5D-5L and CSE will be measured both at baseline and follow-up while medication adherence and healthcare resource use will be measured only at follow-up.

The study's third objective is to assess the acceptability of the text messaging intervention program and to describe the feasibility of the study protocol. Acceptance of the text messaging intervention will be assessed by measuring participants' satisfaction with the program using two five-point Likert items as well as through semi-structured interviews with intervention group participants about their experiences with the text messages. During the semi-structured interviews, we will explore aspects of the text messaging program that were felt to be beneficial and aspects that were considered less beneficial and could be improved (Appendix C). To assess feasibility, we will collect data on recruitment rates, follow-up rates, questionnaire completion rates, method of

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questionnaire completion (e.g., mail, phone), percent of participants randomized within seven days and percent of participants who completed follow-up within six weeks after finishing the 60-day study period. Study staff will keep a log of barriers and challenges, and be asked to provide feedback on their perceptions of the acceptability and feasibility of the program, along with any other feedback they wish to provide.

3.2.7. Statistical Analyses

As this is a pilot study, we are likely underpowered to pick up the magnitude of differences we will be looking for in the full trial. Nevertheless, we will undertake similar analyses to those we will use in the full trial, and regard them as exploratory in nature. First, descriptive statistics will be used to characterize the sample. All variables will be analyzed for their distribution. For the primary outcome, the heiQ, analysis of covariance (ANCOVA) will be used to test the effect of group assignment on the follow-up scores when controlling for baseline scores using the intent to treat principle. Change in health-related quality of life and self-efficacy questionnaire scores will also be analyzed with an ANCOVA. Continuous scores from the MMAS will be assessed with a t-test while categorical scores will be assessed with a chi-square test. We will also calculate Cohen's *d* effect sizes (mean difference score from Txt2Prevent group minus mean difference score for usual care group divided by pre-test pooled standard deviation [174]) to provide more context for the continuous data results.

For count data from the healthcare resource use questionnaire (e.g., number of readmissions), we will use a negative binomial regression analysis. For binary response data from the healthcare resource use questionnaire (e.g., cardiologist visit within 60 days – yes/no), we will use a robust Poisson regression to determine relative risk. Chi-square tests will be used for categorical variables from the healthcare resource use questionnaire. For all analyses, when adjustment is possible, age, sex, and any clinically relevant baseline factors identified will be included as covariates. Both adjusted and unadjusted results will be presented. Missing values will be addressed as per the guidelines provided with the questionnaires. SPSS will be used for statistical analysis. Statistical significance will be set at $P < .05$.

3.2.8. Assessments

Baseline Assessment

When possible, the baseline assessment will be done as a face-to-face session prior to hospital discharge. In situations where the baseline assessment cannot be completed prior to discharge, it will be completed by phone or through an online survey within seven days of discharge. The assessment will consist of the heiQ, EQ-5D-5L, and CSE questionnaires. Participants will also be asked demographic questions (age, sex, marital status, geographic location, employment status, education, and household income) and questions about their mobile phone (frequency of use, texting frequency, need for help or support, confidence in using, type of mobile phone, and ownership). Medical history (reason for admission, co-morbidities, previous cardiac events, and smoking status) will also be obtained through a combination of self-report and medical record review. Trained assessors will be blinded as randomization will not occur until after the baseline assessment.

Follow-Up Assessment

Sixty days following randomization, all participants will be contacted to complete a follow-up assessment. The assessment will consist of the re-administration of the heiQ, EQ-5D-5L, and CSE questionnaires. Additionally, the MMAS, healthcare resource use and smoking status questionnaire, and readmission assessment will be completed. All readmission events per participant will be recorded. The healthcare resource use questionnaire will be administered over the phone, while the other questionnaires (heiQ, EQ-5D-5L, CSE, and MMAS) will be sent by mail, along with a $20 gift card. If the participant is unable or unwilling to complete the questionnaires by mail or phone, or is unresponsive to our attempts at mail or phone contact, they will have the option to complete the questionnaires via an online survey. An approved online version of the EQ-5D-5L will be used (approval from the EuroQol Group), while the other outcome measures will be adapted to an online survey format and tested for user-friendliness. The method for assessment will be documented in the study database. If the participant cannot be contacted, we will attempt to contact them every 3-5 days by using phone, mail and email contact information. Participants will be considered lost to follow-up if the follow-up session is not completed within 6 weeks after the 60 days following randomization.

Participants who are randomized to the Txt2Prevent group will also be invited to participate in a semi-structured phone interview after completion of the 60-day follow-up. Interviews are expected to be approximately 30 minutes and will be done at a different time than the follow-up assessments in order to avoid a lengthy phone call. Interview participants will be selected to cover a range of characteristics to represent the sample of study participants (e.g., male/female, rural/urban, and different age groups). Participants will be asked to share their experiences of living with and managing their condition, as well as their views on the text messaging program (e.g., "*Can you tell me about how you have managed your heart condition over the past 2 months?*"; "*Has the text messaging program impacted your life over the past two months? If so, how?*"). Questions to evaluate the text messages will ask about the clarity, tone, and frequency of the messages; the duration of the program; what topics were the least or most helpful; and what proportion of messages they read. Interviews will be recorded and transcribed verbatim and analyzed using thematic analysis [175,176]. Through an iterative process, categories and themes will be created by detailed reading and line-by-line coding. Interviews will continue until theme saturation occurs [177]. NVivo software will be used for qualitative analysis. The findings from the interviews will be valuable in providing the context for the quantitative findings and for assessing the acceptability of the intervention.

3.3. Results

Study results are presented in Chapters 4 and 5.

3.4. Discussion

This study aims to evaluate whether a text messaging program can help support patients with ACS after their discharge from the hospital. A randomized controlled pilot trial with semi-structured interviews will be used to determine preliminary efficacy, feasibility and acceptability. Although previous studies have looked at text messaging in patients with CVD, we are unaware of any studies that have evaluated a text-messaging only intervention targeting multiple self-management among patients with ACS during the hospital-to-community transition period, which is a high-risk time for readmission [6].

3.4.1. Study Considerations

The Txt2Prevent study is an exploratory pilot study to assess the preliminary efficacy, acceptability, and feasibility of a text messaging program to improve self-care and management in patients with ACS after discharge, which leads to several study considerations. First, due to the nature of the intervention, the participants are not blinded. Additionally, it is difficult to create a suitable attention control, so the intervention group is being compared to usual care. Second, we are unable to objectively determine adherence or even if participants read the messages; however, we will ask participants about their experiences in semi-structured interviews. Third, several of the outcomes are self-reported, which may introduce bias; however, the study will primarily use common and validated measures.

3.4.2. Conclusion

The Txt2Prevent study is a novel project to determine if text messaging can support patients with ACS in the critical period immediately after discharge. We intend to use the results of the study to inform a larger clinical trial. If effective, the Txt2Prevent program has the potential to be translated into practice and be scaled-up and implemented in clinical settings. Implementing the program on a larger scale is likely to be feasible because the program requires limited human resources and text messages are low cost. The study will contribute to our understanding of ICT in health services research and will inform future studies on the use of text messaging to support patients with ACS as they transition from hospital to home.

Chapter 4.

Self-management, Self-Efficacy, Medication Adherence, Health-Related Quality of Life, Healthcare Resource Use and Feasibility Results from the Txt2Prevent Study

4.1. Introduction

Acute coronary syndrome (ACS), which includes unstable angina and myocardial infarction, is a leading cause of hospitalization in North America [108,147]. Once discharged, 20-34% of patients are readmitted within 30 days [7,10]. While reducing readmissions is a complex issue, patients with ACS may experience several challenges after discharge that negatively impact their clinical outcomes and psycho-social well-being. One-third of patients with ACS do not adhere to the behavioural advice regarding diet, physical activity and smoking cessation [31]; 44% do not have early physician follow-up [51]; and around a quarter of cardiac medication prescriptions are not filled within the first week of discharge [33]. Patients also report feeling overwhelmed or uncertain [40], being fearful of another cardiac event [43], and experiencing depression [178]. Therefore, providing continuing support after hospital discharge may affect several key factors in post-ACS management, including lifestyle changes, medication adherence, and psychosocial well-being.

Home-based programs, often nurse-led, can improve quality of life and reduce readmissions [179,180], but these face-to-face interventions can be a challenge for strained health care systems. The widespread use of information and communication technology, such as mobile phones, may be an easier and more convenient way to reach patients. In particular, text messages are an attractive technology, as over 85% of adults aged 65 years or older own a mobile phone [78], and 80% of mobile phone owners currently text [85]. Text messages also have the benefits of having a wide geographic reach, being convenient due to the asynchronous nature of communication, having low delivery costs, and can be stored and re-accessed. Previous text messaging studies in patients with or at risk for CVD have reported improvements in self-management behaviours (e.g., medication adherence [98] and increases in leisure physical activity and walking [103]) and cardiac risk factors (e.g., lowering low-density lipoprotein cholesterol and systolic blood pressure [93,181]). These studies show the promise of text-messaging aiding in the care of patients with CVD. However, they do not specifically target the wide-ranging self-management activities that are required in the immediate period after discharge. We report on a pilot study of a one-way text messaging intervention (Txt2Prevent) aimed at supporting patients with ACS after hospital discharge in an assessor-blinded randomized controlled trial. The study's primary objective was to assess the effect of the Txt2Prevent intervention on self-management domains, compared to usual care. The other objectives were to compare quality of life, self-efficacy, medication adherence and healthcare resource use between the two groups, as well as to assess the feasibility of the study protocol and acceptability of the Txt2Prevent intervention.

4.2. Methods

The Txt2Prevent study was a mixed methods, assessor-blinded, randomized controlled trial with a parallel group design. The study protocol and intervention development have been previously reported [182]. This study is reported in accordance with the Consolidated Standards of Reporting Trials (CONSORT) eHealth checklist [160] and is registered at ClinicalTrials.gov [NCT02336919].

4.2.1. Participants

Patients with a diagnosis of ACS, as identified by clinical staff, were recruited from St. Paul's Hospital, a tertiary care hospital, in Vancouver, Canada between June 2015 and December 2016. Patients were eligible to participate if they had ACS (unstable angina or any type of myocardial infarction) as their primary admitting diagnosis, had daily access to a phone with text-messaging capabilities, were able to provide informed consent, and were able to read and understand English. Exclusion criteria comprised having coronary artery bypass graft surgery as a treatment for the ACS admission, having a pre-scheduled surgery within the study period, an expectation that the individual would not survive the duration of the study due to non-CVD reasons, being discharged to a long-term care center, or living outside the province of British Columbia. As this was a pilot study, the sample size was based on convenience. We aimed to recruit 76 participants, as we previously estimated this was feasible over six months of recruitment. All participants provided written informed consent. Ethics and institutional approvals were obtained from Providence Health Care Research Ethics Board and Simon Fraser University's Office of Research Ethics.

Baseline questionnaires, which included demographic information as well as measures of self-management, health-related quality of life, and cardiac self-efficacy, were administered in-person in the hospital when possible or within seven days after discharge. Clinical information was gathered from the participant's medical record.

4.2.2. Randomization

After participants completed the baseline questionnaires and were discharged from the hospital, they were randomly assigned to either the intervention (Txt2Prevent plus usual care) or usual care. A statistician not associated with the study generated a random allocation schedule, which randomized participants in a 1:1 ratio using variable block sizes, stratified by sex. A research assistant not involved in recruitment or outcome assessment accessed a secure randomization database to obtain allocations for each patient and informed participants of their group assignment.

4.2.3. Intervention and Usual Care

Participants in the Txt2Prevent group received 48 automated, one-way messages over 60 days following randomization, in addition to usual care. Messages were delivered at a time of day specified by the participant. The messages began after the participant was randomized and were sent daily for the first 36 days and then every other day until day 60. Messages covered a range of topics, from time-sensitive information regarding their recovery (e.g., timely follow-up with their healthcare professional) to general healthy living advice (e.g., messages regarding physical activity, diet, and psychosocial health), and were delivered in a pre-specified order (see Table 4.1; Appendix B). Participants received different messages on two instances, depending on their smoking status (current/quit within six months versus never/quit more than six months ago); no other aspects were personalized. The usual care group did not receive any text messages or have any contact from research staff during the study period.

Table 4.1. Examples of the text messages in the intervention group (Txt2Prevent).

Topic	Example Text Message
Appointment Reminders	T2P: Make an appointment to see your family doctor within 2 weeks of leaving the hospital. If you need a doctor, try the tool at: http://bit.ly/findaMD (Day 2)
Smoking Cessation	T2P: Not smoking is one of the most important things you can do for your health. For quitting resources, check out: http://bit.ly/quitnow.bc (Day 8)
Recovery Guidelines	T2P: Resuming sex: A general guide is that if you can go up a flight of stairs without symptoms, it is probably safe to restart sexual activities. (Day 14)
Psychosocial	T2P: It is common to feel sad or depressed after a heart attack or being in the hospital. If you feel this way for 2+ weeks, contact your doctor. (Day 16)
Physical Activity	T2P: Have you done something physically active today? If you have questions, call the Physical Activity Line at 1-877-725-1149 or talk to your doctor (Day 21)
Medication Reminders	T2P: Bring a list of your medications to your appointment when you see your doctor. You can get copies from your pharmacist. (Day 9)

4.2.4. Outcome Measures and Data Collection

The primary outcome was follow-up scores (controlled for baseline scores) in self-management domains between the two groups as measured by the Health Education Impact Questionnaire (heiQ; version three) [159]. The HeiQ comprises 40 questions that cover eight domains in total. All eight were measured and analyzed separately: health-directed behaviour (four questions), positive and active engagement in life (five questions), emotional distress (six questions), self-monitoring and insight (six questions), constructive attitudes and approaches (five questions), skill and technique acquisition (four questions), social integration and support (five questions), and health service navigation (five questions). As per the questionnaire's scoring instructions, each domain score was calculated by averaging Likert scale responses (scaled from 1-4). Higher values are desirable, except for the emotional distress domain.

The secondary outcomes were health-related quality of life, cardiac self-efficacy, medication adherence and healthcare resource use. Health-related quality of life was measured with the EQ-5D-5L [165], using health state valuations derived from a representative sample of the Canadian adult general population [166]. Self-reported health status was also captured using the EQ-5D-5L visual analogue scale (EQ VAS), a 0-100 visual analogue scale with anchors defined as 'the best health you can imagine' (100) and 'the worst health you can imagine' (0)[167]. Cardiac self-efficacy was measured with a modified Sullivan Cardiac Self-Efficacy scale (CSE) [168], such that scores were calculated for the two domains (control symptoms, maintain function) as well as for the total by averaging Likert scale responses (0-4). For the modifications, we combined the first four questions regarding symptom control into two questions, as well as added three questions about diet and emotional well-being. We calculated the total for the original questions ('Total') as well as a total including the additional questions about diet and emotional well-being ('Total Plus'). Medication adherence was measured with the Morisky Medication Adherence Scale (MMAS) [169–171]. As per questionnaire documentation, we calculated an adherence score on a scale from one to eight and categorized participants as having low (<6), medium (6 to <8) or high adherence (8). We also assessed how many participants at follow-up reported taking the recommended medications for post-ACS treatment [183]: acetylsalicylic acid (ASA), ticagrelor/clopidogrel, a statin, a beta blocker and an angiotensin-converting-enzyme inhibitors (ACEI)/angiotensin receptor blocker (ARB) for those with reduced ventricular function. Healthcare resource use over the 60-day follow-up period (e.g., visits to health care practitioners, visits to hospitals, cardiac rehabilitation program participation) was self-reported through a questionnaire developed by the research team. Any self-reported hospitalizations were verified with hospital records. Two blinded assessors categorized hospital readmissions as cardiac or non-cardiac.

Study feasibility was assessed through descriptive statistics on recruitment rates, follow-up rates, questionnaire completion rates, method of questionnaire completion (e.g., mail, phone), the proportion of participants randomized within seven days and the proportion of participants who completed follow-up within six weeks after finishing the 60-day study period. Additionally, study staff kept a log of barriers encountered. Acceptability was measured via two five-level Likert scale survey questions that asked how satisfied participants were with the program (strongly disagree to strongly agree) and whether they thought the program helped them manage their condition. Acceptability was also assessed via two questions in semi-structured phone interviews—

specifically whether they would recommend the program to other heart patients and whether they read the text messages. Participants with a range of demographic characteristics who were randomized to the Txt2prevent group were invited to participate in the semi-structured interviews after the 60-day study period. Detailed findings from the interviews, which covered participants' experiences with the program and gathered feedback on program attributes, will be presented in Chapter 5.

Follow-up questionnaires were administered 60 days after randomization, primarily via mail, except for the healthcare resource use questions, which were completed over the phone for most participants due to its complex branching. All surveys were administered at baseline and at follow-up, except for the medication adherence scale and healthcare resource use questionnaire, which were only administered at follow-up.

4.2.5. Statistics

As this was a pilot study, we undertook similar analyses to what is anticipated for a full trial and considered them exploratory in nature. Descriptive statistics are presented as the mean and standard deviation (SD), or count data with percentages. Analyses were conducted following the intent-to-treat principle. Only complete cases were analyzed. For continuous data from the heiQ, EQ-5D-5L, EQ VAS, and cardiac self-efficacy questionnaires, analysis of covariance (ANCOVA) was used to test the effect of group assignment on the follow-up scores when controlling for baseline scores. We then re-ran the ANCOVA adjusting for age and sex as pre-specified covariates as well as previous CVD status for the heiQ, and previous CVD status and marital status for the cardiac self-efficacy, due to their prognostic value [184]. We tested for the following assumptions for ANCOVA tests: independence of covariate and treatment effect, homogeneity of regression slopes, linearity, normality of residuals, homoscedasticity and homogeneity of variances. The cardiac self-efficacy scales, the EQ-5D-5L and the EQ VAS were negatively skewed, which was primarily driven by outliers. We conducted the analyses with and without the outliers and present results of both analyses in situations where the outlier impacted the conclusion. We also calculated Cohen's *d* effect sizes (mean difference score from Txt2Prevent group minus mean difference score for usual care group divided by pre-test pooled standard deviation [174]) to provide more context for the continuous data results. For our questionnaires, a negative Cohen's *d* effect size implies the Txt2Prevent group had worse outcomes than the usual care group.

For count data from the healthcare resource use questionnaire (e.g., number of readmissions), we used negative binomial regression analyses as our data had some overdispersion. For these analyses, we adjusted for age and sex, as pre-specified. For binary response data from the healthcare resource use questionnaire (e.g., cardiologist visit within 60 days – yes/no), we used a robust Poisson regression to determine relative risk, as our outcomes occurred frequently [185]. For the robust Poisson regression, we adjusted for age and sex as pre-specified, as well as geographic region [51] and income [51]. Chi-square tests were used for categorical variables unless there were low expected counts, in which case Fisher's exact test was used. Analyses were done using SPSS 25 (IMB Corp). Statistical significance was set at *P* < .05.

4.3. Results

Four hundred patients were assessed for eligibility from June 2015 to October 2016. After excluding those who did not meet inclusion criteria and those who declined to participate, 76 participants were randomized (Figure 4.1).

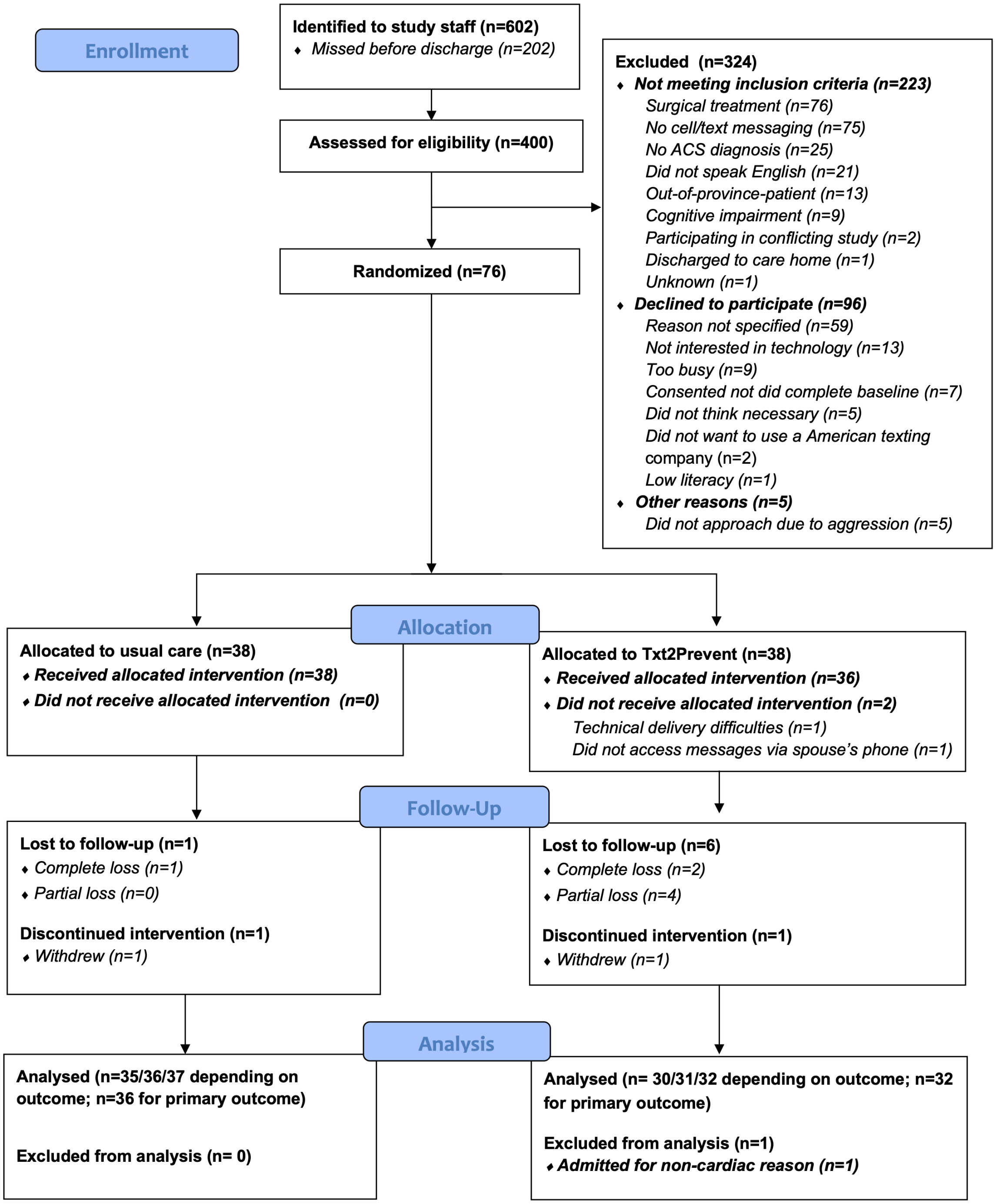

Figure 4.1. CONSORT flow diagram.

The mean age of participants was 60 years (SD: 9.3) and 73% (n=55) were male (Table 4.2, Table 4.3). Nine participants did not complete the study (two withdrew, three failed to complete any of the follow-up questionnaires and four partially completed the follow-up questionnaires)(Figure 4.1). There were no statistically significant differences in baseline characteristics between those who did not complete the follow-up assessments compared to those that did (analyses not shown). Data collection ended in December 2016.

Table 4.2 Baseline demographics, by group.

Variable	Group	
	Txt2Prevent (n = 37)	Usual Care (n = 38)
Socioeconomic Status		
Age, mean (SD)	59.5 (9.1)	61.1 (9.6)
Male	27 (73%)	28 (74%)
Married (yes/no)	27 (71%)	31 (82%)
Geographic Region		
Census metropolitan area (100,000+ urban core) [124]	13 (35%)	21 (55%)
Census agglomeration (10,000 – 99,999 urban core) [124]	18 (49%)	8 (21%)
Rural [124]	6 (16%)	9 (24%)
Greater than high school education (yes/no)	23 (61%)	25 (66%)
Employed full-time (yes/no)	20 (54%)	17 (45%)
Household Income		
Less than $29 999	6 (18%)	7 (19%)
$30 000 to $69 999	9 (27%)	7 (19%)
$70 000 to $99 999	6 (18%)	6 (17%)
$100 000 or higher	12 (36%)	16 (44%)
Technology Use		
At least daily cell use	26 (72%)	34 (90%)
Very or completely confident using a mobile phone	18 (55%)	26 (70%)
Own a smartphone	34 (92%)	33 (90%)
Comorbidities and Medical History		
Hypertension	25 (68%)	19 (50%)
Dyslipidemia	18 (49%)	12 (32%)
Diabetes (Type 1 or Type 2)	14 (38%)	7 (18%)
Previous any type of CVD	16 (43%)	16 (42%)
Treatment in Hospital		
Days in hospital	5.1 (3.0)	5.2 (4.1)
Primary reason for admission		
NSTE-ACS	10 (27%)	18 (47%)
STEMI	22 (60%)	17 (45%)
Other	5 (14%)	3 (8%)

Revascularization	29 (78%)	33 (89%)
Current/quit within 6 month smoker	8 (22%)	8 (22%)
Medication at Discharge		
ASA	33 (91%)	36 (97%)
Ticagrelor or clopidogrel	31 (86%)	36 (97%)
Statin	33 (92%)	33 (89%)
Beta blocker	29 (81%)	33 (89%)
ACE inhibitor or angiotensin II receptor blockers	31 (83%)	32 (84%)

Abbreviations: ACE = angiotensin-converting-enzyme, ASA = acetylsalicylic acid, CVD = cardiovascular disease, NSTE-ACS = Non-ST-segment elevation acute coronary syndrome, SD = standard deviation, STEMI = ST-segment elevation myocardial infarction.

Table 4.3. Baseline questionnaire scores, by group.

Baseline variables, mean (SD)	Group	
	Txt2Prevent (n = 37)	Usual Care (n = 38)
heiQ: health-directed activity	2.93 (0.80)	2.93 (0.78)
heiQ: positive and active engagement in life	3.10 (0.53)	3.27 (0.48)
heiQ: emotional distress	2.25 (0.68)	2.02 (0.60)
heiQ: self-monitoring and insight	3.19 (0.89)	3.08 (0.59)
heiQ: constructive attitudes and approaches	3.17 (0.51)	3.35 (0.46)
heiQ: skill technique and acquisition	3.02 (0.34)	3.09 (0.53)
heiQ: social integration and support	3.11 (0.49)	3.30 (0.41)
heiQ: health service navigation	3.08 (0.47)	3.27 (0.47)
EQ-5D-5L	0.833 (0.119)	0.849 (0.109)
EQ VAS	67 (19)	68 (17)
CSE Symptoms	3.14 (0.63)	3.25 (0.52)
CSE Function	2.85 (0.91)	2.91 (0.83)
CSE Total	3.02 (0.61)	3.10 (0.57)
CSE Total Plus	2.94 (0.58)	3.02 (0.54)

Abbreviations: CSE = Cardiac Self-Efficacy, EQ VAS = EQ-5D-5L visual analogue scale, heiQ = Health Education Impact Questionnaire, SD = Standard deviation.

4.3.1. Primary Outcome

There were no statistically significant differences between groups for the heiQ scores in either the unadjusted (Table 4.6) or adjusted model in any of the eight domains (adjusted mean difference [Txt2Prevent minus usual care] for each domain: health directed activity: -0.13 [95% confidence interval (CI): -0.39 – 0.13]; positive and active engagement in life: 0.03 [95% CI: -0.19 – 0.25]; emotional distress: 0.04 [95% CI: -0.22 – 0.29]; self-monitoring and insight: 0.14 [95% CI: -0.33 – 0.05]; constructive attitudes and approaches: -0.10 [95% CI: -0.36 – 0.17]; skill technique and acquisition: 0.05 [95% CI: -0.18 – 0.27]; social integration and support: -0.12 [95% CI: -0.34 – 0.10]; health services navigation: -0.05 [95% CI: -0.29 – 0.19]) (Table 4.4). Cohen's effect sizes were all below 0.20, indicating negligible effects, except for the self-monitoring and insight domain, where the Txt2Prevent group had worse outcomes than the usual care group, estimated at a small negative effect (Cohen's *d*: -0.48) (Table 4.4).

Table 4.4. Adjusted 60-day Health Education Impact Questionnaire (heiQ) scores, by group.

Outcome	Group		Adjusted Mean Difference (95% CI)	*P* value	Effect Size
	Txt2Prevent (n=32)	Usual Care (n=35/36)			
	Adjusted Mean (95% CI)	Adjusted Mean (95% CI)			
heiQ: Health directed activity	3.02 (2.82 – 3.21)	3.15 (2.96 – 3.35)	-0.13 (-0.39 – 0.13)	.31	-0.15
heiQ: Positive and active engagement in life	3.10 (2.93 – 3.26)	3.06 (2.91 – 3.22)	0.03 (-0.19 – 0.25)	.76	0.10
heiQ: Emotional distress	2.37 (2.18 – 2.56)	2.33 (2.15 – 2.51)	0.04 (-0.22 – 0.29)	.77	-0.05
heiQ: Self-monitoring and insight	3.08 (2.94 – 3.23)	3.22 (3.09 – 3.36)	-0.14 (-0.33 – 0.05)	.15	-0.48
heiQ: Constructive attitudes and approaches	3.09 (2.89 – 3.29)	3.18 (2.99 – 3.38)	-0.10 (-0.36 – 0.17)	.47	-0.06
heiQ: Skill technique and acquisition	2.91 (2.73 – 3.08)	2.86 (2.70 – 3.03)	0.05 (-0.18 – 0.27)	.69	0.14
heiQ: Social integration and support	3.04 (2.87 – 3.2)	3.17 (3.01 – 3.32)	-0.12 (-0.34 – 0.10)	.27	-0.04
heiQ: Health services navigation	3.15 (2.97 – 3.33)	3.19 (3.02 – 3.37)	-0.05 (-0.29 – 0.19)	.69	0.15

Abbreviations: CI = confidence interval, heiQ = Health Education Impact Questionnaire.
The adjusted heiQ model includes baseline scores, age, sex and previous cardiovascular disease status (yes/no).
Effect size is Cohen's *d* (mean difference score from theTxt2Prevent group minus the mean difference score for usual care group divided by pre-test pooled standard deviation [174]). For our questionnaires, a negative number implies the Txt2Prevent group had worse outcomes than the usual care group.

4.3.2. Secondary Outcomes

There were no statistically significant differences in EQ-5D-5L health state values or EQ VAS scores (Table 4.5). For cardiac self-efficacy, in the adjusted models, there were no statistically significant differences between the two groups, except for the ‘Total Plus’ domain where the Txt2Prevent group had worse outcomes (Table 4.5). The statistically significant finding on the ‘Total Plus’ scale was due to an influential outlier that impacted the normality assumptions of ANCOVA. When the influential outlier was excluded in the adjusted analysis, the P value for the Total Plus scale was no longer significant. Depending on the self-efficacy domain, there were small or medium negative effects for the Txt2Prevent group (i.e., this group had worse outcomes) based on the Cohen’s d values for the self-efficacy scores (Table 4.5). Unadjusted scores are presented in Table 4.6.

Table 4.5. Adjusted 60-day EQ VAS, EQ-5D-5L, and Cardiac Self-Efficacy (CSE) results, by group.

Outcome	Group		Mean Difference (95% CI) – Adjusted	*P* value – Adjusted	Effect Size
	Txt2Prevent (n=31/32)	Usual Care (n=36)			
	Adjusted Mean) (95% CI)	Adjusted Mean (95% CI)			
EQ VAS	70.94 (65.91 – 75.98)	69.68 (64.84 – 74.52)	-1.27 (-5.41 – 7.94)	.71	0.10
EQ-5D-5L	0.82 (0.78 – 0.86)	0.84 (0.80 – 0.88)	-0.018 (-0.07 – 0.04)	.51	-0.13
CSE: Control Symptoms	2.49 (2.24 – 2.75)	2.76 (2.49 – 3.02)	-0.27 (-0.58 – 0.05)	.10	-0.43
CSE: Control Symptoms (2 outliers removed)	2.57 (2.36 – 2.78)	2.80 (2.57 – 3.02)	-0.23 (-0.49 – 0.04)	.09	-0.37
CSE: Maintain Function	2.14 (1.84 – 2.45)	2.52 (2.20 – 2.84)	-0.38 (-0.76 – 0.004)	.05	-0.46
CSE: Maintain Function (1 outlier removed)	2.23 (1.95 – 2.50)	2.50 (2.22 – 2.78)	-0.27 (-0.61 – 0.07)	.11	-0.35
CSE: Total	2.35 (2.09 – 2.60)	2.66 (2.39 – 2.93)	-0.31 (-0.63 – 0.003)	.05	-0.55
CSE: Total (1 outlier removed)	2.42 (2.20 – 2.64)	2.64 (2.41 – 2.86)	-0.22 (-0.49 – 0.053)	.11	-0.40
CSE: Total Plus	2.28 (2.03 – 2.53)	2.64 (2.38 – 2.90)	-0.36 (-0.66 – -0.5)	.03	-0.65
CSE: Total Plus (1 outlier removed)	2.35 (2.14 – 2.57)	2.61 (2.39 – 2.84)	-0.26 (-0.53 – 0.003)	.05	-0.51

Abbreviations: CI = confidence interval, CSE = Cardiac Self-Efficacy Scale, EQ VAS = EQ-5D-5L visual analogue scale.

The adjusted EQ-5D-5L and EQ VAS models include baseline scores, age and sex. The adjusted CSE model includes baseline scores, age, sex, marital status and previous cardiovascular disease status (yes/no).

Effect size is Cohen's d (mean difference score from the Txt2Prevent group minus the mean difference score for usual care group divided by pre-test pooled standard deviation [174]). For our questionnaires, a negative number implies the Txt2Prevent group had worse outcomes than the usual care group.

Table 4.6. Unadjusted Health Education Impact Questionnaire (heiQ), EQ-5D-5L, EQ VAS, Cardiac Self-Efficacy (CSE), and Morisky Medication Adherence Scale (MMAS) results at 60-days (controlling for baseline scores).

Outcome	Txt2Prevent Mean (n=31/32) (95% CI) – Unadjusted	Usual Care Mean (n=35/36) (95% CI) – Unadjusted	Mean Difference (95% CI) – Unadjusted	*P* value - Unadjusted
heiQ: Health directed activity	3.08 (2.88 – 3.27)	3.22 (3.04 – 3.41)	-0.14 (-0.41 – 0.13)	.29
heiQ: Positive and active engagement in life	3.15 (2.99 – 3.31)	3.12 (2.97 – 3.27)	0.03 (-0.20 – 0.25)	.82
heiQ: Emotional distress	2.29 (2.10 – 2.48)	2.24 (2.06 – 2.42)	0.05 (-0.22 – 0.31)	.73
heiQ: Self-monitoring and insight	3.13 (2.98 – 3.27)	3.26 (3.12 – 3.39)	-0.13 (-0.33 – 0.07)	.21
heiQ: Constructive attitudes and approaches	3.14 (2.95 – 3.34)	3.25 (3.07 – 3.43)	-0.10 (-0.37 – 0.16)	.44
heiQ: Skill technique and acquisition	2.93 (2.76 – 3.10)	2.90 (2.74 – 3.06)	0.03 (-0.20 – 0.26)	.80
heiQ: Social integration and support	3.09 (2.93 – 3.25)	3.21 (3.06 – 3.36)	-0.12 (-0.35 – 0.10)	.29
heiQ: Health services navigation	3.20 (3.02 – 3.37)	3.24 (3.07 – 3.40)	-0.04 (-0.29 – 0.20)	.73
EQ VAS	73.10 (67.96 – 78.22)	72.33 (67.50 – 77.17)	0.76 (-6.29 – 7.82)	.83
EQ-5D-5L	0.84 (0.80 – 0.88)	0.86 (0.82-0.90)	-0.02 (-0.08 – 0.04)	.52
CSE: Control Symptoms	2.68 (2.43 – 2.92)	2.97 (2.74 – 3.20)	-0.30 (-0.63 – 0.04)	.08
CSE: Control Symptoms (2 outliers removed)	2.75 (2.54 – 2.96)	3.03 (2.83 – 3.23)	-0.28 (-0.57 – 0.01)	.06
CSE: Maintain Function	2.31 (2.04 – 2.59)	2.73 (2.47 – 2.99)	-0.41 (-0.79 – -0.36)	.03
CSE: Maintain Function (1 outlier removed)	2.72 (2.48 – 2.95)	2.39 (2.14 – 2.65)	-0.32 (-0.67 – 0.02)	.07
CSE: Total	2.52 (2.28 – 2.76)	2.86 (2.64 – 3.08)	-0.34 (-0.67 – -0.02)	.04
CSE: Total (1 outlier removed)	2.60 (2.38 – 2.81)	2.86 (2.66 – 3.06)	-0.26 (-0.55 – 0.03)	.08
CSE: Total Plus	2.45 (2.2 – 2.68)	2.83 (2.62 – 3.05)	-0.38 (-0.70 – -0.07)	.02
CSE: Total Plus (1 outlier removed)	2.53 (2.32 – 2.74)	2.83 (2.64 – 3.03)	-0.30 (-0.59 – -0.02)	.04
MMAS	6.75 (6.34 – 7.16)	7.05 (6.72 – 7.38)	-0.30 (-0.83 – 0.23)	.27

Abbreviations: CSE = Cardiac Self-Efficacy, CI = confidence interval, EQ VAS = EQ-5D-5L visual analogue scale, heiQ = Health Education Impact Questionnaire, MMAS = Morisky Medication Adherence Scale.

The unadjusted model includes baseline scores as a covariate except for the Morisky Medication Adherence Scale, which was not measured at baseline.

There were no statistically significant differences in medication adherence (measured with the MMAS) scores between the two groups (Table 4.6). When categorized into low, medium and high adherence, 34% (n = 11) percent of the Txt2Prevent group and 42% (n = 15) of the usual care group were classified as high adherers (chi-square = 2.10, *P* = .350). There were no statistically significant differences between the two groups for the categories of cardiac medications they were prescribed (chi-square; *P* values ranged from 0.24 for statins to 1.00 for beta blockers; Table 4.7).

Table 4.7. 60-day follow-up medication prescriptions, by group.

Medication	Usual Care (n=35/36)	Txt2Prevent (n=31/32)	*P* value
ASA	31 (89%)	29 (94%)	.68
Ticagrelor/Clopidogrel	33 (92%)	25 (81%)	.28
Statin	32 (91%)	32 (100%)	.24
Beta blocker	31 (89%)	28 (90%)	1.00
ACEI/ARB	33 (94%)	27 (87%)	.41

Abbreviations: ACEI = angiotensin-converting-enzyme inhibitor, ASA = acetylsalicylic acid (aspirin), ARB = angiotensin II receptor blockers.

There were no differences between the groups in either the percent of participants who visited the hospital or the mean number of visits to the hospital for all-cause or cardiac visits (Table 4.8).

Table 4.8. Type of and mean hospital visits within 60-days, by group.

Outcome	Group		*P* value	Group		*P* value
	Txt2Prevent (n=32)	Usual care (n=37)		Txt2Prevent (n=32)	Usual Care (n=37)	
	Adjusted mean visits (95% CI)	Adjusted mean visits (95% CI)		Number of participants admitted (%)	Number of participants admitted (%)	
Cardiac ED	0.00 (–)	0.08 (0.02 – 0.38)	N/A	0 (0%)	3 (8%)	.24
All-cause ED	0.20 (0.08 – 0.48)	0.33 (0.16 – 0.66)	.36	3 (9%)	9 (24%)	.10
Cardiac Hospitalization	0.13 (0.04 – 0.37)	0.12 (0.04 – 0.34)	.92	3 (9%)	3 (8%)	1.00
All-Cause Hospitalization	0.16 (0.06 – 0.42)	0.21 (0.09 – 0.48)	.70	4 (13%)	6 (16%)	.74

Abbreviations: CI = confidence interval, ED = emergency department.
Mean visits were analyzed with a negative binomial regression adjusted for age and sex.
The number of participants admitted was analyzed with chi-square or Fisher's exact test dependent on expected cell counts.

There were no differences in whether participants had visited a family physician or joined a cardiac rehabilitation in unadjusted or adjusted analyses (Table 4.9). While those in the Txt2Prevent group were less likely to have visited a cardiologist in unadjusted analyses, this association was no longer significant in adjusted analyses (Table 4.9).

Table 4.9. Physician visits and cardiac rehabilitation enrolment within 60-days, by group.

	Txt2Prevent (n=32) – Unadjusted	Usual Care (n=35/36) – Unadjusted	RR (95% CI) – Unadjusted	*P* value	RR (95% CI) – Adjusted	*P* value
Visited a family physician	29 (91%)	34 (94%)	0.96 (0.84 – 1.10)	.55	0.93 (0.82 – 1.04)	.21
Visited a cardiologist	15 (47%)	26 (72%)	0.65 (0.43 – 0.99)	.04	0.73 (0.48 – 1.10)	.13
Joined a cardiac rehabilitation program	7 (22%)	10 (29%)	0.77 (0.33 – 1.77)	.53	0.90 (0.43 – 1.89)	.78

Abbreviations: CI = confidence interval, RR = relative risk
The adjusted model includes age, sex, geographic region and income.

4.3.3. Assessment of Feasibility and Acceptability

Recruitment of the target sample took 17 months (Table 4.10), which was longer than the anticipated six months. Fifty-six percent of patients we approached (n=223) were ineligible (Figure 4.1), of which 34% were scheduled for surgery (n=76) and 34% did not own a mobile phone (n=75). Of those eligible, 56% (n=96) declined to participate (Figure 4.1). Our randomization system worked well, as 97% (n=73) of participants were randomized within our target within seven days of discharge and two thirds (66%) were randomized within two days (Table 4.10). The main reason participants were not randomized within the target time frame was because completion of baseline questionnaires was delayed. Eighty-nine percent of participants (n=68) completed follow-up for the primary outcome. We obtained complete follow-up data for all outcomes for 88% (n=67) of participants and had at least partial data for 93% (n=71) of participants. While we developed electronic versions to provide an alternative option, the majority of participants were willing to complete the questionnaires in their default format (78% completed packaged questionnaires by mail and 85% completed the healthcare resource use by telephone) (Table 4.10).

Table 4.10. Study protocol feasibility measures.

Feasibility Measure	Descriptive Assessment
Recruitment	
Months of recruitment	17
Number participants randomized per month, mean (range)	4.4 (0 – 15)
Number of ineligible patients (%)	223 (56%)
Number of eligible patients who declined to participate (%)	96 (55%)
Randomization	
Mean days from discharge to randomization (SD)	2 (0.5)
Number of participants randomized within seven days of discharge (%)	73 (97%)
Follow-up	
Number of completed packaged follow-up questionnaires (%)	68 (91%)
Number of packaged follow-up questionnaires done by mail (%)	59 (78%)
Mean days after discharge to complete packaged follow-up questionnaires (SD)	72 (16)
Number of completed packaged follow-up questionnaires done within six weeks of the 60-day study period (%)	63 (93%)
Number of completed healthcare resource use follow-up questionnaires (%)	68 (91%)
Number of healthcare resource use questionnaires by phone (%)	64 (85%)
Mean days after discharge to complete healthcare resource use questionnaire (SD)	69 (14)
Number of completed healthcare resource use questionnaires done within six weeks of the 60-day study period	67 (99%)
Number of participants who completed all sets of follow-up questionnaires (%)	67 (88%)
Number of participants who completed no follow-up questionnaires (%)	5 (6%)
Percent of questions completed on received questionnaires	99.8%

Abbreviations: SD = Standard deviation.
Packaged follow-up questionnaires included: Health Education Impact Questionnaire, Cardiac Self-Efficacy Scale, Morisky Medication Adherence Scale, EQ-5D-5L, EQ Visual Analogue Scale.

We had a technical problem with our delivery system eleven months into recruitment, in which messages were not delivered for ten days for ten (29%) participants. It is suspected an operating system update caused the error as a server reboot fixed the error. All affected participants were started where they left off. After this technical problem, we implemented more regular system checks by the staff involved in randomization to ensure all messages were being delivered.

Regarding acceptability, over 93% (n=30) of participants in the Txt2Prevent group reported they agreed or strongly agreed that they were satisfied with the program. Seventy-six percent (n = 24) agreed or strongly agreed that it helped them manage their condition. When asked in semi-structured interviews, seventeen of eighteen participants said they would recommend the program to other cardiac patients. The participant who said they would not recommend the program qualified that it would depend on whether the person took the time to read the messages. All but two interview participants reported reading every message; those who did not reported they read the majority of messages but may have missed a couple. Every interviewed participant said they would be willing to use text messaging again for health purposes.

4.4. Discussion

Our pilot study assessed the impact, feasibility, and acceptability of a 60-day text messaging program in supporting patients with ACS following hospital discharge. In exploratory adjusted analyses, we did not find statistically significant differences in follow-up scores (controlling for baseline scores where applicable) between the Txt2Prevent group and usual care group in their self-management domains, health-related quality of life, medication adherence, healthcare resource use and self-efficacy, except for the ‘Total Plus’ domain, which was impacted by an influential outlier. The study protocol was generally feasible, as seen by high adherence to the study protocol targets for randomization time frames and questionnaire completion rates although recruitment took much longer than estimated. In terms of acceptability, participants reported they generally found the program acceptable and believed it helped them manage their condition.

In our pilot study, we failed to demonstrate any positive effect of text messaging on our questionnaire outcomes, including the heiQ, cardiac self-efficacy and medication adherence. Previously, two interventions that used apps reported improvements in heiQ domains over the short-term [186,187], although this was not the case for two web-based interventions [188,189]. We also did not find improvements in self-efficacy scores, which is in contrast to a study that used text messages and phone calls for patients with CVD [106]. Additionally, several previous text-messaging studies targeting CVD medication adherence have had a positive effect [97]. Other studies assessing text-messaging in a CVD population have measured specific risk factors, such as blood pressure and cholesterol. Chow et al. reported positive effects on LDL-cholesterol, systolic blood pressure, body mass index, physical activity, and smoking in a text-messaging program [93]. However, not all studies have reported positive effects [98]. Zheng et al., who used a similar framework to Chow et al.’s, found greater levels of physical activity at six months in the intervention group compared to the control group but did not observe statistically significant effects on blood pressure [94]. Another study investigating the effect of weekly text messages or emails on the primary prevention of CVD risk factors found no improvements after one year [190]. Therefore, while many previous studies have reported positive effects, the results are not consistent.

Differences between our findings and others may be due to our intervention's design. Guided by an advisory committee that included clinicians (a cardiac nurse, a family physician, a community pharmacist, and two cardiologists), researchers and two people with lived experiences of CVD, the messages were education-based and included prompts that aligned with hospital messaging and current guidelines [191]. The messages were revised according to feedback from patient focus groups. We wanted to test whether a simple program design (i.e., one-way delivery, pre-specified order of messages) was effective before considering more complicated interventions. In addition, messages were designed to broadly apply to patients and did not include tailoring, such as personalization, feedback or content-matching. However, incorporating tailored messages could be beneficial, as systematic reviews identified that mobile health studies with positive effects often used tailoring [192,193]. Additionally, by having a multi-factorial-focus, we may not have covered topics frequently enough to instigate change. For example, our medication adherence results contrast previous studies reporting positive effects [98], but only 7 of our 48 messages covered medication. The messages were also one-way only in part because this required fewer resources to implement. This may be a limitation as some meta-analyses and reviews have reported that two-way messages were more effective, although this is not consistent [193–195]. Chow et al. incorporated behaviour change techniques such as intention formation and self-monitoring of behaviour [196]. It is unclear which behaviour change techniques are effective, but a future study could consider including more behaviour change techniques [197,198].

Regarding the feasibility of the study protocol, we required 17 months to recruit 76 participants instead of the anticipated 6 months. Six months was estimated because there were approximately 750 ACS discharges in the previous year, and a feasibility survey showed 50% (n=14) of patients owned a mobile phone. We assumed 40% of patients would be eligible and of those 50% would agree to participate. However, we missed approaching many patients due to restrictions required by our ethics board. The research assistant had to obtain bed numbers of patients with ACS from the clinical nurse leader. The research assistant then asked the bedside nurse to confirm with the patient if they were interested in hearing about the study. This required forming strong relationships with clinical staff for this to work. Evening recruitment visits also helped, as patients were often discharged shortly after returning to the ward from the catheterization lab in the late afternoon. Ultimately, 44% of approached patients were eligible and 45% of eligible patients agreed to participate. More patients declined to participate in our study compared to the 10-30% refusal rates reported by other CVD text-messaging studies that recruited from hospitals or outpatient clinics [103,199]. Many patients refused when initially approached by clinical staff, so we could not document their reasons. Having brief, standardized wording for clinical staff to use could increase uptake. Although the focus groups and feasibility survey indicated patients were interested in this type of program, the hospital environment could have created challenges as patients may have been overwhelmed, unsure of their post-discharge needs or have been wary of committing to a research project [200]. However, recruiting outside the hospital would contradict with the time-sensitive nature of the program. The randomization process worked well although delays happened when questionnaires could not be completed before discharge. Our follow-up rates were slightly lower than previous CVD text-messaging studies, which were often between 97%-91% [94,199,201,202]. Having two different questionnaire formats (telephone for one questionnaire and mail for the remaining questionnaires) likely caused some of the partial completions.

4.4.1. Limitations

Our study has several limitations to consider. As this was a pilot study, we did not determine our sample size based on power calculations and were likely underpowered to detect clinically important differences. Other text-messaging studies frequently use clinical measures, such as blood pressure, making it difficult to compare our results directly. We chose the heiQ as it covers potential proximal and intermediate outcomes of self-management programs [159]. Self-management is important as it is linked with improved health behaviours and reduced costs and healthcare visits [42,69,70]. Previously, a 10-week proof-of-concept study (n=35) evaluating a peer-support app reported improvements in heiQ domains, indicating changes are possible in small samples over the short-term [187]. Additionally, as our measures were self-reported, there may have been biases (e.g., social desirability bias or recall bias); however, we confirmed self-reported hospital visits with hospital records and primarily used validated questionnaires. For some measures, a clinically meaningful change has not yet been determined, which makes it difficult to interpret results, so we calculated Cohen's *d* effect sizes for better comparison [203]. Participants in the intervention group may have been impacted in ways not captured by the questionnaires or had a different perspective at follow-up (e.g., been more aware they were not meeting recommendations). While we cannot know this, it is possible, as participants in the interviews and acceptability survey provided positive feedback about the program. Additionally, we only measured two time points, so we cannot comment on the shape of participants' outcome trajectories in either group. As our statistical analyses were considered exploratory in nature, we did a complete case analysis. If our missing data were missing completely at random, this could reduce statistical power and precision of estimates. While our missing data was not associated with baseline variables, it is possible that responses were not missing completely at random, which could result in biased estimates. Lastly, participants could not be blinded, due to the nature of the intervention.

4.4.2. Conclusions

In our exploratory analyses, we did not demonstrate any positive effects of the text-messaging intervention in terms of self-management, medication adherence, health-related quality of life, cardiac self-efficacy or healthcare resource use. The Txt2Prevent program had an intentionally simple design and was acceptable to participants, but design changes may be needed before proceeding to a larger study. The study protocol was feasible to implement, although improvements to the recruitment process are likely required. Future work should investigate the effect of tailoring, multi-factor versus single-factor interventions, two-way versus one-way messaging and the effectiveness of behaviour change techniques.

Chapter 5.

Participants' Experiences with and Feedback on the Txt2Prevent Program

5.1. Introduction

Acute coronary syndrome (ACS), which includes myocardial infarction and unstable angina, is one of the leading causes of hospital admission [108,147]. Patients with ACS experience a range of difficulties after discharge that impact their prognosis and psychosocial well-being. These include: feeling overwhelmed and uncertain [40], wanting more information to feel reassured [52], fear of a repeat cardiac event [43], managing physical symptoms [43], anxiety and/or depression [53,204], non-adherence to behavioural-change recommendations regarding diet, physical activity and smoking cessation [31], lack of early follow-up with a physician [51], and non-adherence to medication prescriptions [33]. These difficulties can contribute to 30-day readmission rates of 20% to 34% [7,10]. Additionally, although patients may be motivated to make important behavioural changes after discharge, they can be overwhelmed [36]. Providing more support during this initial period could be beneficial to patients' outcomes and experiences.

Information and communication technology, such as text messaging, has the potential to support patients during this transition due to its widespread use. In the United States, over 85% of adults ages 65 or older own a mobile phone and more than 80% send or receive text messages [78,85]. Text messaging has many advantages as it can store information to be re-accessed, be used across geographic regions, be accessed when convenient to the user and is low cost. In patients with cardiovascular disease, receiving supportive text messages has been associated with improved cholesterol, blood pressure, body mass index, physical activity and smoking cessation [93] while a systematic review reported improvements in medication adherence, but inconsistent improvements in other outcomes [98].

To our knowledge, no studies have investigated the use of a text messaging only intervention that targets multiple self-management topics immediately after discharge in an ACS population. More research is needed to determine which program features are beneficial as well as to determine whether targeting the initial discharge period is effective at improving patient outcomes. Qualitative research methods are a valuable approach to help with this as they can contextualize findings and allow us to better understand how patients engage with and are impacted by these programs.

To address this gap, we undertook the Txt2Prevent pilot study. The aim of Txt2Prevent was to test whether a one-way text messaging intervention program (Txt2Prevent) can support patients with ACS following their hospital discharge. This was a mixed-methods, assessor-blinded randomized controlled trial. This paper reports on the acceptability of, and users' experience with, the text messaging intervention program.

5.2. Methods

The justification, protocol, and description of the intervention for this study are outlined in previous chapters and have been published [182]. The study was registered at ClinicalTrials.gov [NCT02336919]. Ethics and institutional approval were obtained from the Providence Health Care Research Ethics Board and Simon Fraser University's Office of Research Ethics. In summary, 76 non-surgical patients with ACS were recruited from a tertiary care hospital in Vancouver, Canada and provided written, informed consent. Participants were randomized in a one-to-one ratio, stratified by sex, to receive either usual care or usual care plus one-way text messaging for 60 days after discharge. Messages included time-sensitive topics as well as topics addressing general healthy living, and began on a daily basis for the first 36 days and then every other day for the remainder. Some messages included websites or province-wide phone numbers for obtaining more resources. All messages were unique. Participants could use their own mobile phone or a family member's phone, provided the family member agreed. They also could specify what time of day to receive the messages. Message delivery status, as well as any incoming messages, were recorded in our delivery log system.

During follow up questionnaires at 60-days post-randomization, we asked participants two five-point Likert questions about their satisfaction with the program and if they had used any of the telephone resources provided in the text messages. After completing the questionnaires, we then invited text message participants to participate in the semi-structured phone interviews. The semi-structured interview guide is included in Appendix C. Participants were selected in order to provide representation across a range of demographics (e.g., sex, geographic location) in the text messaging group. Recruitment for interviews continued until theme saturation occurred [205]. Topics covered general impressions and specific questions about the text messaging program design and logistics (e.g., program length, message topics; Appendix 1). We also included any verbal or written feedback given by participants when they completed their follow-up questionnaires in our analysis.

We used thematic analysis to analyze the interviews [175,176]. Interviews were recorded and transcribed verbatim. The transcriptions were checked for accuracy against the audio recordings. Two members of the research team then coded the interviews using NVivo 12 [QSR International]. The primary coder (ER) coded ten interviews to develop an initial codebook using both a priori codes (based on the questions in the interview guide) and emergent codes [175]. Feedback on the program design and logistics were grouped together based on responses to the interview questions and summarized descriptively. We used both descriptive and latent codes to describe participants' engagement with the program as well as the impact the program had.

After the primary coder (ER) coded ten interviews, she revised the codebook to ensure each code was unique and clearly defined, and then recoded nine interviews. A secondary coder (KV) independently coded these nine interviews with the revised codebook. Both coders discussed their coding after completing each interview. ER and KV made iterative changes to the coding and codebook via consensus. The primary coder then coded the remaining nine interviews. All content within a code was checked to make sure it was consistent with the latest version of the codebook. The finalized codebook is included in Appendix D.

5.3. Results

Eighteen participants completed the interviews. Forty-four percent (n = 8) were male and 28% (n = 5) lived in the metropolitan area where they had received treatment for their ACS event (Table 5.1). The average interview length was 31 minutes (range 18 minutes to 45 minutes).

Table 5.1. Demographic, clinical and telephone use characteristics of interview participants.

Characteristic	N (%) or mean (SD) of interview participants
Age	60.8 (SD: 9.6)
Male	8 (44%)
Lives metropolitan area of Greater Vancouver	5 (28%)
Married	15 (83%)
Greater than high school education	12 (67%)
Income	
Less than $29,000	2 (11%)
$30,000 to $69,999	4 (22%)
$70,000 to $99,999	5 (28%)
More than $100,000	5 (28%)
Uses their mobile phone more than once per day	10 (56%)
Mobile phone owner (versus using a family member's phone)	12 (67%)
Previous cardiovascular disease	9 (50%)
Joined a cardiac rehabilitation program	5 (28%)

Abbreviations: SD = standard deviation

5.3.1. Feedback on Program Design and Logistics

Overall, people liked many aspects of the program's design regarding the topics, tone, frequency and program length.

Topics

Most participants found the following topics particularly helpful: depression and mental health, resuming sexual activity, encouraging physical activity, and encouraging social support. Participants suggested messages should include more information about diet, coping strategies, information about cardiac symptoms including differences between men and women, and heart research news. Most participants reported the topics covered information they knew from other sources, although for some it was new. Many reported that topics were in a logical order and felt appropriate according to specific points in their recovery timeline. One person suggested we encourage more physical activity earlier on. All perceived the messages' content as trustworthy.

Tone and Clarity

Participants described the texts as general and straightforward. All participants thought the messages were clear and easy to understand.

> "I thought they were clear and precise and, you know, which is what I need. I don't need three paragraphs of something." [Participant ID: 18, Female, Age 46]

Text Message Frequency

Most participants liked receiving messages once a day. A few felt every other day was better as they were too busy. Participants were divided on whether they thought the messages should switch to every other day partway through. No one wanted multiple messages a day.

Program Length

Most participants liked that the program was 60 days as they started to return to their routines at this point. Several wanted to program to be longer. No participant said it was too long.

Time of Day Delivery Preferences

Among all study participants, 25 (33%) selected a time in the morning (6am – 11am), 27 (36%) selected a time in the afternoon (12-5pm), and 23 (30%) selected a time in the evening (6pm – 9pm). Participants liked that they could specify what time of day to receive the messages and liked having a standard time as they looked forward to the message.

> The text message coming every day at the same time… I use the word 'comforting… You knew it was coming if everything else fell apart. You knew you were gonna get your text message." [Participant ID: 15, Female, Age 72]

Message Delivery

Generally, messages were successfully delivered to the participants' phone on time; however, there was a technical problem in which messages were not delivered for ten days for ten (29%) participants. Participants noticed they stopped and were disappointed the program had seemingly ended. The affected participants indicated they were happy when the messages started again. Additionally, one participant (3%) wanted to use their computer to receive text messages but reported difficulties receiving the messages. Eight text-messaging recipients (23%) used a family member's phone to receive the messages. Participants reported this worked well in all cases except one, in which the participant felt his wife did not have time to show him the messages.

5.3.2. Engagement with the Text Messages

We explored how participants engaged with the program (e.g., whether they read the messages or shared them with others) and what factors influenced their engagement (e.g., the perceived relevance of the messages).

Reading the Text Messages

Almost all interview participants read the messages on the day they received them. Some said there were times when they read a couple of days' messages at once. Eight participants (44%) said they went back to review the messages, and two more (11%) said they planned to in the future. Most kept the messages on their phone although a couple deleted them.

When participants went back to review the messages, their reasons included:

> "just to see the confirmation I'm on track, I'm not slipping" [Participant ID: 8, Male, Age 54]
>
> "if I'm really not having a good day, I actually will go through the text messages… and think 'hey, that's right'." [Participant ID: 13, Female, Age 55]

One-Way Versus Two-Way Messaging

Because the program was a one-way messaging intervention, some participants reported they wished they could have responded to the messages with a question or to connect with someone. Others did not feel this was necessary.

> "Well, I think in some ways, it would be kind of nice to be able to text back… I think that there could definitely be a purpose for that, I mean if you had a question, or something like that." [Participant ID: 12, Female, Age 66]
>
> "I don't feel much need to give you an answer as I need to answer that question for myself." [Participant ID: 18, Female, Age 46]

While participants were informed they should not respond, eight participants (22%) still responded a total of 14 times, mostly confirming they had done what was suggested, which indicates that at least some participants wanted to or were willing to engage in the text messaging program in this manner.

Sharing the Text Messages with Others

Only two participants (11%) told their doctor they were participating in this study while another one brought up something in an appointment from the text messages without referring to the study. Seven participants (39%) reported sharing their messages with their families. They perceived this had positive aspects, as it involved their family members or helped increase accountability.

> "It was good actually because my husband nagged me a couple of times about something [laughing], you know, he would say 'don't forget, this is what you have got to do'." [Participant ID: 16, Female, Age 72]

Perceived Relevance of Messages

Most participants understood the messages were going out to many patients with ACS and recognized the messages were broad and generic as a result. Generally, participants reported they did not mind this, although in some cases, this led participants to be less engaged in the program. This was often in regards to messages encouraging participants who had never smoked or quit over six months ago to remain smoke-free or about receiving multiple messages regarding depression

> "It was just kind of like 'oh, okay it's just another one on that [depression]; and then I would just almost, kind of, not look at it." [Participant ID: 8, Male, Age 54]

Additionally, other participants felt the messages were very relevant to their situation, despite knowing the messages were not tailored, which made them react positively to the program.

> "This is special to me because it was so pertinent to what I was going through…. And, I tell you that just, it kind of blew my mind in a way because I really thought you guys were talking to my doctors." [Participant ID: 12, Female, Age 66]

Resource Links

Most participants reported that they did not use the resource links (phone numbers and websites) (Table 5.2). However, they thought the resources should be included. Reasons they did not use the resources were: too busy, forgot to take their phone to their computer to access them, did not have reliable internet access or did not feel they needed them.

Table 5.2. **Number of times resource links and phone numbers were used.**

Website Resource	Total Number of Times Clicked	
Health Link BC [a]	4	
Find a Physician [b]	4	
Antidepressant Skills Workbook [c]	6	
Positive Coping Workbook [d]	5	
Quitnow.ca[e]	0	
Phone Resources	**Number of Participants Called**	**Total Number of Calls**
8-1-1	3	5
Physical Activity Line	1	1

[a] http://www.healthlinkbc.ca/
[b] https://www.cpsbc.ca/physician_search
[c] http://www.comh.ca/antidepressant-skills/adult/
[d] http://www.comh.ca/publications/resources/pub_pchc/PCHC%20Workbook.pdf
[e] http://www.quitnow.ca/

5.3.3. Impact of the Text Messaging Program

Overall Impact

Participants had mixed opinions on the overall impact of the program. Some felt they were already “on the right track” and that the program did not change their behaviours or provide new information. These individuals still thought the program was valuable to them as it was encouraging and provided a reminder of their condition. Generally, participants who had experienced a cardiac event for the first time responded more positively to the messages and reported more value in receiving them.

Others found some aspects of the program positive, but they did not change behaviours in all areas the program was targeting:

> “Most of them were really helpful, talking about how not to feel alone, and, you know, the texts like that, those were great. And you know, the ones for, make sure you eating properly, blah blah blah, you know, it makes me think. Not that I do it, but…” [Participant ID: 13, Female, Age 55]

Some other participants reported stronger positive experiences with the program.

> “It gives the patient some hope. The most important thing.” [Participant ID: 2, Male, Age 52]

> “I really appreciated getting those. They were a good support for me because it’s private and personal. You don’t have to make an

> appointment, you know, all the support people that I have, I have to make appointments with them." [Participant ID: 12, Female, Age 66]

We also identified the following sub-themes regarding the program's impact: making participants feel their recovery process was normal, feeling that they had a source of social support, reinforcing they were on the right track and reminding them of their condition.

Perceived as Social Support

For many participants, the text-messaging program felt like a source of social support. While we did not hide that the system was automated, some participants felt like someone was still available and that support was continued from the hospital.

> "And the other hand, it was, it was making me that feel somebody else out there is thinking about me. And it was, emotionally, it was very great." [Participant ID: 2, Male, Age 52]
>
> "When you're in there and you come out, you don't hear nothing. And so this is sort of better… We live out in the bush…. There's nobody around us, so it's good to get something on the telephone." [Participant ID: 4, Male, Age 68]

Normalcy

The text messages made many participants feel comforted that they were not unique—that their experiences were a normal part of the recovery process. This was most often in relation to mental health aspects such as depression or anger.

> "The encouragement to continue, to know that I'm not the only one who is struggling. I don't know if misery loves company or what, but it just helped me to know that what I was experiencing, that other people were struggling with those kind of things too." [Participant ID: 12, Female, Age 66]

Reinforcement

Many participants reported the text messages were reassuring as they reinforced that they were on the right track. Several reported reviewing the messages to confirm they were following the recommendations.

> "It gives you that little bit of positive feedback that says, 'Oh, I am doing that right, okay'." [Participant ID: 9, Female, Age 64]

A couple of participants also said the messages factored into their decision to seek further care. The messages validated their feelings that they needed further help.

> "But it re-affirmed that, you know, I'm not just being stupid about this. I have chest pain, I've had a heart attack. Deal with it or else, you know, this could go another way, so deal with it." [Participant ID: 18, Female, Age 46]

Reminder of Condition

Eight participants (44%) said the text messages reminded them they needed to stay engaged in their recovery. Simply receiving the message reminded them, even if the topic that day was not particularly relevant.

> "I think the value though of the program for me was getting daily reminders that, you know, I need to be quite on top of things generally." [Participant ID: 1, Male, Age 47]

Recommendation

Every participant except one (5%) said they would recommend the program to other cardiac patients. The participant who said they would not recommend the program qualified this by saying that it would depend on whether the person took the time to read the messages. Every participant said they would be willing to use text messaging again for health purposes.

In the follow-up questionnaires, over 93% (n=30) of participants reported they agreed or strongly agreed that they were satisfied with the program. Seventy-six percent (n = 24) felt that it helped them manage their condition (Figure 5.1).

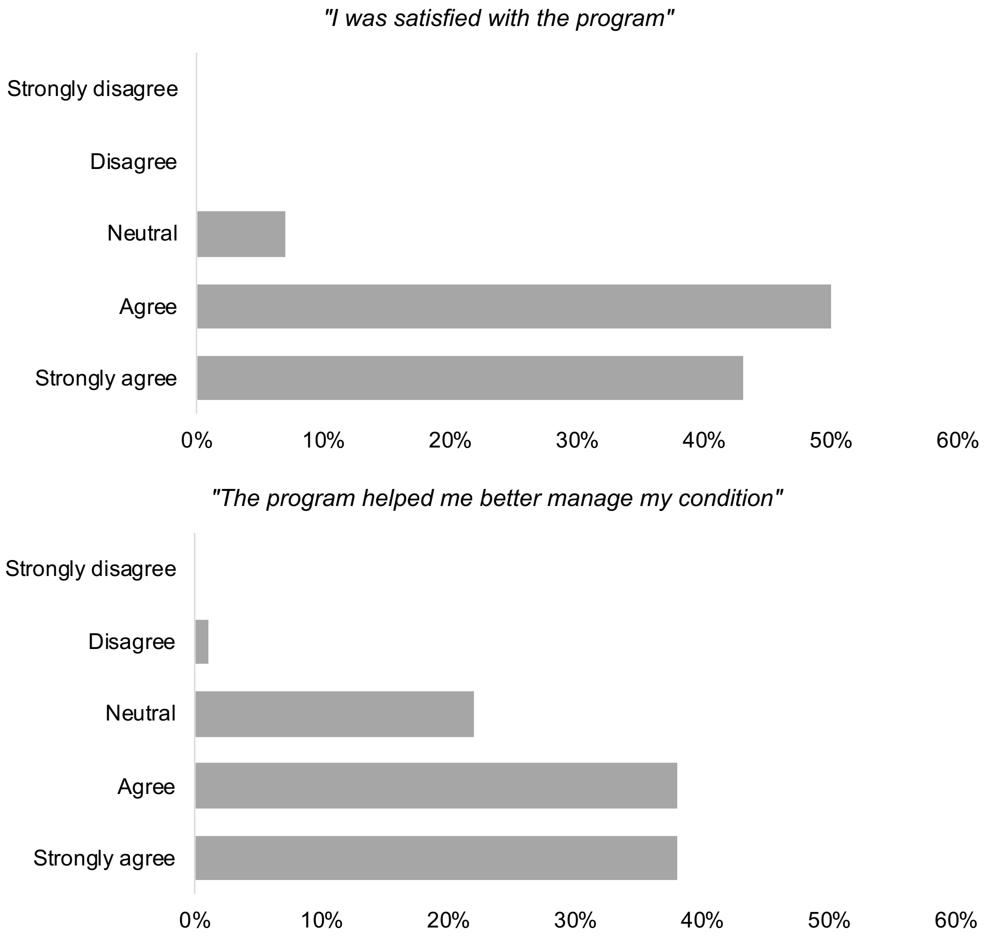

Figure 5.1. Perceived satisfaction and belief that the Txt2Prevent program helped manage their condition (n=32).

5.4. Discussion

Overall, the Txt2Prevent intervention was acceptable and participants liked many of the design elements regarding topics, tone and length. Most participants reported being engaged with the program by reading all of the messages as well as looking forward to their delivery. Participants felt that the program had several impacts, such as helping make participants feel their recovery process was normal, feeling as if they had a source of social support, reinforcing that they were on the right track and reminding them of their condition. These impacts tended to be more related to the psychosocial challenges participants experienced. However, some participants did not feel they needed the text messages, wished for a more tailored experience, and reported they did not change their behaviours as a result of the messages.

Our findings have some consistencies with two other CVD text-messaging studies—CHAT and TEXT-ME. In the CHAT study, participants reported high levels of satisfaction and engagement, and around a quarter of participants shared the messages with others [94]. In the TEXT-ME study, participants liked being able to save and share the messages, had the support of family members, felt support through the program, and found that the messages were credible and consistent with the advice they received from the hospital [206]. The TEXT-ME authors theorized that participants improved their behaviours because they were conditioned to engage in healthy behaviours when they received messages, regardless of their content [206], as it was acting as a general reminder. One difference was that participants in the TEXT-ME study liked that the messages were delivered at random times, whereas ours reported they liked receiving the messages at the same time.

While this has not yet been explored in depth with an ACS population, one benefit reported in studies using information and communication technology is the feeling of social support. Some participants with ACS reported feelings of connectedness after a 14-day pilot study of one-way text messages [207]. A hypertension text-messaging study (the StAR trial) reported participants felt cared for, which improved their motivation to perform self-management activities [208]. Similarly, a telemonitoring study in heart failure patients found participants described the system as a 'friend,' which reduced isolation [209,210]. Social isolation has been associated with a poorer prognosis in patients with CVD, so this may be an important benefit of this type of program [211]—although it has not been determined how much and what type of social support is being provided by interventions using ICT technologies.

Our study identifies that more work must be done to determine whether there may be a subgroup of patients who would benefit most from this type of program and which features are effective at changing behaviour. For example, in the StAR trial, participants who qualitatively reported the most benefit shared that they also had high stress levels [208]. Gender is also important to consider as young women recovering from an AMI tend to have higher perceived stress levels than men and find social support to be particularly important for health status outcomes [212,213]. It would be worthwhile to examine participants' experiences with technology from a gendered lens in future studies. While several of our participants reported they found the program to be beneficial, some did not report many benefits. Additionally, several participants reported that they did not change their behaviours as a result of the messages; however, we do not know if these participants were adhering to the behavioural recommendations and thus making changes may not have been advisable. Further, participants who had experienced an ACS event for the first time generally reported more positive reactions to the text messaging program.

Our study primarily provided directive information and education, but we may have seen more behaviour change if we had incorporated more theoretically-based behaviour change techniques although it is not known which techniques or combinations of techniques are effective [182,197,214]. Several telehealth programs have used different behavioural change techniques and theoretical models [196,198,215,216]; however, it is not clear yet which elements or combinations of elements are the most effective. Additionally, several previous studies across several conditions have reported that personalization was an important aspect of the program, as participants appreciated it when it was incorporated, or requested it when it was not [206,208,217–219]. Similarly, our participants reported that they were more engaged in the program when they perceived the messages applied to them. Future research could explore ways to improve personalization and specificity, such as by asking which topics participants want to receive messages about at the start of the program or asking throughout the program, via an automated algorithm, if they would like more information on a given topic.

5.4.1. Limitations

There were several limitations to this study. The interviewer, ER, was involved in recruitment and data collection, so the participants had the opportunity to develop a rapport with her. It is possible this may have influenced participants to be more positive about the program, as the role of the interviewer has previously influenced the types of responses received [220]. To mitigate this, participants were told at the beginning of the interview that there were no right or wrong answers and that all feedback was valuable. Also, as interviews occurred on average 13 days after the end of the text-messaging program (range three days to 29 days) and some participants had a hard time recalling specifics of the messages, there may have been recall bias. We also did not ask participants about their quantitative assessment of the program (e.g., whether their questionnaire scores improved or decreased), which may have provided more context to their experiences although could have biased the interviewer. We did not collect information about participants’ ethnicities or ask about cultural appropriateness, so we cannot assess how participants’ experiences differed based on their ethnicity and cultural background. We interviewed half of the text messaging recipients and heard many repeating topics and themes, but we likely did not capture all perspectives and experiences, especially as many of our interview participants had high education and income levels.

5.4.2. Conclusion

The Txt2Prevent program was well-received by and acceptable to most participants. In particular, many participants reported psychosocial benefits such as being made to feel normal, perceiving the program as a source of support, and getting reinforcements and reminders about their condition. The feedback received in this study may be helpful to those who are intending to design similar programs. We recommend that future studies assess whether incorporating more personalization and behaviour change techniques results in a more effective program.

Chapter 6.

Discussion

6.1. Overview of Objectives and Main Findings

In this chapter, I summarize the thesis' objectives and main findings, address the implications of the research, including considerations for proceeding to a larger trial of the Txt2Prevent study, recognize limitations, and highlight areas where more research is needed in order to better incorporate information and communication technology (ICT) when supporting patients.

The overall goal of this work was to explore the potential for ICT to support patients with CVD. There were two primary aims: (1) to determine access to and willingness to use technology for health-related information in patients with CVD (Chapter 2); and (2) to develop and pilot test a text-messaging intervention that supports patients with ACS following discharge (Chapters 3, 4, 5).

6.1.1. Aim 1

Aim 1 was covered in Chapter 2. The main objectives of this chapter were to: 1) describe access to and use of ICT in patients with CVD, 2) describe patients' use of and interest to use ICT for health information, and 3) identify factors associated with patients' interest. The objectives were assessed through a cross-sectional survey with 169 participants. The main findings from Chapter 2 were:

- ICT ownership is common as 98% of participants owned at least one ICT device. Computers (88%), landline phones (86%), and mobile phones (83%) were the most owned device. Phone voicemails (96%), Internet (89%), and email (88%) were the most used ICT methods.
- Computers were the most used device to access health information (74% of computer owners) and the device with the most interest for using for health information (72% of computer owners). Email was the most used ICT method for health purposes (45% of email users) and the method with the most interest in using for health purposes (75% of email users).

- Among device owners, participants with lower incomes and education levels were less interested in receiving health information on at least one of their devices.

6.1.2. Aim 2

Aim 2 was covered in Chapters 3, 4, 5. Chapter 3 outlined the intervention development and research protocol of the Txt2Prevent pilot study. Chapter 4 reported on questionnaire outcomes and aspects of the Txt2Prevent program's feasibility and acceptability. Chapter 5 used data from semi-structured interviews to explore user's experiences with the Txt2Prevent program and the program's acceptability.

The highlights from Chapter 3 were:

- The Txt2Prevent pilot study was a mixed-methods, assessor-blinded randomized controlled trial with a parallel group design. The study aimed to evaluate a 60-day one-way text-messaging intervention program (Txt2Prevent) in 76 patients with ACS after hospital discharge.
- The study objectives were: (1) to compare self-management domains between usual care and usual care plus Txt2Prevent; (2) to compare medication adherence, health-related quality of life, self-efficacy, and healthcare resource use between usual care and usual care plus Txt2Prevent; (3) to assess the acceptability of the text-messaging intervention program for participants and the feasibility of the study protocol.
- An advisory committee that included researchers, five clinicians and two people with lived experience guided the design of the program.
- Two focus groups (n=7) assessed the initial appropriateness and acceptability of the messages. After incorporating their revisions, the patient members of the advisory committee pilot-tested the 48 text messages by receiving them for 60 days.

The highlights from Chapter 4 were:

- There were no statistically significant differences for the self-management domains between the intervention and usual care groups in exploratory analyses.
- There were no statistically significant differences in adjusted analyses for medication adherence, health-related quality of life, self-efficacy, and healthcare resource use between the intervention and usual care groups except for one self-efficacy domain ('Total Plus'), which was impacted by an influential outlier.

- The study protocol was feasible, except that recruitment took 11 months longer than expected. The randomization, delivery and follow-up protocols generally worked well. Potential improvements were identified.
- The acceptability of the program was high. Ninety-three percent of participants (n=30) reported they were satisfied with the program, and seventy-six percent (n=24) reported it helped them manage their condition. In interviews, all but one participant said they would recommend the program, and all were willing to use text-messaging for health purposes again.

The highlights from Chapter 5 were:

- Participants liked many elements regarding the topics, tone, frequency and program length.
- Participants reported being engaged by reading all of the messages as well as looking forward to their delivery. Almost half reported they went back to review the messages. Five participants mentioned they felt less interested when they received a message that was perceived to be too generic or not relevant. These comments were often about the message to remain smoke-free or about receiving multiple messages regarding depression.
- Perceptions of the program's impacts included making participants feel their recovery process was normal, feeling as if they had a source of social support, reinforcing that they were on the right track and reminding them of their condition.
- Some participants did not feel they needed the text messages, wished for a more tailored experience, and some reported that they did not change their behaviours as a result of the messages.

6.2. Implications of Findings

The cross-sectional survey as well as the Txt2Prevent study indicate that technology, including text-messaging, can be acceptable to patients with CVD. Therefore, it is worthwhile to continue to explore how to best use technology to support patients.

The Txt2Prevent program had high engagement and acceptability and many aspects of the study protocol were feasible. Learnings about the study protocol and intervention design should be incorporated before proceeding to a larger trial.

6.2.1. Study Protocol Learnings

The main learnings regarding the study protocol are:

- **Study outcomes:** Our outcomes were chosen based on their practicality to measure, potential to change over 60-days, and potential importance to patients' experiences and outcomes. It is worthwhile to consider whether we used the appropriate outcomes. For example, our questionnaires may not have captured the perceived social support identified in the semi-structured interviews. Other trials frequently used other outcomes, including objective clinical measures such as blood pressure and cholesterol or specific health behaviours. Measuring cardiac knowledge could also have provided more detailed information on program effects or potential pathways. When selecting outcomes, it is important to balance the assessment burden on participants, and the intervention design should have plausible mechanisms to impact the outcomes.

- **Recruitment:** Recruitment was a challenge throughout the study period. Our recruitment processes improved as the study progressed, but even so, we would not have met our initial targets. One of the main barriers was the recruitment system required by our ethics boards. We had to rely on clinical nurse leaders, bedside nurses, and/or cardiology fellows to identify and approach all potential participants, which meant we missed potential participants if the clinical staff were too busy to assist us. Hiring a clinical nurse as a research assistant could bypass the barriers posed by recruiting as an external researcher. Additionally, undertaking a multi-site study would increase the number of potentially eligible patients. Expansion sites could include other hospitals with cardiac catheterization labs, which include Vancouver General Hospital in Vancouver, Royal Jubilee Hospital in Victoria, and Kelowna General Hospital in Kelowna, or community hospitals that admit patients with ACS.

- **Follow-up processes:** Due to having two different follow-up procedures (primarily via phone for the healthcare resource use questionnaire and primarily via mail for the remaining questionnaires), we had several participants who completed one or the other, but not both. An online version was available but needed to be requested by the participant. It would be worth exploring whether an all-online option would be suitable, particularly for the healthcare resource use questionnaire.

- **Delivery system:** The delivery system we used, Twilio, generally worked well but had some challenges because it was an American-based company. Although this was felt to be a better choice at the time, privacy issues concerned some participants and would also increase the difficulty in implementing the system. A previous text-messaging project that was implemented at St. Paul's Hospital used a Canadian company called QCare, which could be explored.

6.2.2. Intervention Design Learnings

As we do not have evidence that the Txt2Prevent program changed participants' behaviours, the design of the program may need to be modified. Using both our findings and other text-messaging literature, the following aspects should be considered when revising the Txt2Prevent program.

Theoretical Basis

Theories can explicitly lay out the hypothesized pathway for behaviour change. Theories can be used in several ways, including identifying and targeting antecedents of behaviour change [221], choosing appropriate behaviour change techniques [222], identifying who to include in the study [215], and tailoring the intervention. A review of studies using technology for CVD prevention and treatment reported around half explicitly used a theory [198], with this being less in text-messaging studies [223,224]. Piette et al. in their summary of mobile tools for CVD prevention and management highlighted the need to determine the most effective behavioural theories in technology-based CVD studies [225]. The most frequently used theories in digital health and text-messaging studies include Social Cognitive Theory, Transtheoretical Model, Theory of Planned Behaviour/Theory of Reasoned Action, Health Belief Model, and the information-motivation-behavioural skills model [198,223,224]. CVD text-messaging studies have also used control theory, operant conditioning, and the common sense model [214].

Previous research is not clear on how to best incorporate theory into text-messaging programs. Meta-analyses have reported that explicit use of a theory is not related to significantly better effect sizes [193,226]. On the other hand, meta-analyses of both mobile phone interventions and internet-based interventions have reported greater effect sizes when a theory was used [215,227]. In text-messaging studies, there is too much heterogeneity currently to state which theories are most effective. Some argue that the commonly used theories are too static, particularly for the dynamic, adaptive, “just-in-time” potential of health technologies [228] and that we also need to consider the non-coercive persuasive potential of technology [229–231]. Some theoretical concepts may be difficult to operationalize in one-way, automated text messaging interventions. However, text-messaging may also naturally have some implicit constructs, such as cues to action, reinforcement, and social support and can act as a trigger [88,232]. Regardless of whether one uses a ‘branded’ theory, it is likely beneficial to clearly state the hypothesized mechanistic pathway and to both target and measure constructs along this pathway.

The Txt2Prevent study did not use a ‘branded theory’ and primarily used education-based messaging as well as prompts or cues to action to complete guideline-informed follow-up care. Future iterations could include more explicit theory in the design and/or incorporate the Behaviour Change Wheel developed by Michie et al. [233].

Behaviour Change Techniques

Behaviour change techniques are proposed to be the ‘active ingredients’ of behavioural change interventions [197]. Michie et al., who created a taxonomy of techniques and their definitions, define them as “an observable, replicable, and irreducible component of an intervention designed to alter or redirect causal processes that regulate behaviour” [197]. Behaviour change techniques can be valuable both when designing the intervention, including linking behaviour change techniques with the intervention’s theoretical framework [198,234], as well as when analyzing which techniques or combinations of techniques have worked in previous interventions. Previous CVD text-messaging studies have used between 2-17 different behaviour change techniques per intervention, with the most common being general encouragement, information about the behaviour-health link, information on consequences, time management advice, and goal setting [214]. However, it is not possible at this point to determine which were the most effective since there are only a few studies.

The Txt2Prevent program did not explicitly use behaviour change techniques in the program planning stages, although the messages contain elements of the following techniques: information about health consequences, instructions on how to perform a behaviour, goal setting, social support, and prompts/cues. Prompts may be effective at promoting health behaviours [235,236], although they may be more effective when they include feedback and provide specific strategies for behaviour change instead of only education [236]. Future variations of the intervention could match behaviour change techniques to the chosen theoretical framework.

Tailoring

Tailoring aims to personalize interventions to individuals’ characteristics. Tailoring is believed to increase relevance [237], which in turn increases user engagement and receptivity [238]. Interventions can be tailored on aspects such as content, design features like frequency, behaviour change theory (e.g., staging a participant's place in a behaviour change process as in of the Transtheoretical model), and message framing. Tailoring is possible to do through a computerized process where a computer algorithm selects messages from a message bank based on individuals' characteristics [238]. In some text-messaging studies, tailoring has improved retention rates and outcomes [193,239] although not all systematic reviews have reported improved outcomes for tailored interventions [226,240]. In addition, a drawback is that it tends to increase development costs [241].

The Txt2Prevent program only tailored information based on whether the participant smoked cigarettes. The only personalization was at the beginning of the study when the participant could choose the time of day to receive the messages. Given that some participants indicated the generic nature made them feel less engaged, it is likely worthwhile to explore personalization and tailoring options. Potential options for tailoring include providing feedback on behaviours and asking participants which topics they wish to receive information on (both at the beginning of the intervention as well as throughout). Aspects of the program could also be personalized, such as including their preferred name at the start of the message, using their specific medication prescriptions, providing specific resources available within their community (e.g., cardiac rehabilitation programs), and targeting dietary advice to their preferences. The messages could also be translated into other languages. This would require additional work assessing the cultural context as well as common beliefs, behaviours, and values of the target group [242].

Two-Way Messaging

Two-way or bi-directional messaging can be implemented in various formats. For example, patients can acknowledge message receipt, deliver self-monitoring data, set-up reminders, request further information, or communicate with a healthcare provider. Responses can be delivered via algorithms or machine learning [243], while some require a human to respond. Evidence is mixed on whether two-way messaging improves outcomes. Several systematic reviews and meta-analyses reported that one-way messaging has similar effects to two-way messaging or that results were not sensitive to this feature [193,195,224,226,240,244]. Others have reported though that one-way messaging had larger effect sizes [194] while some report that two-way appears to be better [223,245,246]. At this point, there is not enough evidence to strongly recommend two-way messages over one-way messaging unless there is a clear rationale for how it supports other design choices, such as tailoring, or supports the intervention's theoretical framework. Two-way messaging can also increase the cost, complexity, and potential risk of the program.

Our participants had mixed opinions on one-way messaging. Many reported they were satisfied with the push-style of messages. They preferred to speak with their physician, could look up resources on their own, or would have found it too time-consuming to text back. Others reported they wanted to text back to ask a question, get more information, or wished to report how they are doing. Eight participants responded to the messages, despite being informed it was one-way only, which indicates there is some interest in responding. It may be possible to have a simple two-way system where the participant could confirm they completed a task or request more information about a topic, which would result in an automated text response with further resources.

Tone

Previous research has studied directive wording compared to wording that helped participants develop their own motivations and goals. Participants with preferences for autonomy had better outcomes if they could phrase their own goals [247]; however, not all participants had these preferences. Another study reported participants lost more weight when given directive support [248]. In a study evaluating preferences for message styles, participants generally preferred directive over passive messaging, particularly those of lower educational levels, but did not want commands for immediate action [249]. The Txt2Prevent messages used a formal, informational, and directive tone. All participants in the semi-structured interviews liked the tone of the messages. It may be worth exploring alternative tones if implementing tailoring and/or bi-directional messaging; otherwise, the directive tone was generally well-received by participants.

Frequency

The frequency that messages are delivered is also an important design consideration. As with other design factors, the findings from systematic reviews and meta-analyses are mixed. One systematic review reported that message frequency that decreased overtime or was individualized had the highest effect sizes [193]. Others reported that messaging frequency did not appear to impact findings [195,236], higher frequency was better [240], at least every three days was associated with an effect [107], or that less than daily was better [246]. Many studies have not specifically compared different frequencies within the same study. One that did explore this found no difference between the two groups [199]. If using frequent messages, it is important to ensure the messages do not come across as monotonous or repetitive, which can be perceived as nagging [219]. As many of our participants liked daily messages, especially at the beginning, I would recommend remaining with that frequency for the beginning and decreasing the frequency as participants start to return to “normal” or providing the option for individualization [219]. More frequent messages may overwhelm patients, potentially leading to reduced engagement.

Intervention Design Learnings Summary

In summary, there are several design considerations, particularly around the theoretical framework, behaviour change techniques, and tailoring, that could be modified in a future text-messaging program. The Txt2Prevent program covered multiple domains instead of focusing on a single behaviour such as medication adherence. It will be necessary to consider whether the program wishes to remain broad to address patients’ many potential needs or to specifically target one element of recovery given that it can be more difficult to design an intervention that addresses multiple needs [215]. Design modifications should also consider contextual factors for implementation. For example, if the design change requires staff time, but there is no available time or budget, this is likely a poor design choice. Continued engagement with patients and hospital stakeholders will be important, especially to increase implementation and dissemination potential.

6.2.3. Suitability of SMS versus Other ICT

While the Txt2Prevent study specifically evaluated text messages, it is important to consider how text messages fit into the broader landscape of ICT for health purposes, given there was also interest in other devices and methods according to the survey we conducted. Text messages have several advantages. As phones are already part of many people’s habits and routines, they may have better uptake than interventions requiring additional devices such as wearables [250]. Marketers report over 80% of people keep their notifications on for text messages [251] and approximately 90% of text messages are read within the first three minutes [87], potentially because text messages are perceived as dual-communication. They also work on all operating systems and do not require as much maintenance. In a pilot smoking cessation program, fewer participants read emails compared to text messages, especially after four weeks [252]. Text-messaging may not be as helpful if the information needs to be referenced later, or the content requires more than 160 characters. Additionally, despite the advantages, text messages may not appeal to everyone. Participants in our survey were less interested in using text messages compared to emails and apps although we do not have further contextual details about this finding.

Apps and websites have potential [253–255], but they also have some limitations. Many design considerations are required for websites and apps, particularly if targeting older adults, while text messages have relatively fewer aspects to consider [256,257]. Factors such as interface, navigation, notification, data collection, goal management, depth of knowledge, and actionable recommendations are important aspects that influence whether users continue to engage with apps [258]. Additionally, attrition can be a problem [253,259], while text-messaging studies have generally had better retention [260]. It may be possible to combat the attrition issue by using characteristics to increase engagement, such as interactivity, tailoring, and content matching [259,261]. There is a benefit to mobile interventions in that they can act as a "just-in-time" intervention and can support patients in real-world settings in real-time. This feature has been used particularly in the area of smoking cessation [262], but it could be explored in CVD research. Multiple complementary technologies may be helpful [194,215,223,226,227] although some report that websites are underutilized or are not associated with increased effect sizes [107,193].

6.3. Limitations

In addition to the limitations explored within each chapter, there are further limitations to consider. The survey regarding technology preferences was completed in 2014, so ownership and preferences may have changed. On a population level in the United States, computer use has remained fairly stable over time while internet, tablet, smartphone, and cellphone use has increased [78,263], even among older people [264].

There have been no indications that interest in using technology for health purposes has decreased [265,266], meaning that any changes to our findings would likely be increased ownership and interest.

It is also important to consider the external validity of the studies. It is possible that participants in the technology survey were more interested in technology than non-participants, although we stressed that all participants were welcome. The Txt2Prevent program also required that participants had access to a mobile phone. Twelve percent of patients assessed for eligibility were excluded due to not having a mobile phone. While both of the studies were around 70-75% male participants, this is similar to the male/female ratio on the hospital's cardiac wards. Additionally, the two studies were limited to English speaking populations. In Metro Vancouver, 93% of residents can speak English [143], meaning that an English-based program may be widely accessible; however, it is worth noting that 26% of the population speaks another language at home [143]. The most common non-English mother-tongue languages are Cantonese, Mandarin, Punjabi, Tagalog and Korean [143]. We did not assess whether the program was appropriate for different cultures and ethnic backgrounds.

For the Txt2prevent pilot study, we did not set criteria for success a priori to determine whether the study should proceed to a larger trial, which is recommended by some [267]. We did measure several feasibility indicators descriptively and commented on which elements worked well and which did not. The pilot study sample size was determined based on perceived feasibility, not a power calculation. This makes it difficult to draw conclusions about the effectiveness of the intervention. These analyses were considered exploratory and results were complemented with qualitative findings.

Another limitation is regarding the challenges associated with obtaining feedback and measuring preferences and satisfaction. User feedback can be in tension with previous research about what works [268], so it is necessary to balance feedback with previous evidence. With the technology survey, participants indicated their preferences and willingness, but it is difficult to know how this would play out in practice, particularly as our questionnaire was quite general and broad. Satisfaction, such as in the case of the Txt2Prevent program, can also be difficult to measure, in part due to social desirability bias, reluctance to express a negative opinion, and lack of clarity around the concept of satisfaction itself [269]. However, in addition to the questionnaires regarding satisfaction, we also included follow-up interviews, which gave more context.

6.4. Future Research

The work in this thesis highlights that more research is required to understand how to design effective interventions, who to target with these interventions, and whether the interventions are cost-effective.

6.4.1. Effective Design Features and Alternative Research Designs

It remains unclear which design features are associated with effective interventions. Many programs use different components, making it difficult to compare studies. There is concern that many pilot studies are testing their own “black box” [270]. Some researchers have pushed to use more methods than just individual randomized controlled trials. Efficient learning may occur in smaller, formative studies about intervention components’ effects on proximal outcomes. This can be done in factorial experiments or micro-randomized trials. Other options include the Multiphase Optimization Strategy (MOST) and Sequential Multiple Assignment Randomized Trial (SMART). MOST aims to determine which interventional components are effective before moving onto a standard RCT [271,272]. The SMART approach is designed for programs that adapt over time and aims to answer questions about how to best sequentially deliver components as well as which aspects to tailor on [271]. It is also worth considering that because technologies change over time and technologies often need to be fixed or improved post-launch [273], it may be more useful to think of studies as “trials of intervention principles” instead of testing a specific technology [273]. This approach requires one to think through the theoretical components (i.e., the aims and strategies) versus the technical implementation (elements, characteristics, workflows). While the technology is important, clarifying the underlying principles may improve crossover between work. We still do not know how to best design text-messaging interventions for chronic disease prevention and management, despite the first study being published in 2005 [232], so it may be worthwhile to step back and focus on the basic underlying principles.

6.4.2. Target Populations

Another question is to determine who benefits the most from these interventions. Factors may include gender or health literacy as well as other cognitive and psychological factors [274,275]. Currently, many ICT studies do not perform nor are powered for sex and/or gender analyses [276]. An approach called Signal Detection Methodology has been proposed to identify subgroups who benefit more from an intervention, as it can incorporate higher-order interactions than a standard interaction analysis [277]. However, at this point, there is little research about who benefits the most from technological interventions, and they may be targeting the 'worried well'.

There is also the concern of a 'digital divide', and that programs increase existing differences in care. Equity is important to consider, especially as we found that income and education were linked with less interest in using technology for health purposes. Associations of technology use with gender and sex has been inconsistent with some finding females are more likely to use health apps and others finding no differences between males and females [278,279]. Age and physical limitations and disabilities are additional factors identified by others [280,281]. Importantly though, baby-boomers are using technologies for health on similar levels as younger adults [280]. As baby-boomers are reaching the age where they are at higher risk for CVD, it is likely they will continue to use technology. Additionally, many older adults are willing to engage in technology [256], especially if perceived to be useful. In the Txt2Prevent study, the mean age was 60 years old (SD 9.5). We had five participants who were over 80 years old meaning that the technology can also be used with older adults.

Race and ethnicity are other common equity concerns [282]. There can be differences among technology ownership, with Chinese, African-American, and Hispanic speaking participants being more likely to use smartphones, in part due to not owning other computing devices [283,284]. We are unaware of research assessing whether willingness to use technology for health purposes varies by ethnicity in a Canadian population. However, there has been demonstrated willingness to use technology for health purposes in various ethnic backgrounds [130,285,286], including in the Australian TEXT-ME study where 35% of study participants were of non-European descent [93]. Overall, when developing a technology-based intervention in any context, formative or co-design work with the target community is important to help ensure that the program is appropriate for the health literacy levels, cultural beliefs, motivations, language, and contextual and environmental realities of participants [287,288]. This may require providing tailored options for participants' depending on the scale and reach of the project.

6.4.3. Cost-Effectiveness

Another area that needs more research is the cost-effectiveness of technological interventions. A systematic review of mobile health economic evaluations determined that 75% (n=29) of studies concluded that the mobile health intervention was cost-effective, economically beneficial, or cost-saving—with many of these being behaviour-change, community-type interventions being delivered by text message [289]. A systematic review of the cost-effectiveness of digital health interventions for CVD (including one text-messaging study) reported all studies were cost-effective (either saving costs or increasing quality-adjusted life years at an acceptable cost) [290]. The TEXT-ME study determined that the text-messaging program led to both better health outcomes as well as cost-savings and would be cost-effective by one year [119]. Therefore, there is promising evidence regarding the cost-effectiveness of interventions, but as it is a fairly new area it will be important to monitor this as the field progresses.

6.5. Conclusion and Final Thoughts

The work in this thesis provides both an overview of CVD patient preferences for technology use and an example and evaluation of a novel pilot project. As many surveys examining technology ownership and use are at the general population level, it is important to have information specific to the target population, especially as the CVD demographic tends to include older patients. The technology survey can be a resource to others as they design their interventions. Additionally, the Txt2Prevent study indicates that patients are open to text-messaging technology. It also highlights that patients are both wanting and willing to engage in a program that supports them in their transition period after hospital discharge, suggesting this period remains a time when patients need support. The mixed-methods approach provides insight into participants' experiences, something which has not been explored in great detail in CVD mobile studies [223]. Our qualitative findings are both important in understanding our results, but also for others designing future programs. Overall, there is potential for low-cost ICT to assist patients with CVD in managing their condition; however, more work must be done to develop effective and appropriate interventions. It will be important to view technology as a complementary tool, instead of a panacea.

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Appendix A.

Information and Communication Technology Use Survey Data Collection Form

PART 1: INFORMATION AND COMMUNICATION TECHNOLOGY USE

1. Do you have any of the following devices at home (mark all that apply)?

- ☐ Desktop computer
- ☐ Laptop computer
- ☐ Tablet (e.g iPad, Samsung Galaxy tablet [ipod touch included])
- ☐ Landline phone
- ☐ Cell phone (not a smart phone)
- ☐ Smart phone (e.g. iPhone, BlackBerry, Android phone)
- ☐ Smart TV (a TV that has wireless (internet) capabilities)
- ☐ Gaming consoles (e.g. Wii, Playstation)

2. How frequently do you use the following devices?

Device	**Daily**	**> 1x a week**	**Once a week**	**Once a month**	**Never**	**N/A**
Desktop computer	☐	☐	☐	☐	☐	☐
Laptop computer	☐	☐	☐	☐	☐	☐
Tablet	☐	☐	☐	☐	☐	☐
Landline phone	☐	☐	☐	☐	☐	☐
Cell phone (not a smart phone)	☐	☐	☐	☐	☐	☐
Smart phone	☐	☐	☐	☐	☐	☐
Smart TV	☐	☐	☐	☐	☐	☐
Gaming consoles	☐	☐	☐	☐	☐	☐

3. What time of day do you typically usually use the following devices (mark all that apply)?

Device	**Morning**	**Afternoon**	**Evening**	**Night time**	**No regular time**	**N/A**
Desktop computer	☐	☐	☐	☐	☐	☐
Laptop computer	☐	☐	☐	☐	☐	☐
Tablet	☐	☐	☐	☐	☐	☐
Landline phone	☐	☐	☐	☐	☐	☐
Cell phone (not a smart phone)	☐	☐	☐	☐	☐	☐
Smart phone	☐	☐	☐	☐	☐	☐
Smart TV	☐	☐	☐	☐	☐	☐
Gaming consoles	☐	☐	☐	☐	☐	☐

4. On which of the following devices can you access the Internet (mark all that apply)?

Device	**Yes**	**No**	**Don’t know**	**N/A**
Desktop computer	☐	☐	☐	☐
Laptop computer	☐	☐	☐	☐
Tablet	☐	☐	☐	☐
Cell phone (not a smart phone)	☐	☐	☐	☐
Smart phone	☐	☐	☐	☐
Smart TV	☐	☐	☐	☐
Gaming consoles	☐	☐	☐	☐

5. How frequently do you use the following devices to access the internet?

Device	**Daily**	**> 1x a week**	**Once a week**	**Once a month**	**Never**	**N/A**
Desktop computer	☐	☐	☐	☐	☐	☐
Laptop computer	☐	☐	☐	☐	☐	☐
Tablet	☐	☐	☐	☐	☐	☐
Cell phone (not a smart phone)	☐	☐	☐	☐	☐	☐
Smart phone	☐	☐	☐	☐	☐	☐
Smart TV	☐	☐	☐	☐	☐	☐
Gaming consoles	☐	☐	☐	☐	☐	☐

6. How is your household computer connected to the Internet (mark all that apply)?

- ☐ Telephone line connected to a computer
- ☐ Cable line connected to a computer
- ☐ Connected through television
- ☐ Wireless
- ☐ Other ______________________
- ☐ Don’t know
- ☐ N/A

7. Is your household Internet connection a “High Speed” connection?

- ☐ Yes
- ☐ No
- ☐ Don’t know
- ☐ N/A

8. Do you have an email account?

- ☐ Yes
- ☐ No

9. If you have an email account, how frequently do you use it?

- ☐ Daily
- ☐ More than once a week
- ☐ Once a week
- ☐ Once a month
- ☐ Never
- ☐ N/A

10. If you have a landline phone cell phone, or a smart phone, do you have voicemail or an answering machine?

Device	**Yes**	**No**	**Don’t know**	**N/A**
Landline phone	☐	☐	☐	☐
Cell phone	☐	☐	☐	☐
Smart phone	☐	☐	☐	☐

11. If you have a cell phone, smart phone, or tablet, can you send and receive text messages?

- ☐ Yes
- ☐ No
- ☐ Don’t know
- ☐ N/A

12. If you can send and receive text messages, how frequently do you do so?

- ☐ Daily
- ☐ More than once a week
- ☐ Once a week
- ☐ Once a month
- ☐ Never
- ☐ N/A

13. If you have a smart phone or tablet, do you use applications (“apps”)?

- ☐ Yes
- ☐ No
- ☐ N/A

14. If you use applications, how frequently do you do so?

- ☐ Daily
- ☐ More than once a week
- ☐ Once a week
- ☐ Once a month
- ☐ Never
- ☐ N/A

15. If you do not have an information or communication technology device, why don't you have one? (select all that apply) *(Note to RA: do not read aloud first)*

- ☐ Too busy/don't have time
- ☐ Other family members use their devices for me
- ☐ Concerned about security, confidentiality or privacy
- ☐ My health conditions (e.g., poor health, poor eyesight, arthritis)
- ☐ Financial limitations
- ☐ No/limited technical support available
- ☐ Other____

16. For the devices that you use, do you require help/support using any of them?

Device	**Yes**	**No**	**N/A**
Desktop computer	☐	☐	☐
Laptop computer	☐	☐	☐
Tablet	☐	☐	☐
Landline phone	☐	☐	☐
Cell phone (not a smart phone)	☐	☐	☐
Smart phone	☐	☐	☐
Smart TV	☐	☐	☐
Gaming consoles	☐	☐	☐

17. Which of the following devices do you use to access or receive health-related information (mark all that apply)?

- ☐ Desktop computer
- ☐ Laptop computer
- ☐ Tablet
- ☐ Landline phone
- ☐ Cell phone
- ☐ Smart phone
- ☐ Smart TV
- ☐ Gaming consoles
- ☐ I do not use any of them

18. Which is your preferred device to access or receive health-related information (mark all that apply)? *(Note to RA: Do not read aloud first)*

- ☐ Desktop computer
- ☐ Laptop computer
- ☐ Tablet
- ☐ Landline phone
- ☐ Cell phone
- ☐ Smart phone
- ☐ Smart TV
- ☐ Gaming consoles
- ☐ I do not wish to receive health-related information this way

19. If you do not access or receive health-related information with your device now, would you be willing to receive this type of information on a communication or an information device in the future?

- ☐ Yes
- ☐ No

20. If you selected ‘Yes’ to question 19, which device would prefer to use when accessing or receiving health-related information (mark all that apply)?

- ☐ Desktop computer
- ☐ Laptop computer
- ☐ Tablet
- ☐ Landline phone
- ☐ Cell phone
- ☐ Smart phone
- ☐ Smart TV
- ☐ Gaming consoles
- ☐ Other: ____________________

21. Do you use any of the following methods to access or receive-health related information?

Method	**Yes**	**No**	**N/A**
Email	☐	☐	☐
Voice telephone calls or messages	☐	☐	☐
Text messaging	☐	☐	☐
Applications (“apps”)	☐	☐	☐

22. Which is your preferred method to access or receive health-related information (mark all that apply)? *(Note to RA: Do not read aloud first)*

- ☐ Email
- ☐ Voice telephone calls or messages
- ☐ Text messaging
- ☐ Applications (“apps”)
- ☐ I don’t wish to receive health-information this way

23. If you do not access or receive health-related information with these methods, would you be willing to receive this type of information with at least one of these methods in the future?

- ☐ Yes
- ☐ No

24. If you selected ‘Yes’ to question 23, which method would prefer to use when accessing or receiving health-related information (mark all that apply)?

- ☐ Email
- ☐ Voice telephone calls or messages
- ☐ Text messaging
- ☐ Applications (“apps”)

Notes:

PART 3: ABOUT YOU (DEMOGRAPHICS)

1. Sex:

☐ Male ☐ Female

2. What city or town do you live in?

____

3. What is your current marital status?

- ☐ Single
- ☐ Married/Common Law
- ☐ Divorced
- ☐ Widowed
- ☐ Other _______________

4. What is your highest level of education?

- ☐ less than high school
- ☐ high school graduate (or equivalent)
- ☐ some post-secondary education
- ☐ post-secondary degree or diploma
- ☐ post graduate education
- ☐ other _____________________

5. What is your current employment status?

- ☐ full-time work
- ☐ full-time homemaker
- ☐ part-time/casual ___________
- ☐ unemployed
- ☐ disability pension
- ☐ retired
- ☐ other _______________

6. What is your total pre-tax ***household*** income (***show patient income cards***)?

- ☐ Less than $20 000
- ☐ $20 000 to $29,999
- ☐ $30 000 to $39,999
- ☐ $40 000 to $49,999
- ☐ $50 000 to $59,999
- ☐ $60 000 or more
- ☐ Refused: ________________

PART 4: MEDICAL HISTORY (* OBTAIN FROM MEDICAL CHART)

1. Reason for admission **(MARK ALL THAT APPLY)**
   - ☐ Myocardial Infarction
   - ☐ CABG
   - ☐ Heart failure
   - ☐ Angioplasty
   - ☐ Arrhythmia
   - ☐ Other cardiac surgery (specify):________________________
   - ☐ Unstable angina
   - ☐ Diagnostic testing (various)
   - ☐ Other_____________________________

2. Co-morbidities **(MARK ALL THAT APPLY)**
   - ☐ Hypertension
   - ☐ Diabetes
   - ☐ COPD/other respiratory disease
   - ☐ Renal Insufficiency
   - ☐ Arthritis
   - ☐ Cancer
   - ☐ Gastrointestinal (GI) disease
   - ☐ Other_______________

3. Previous events and year(s) **(MARK ALL THAT APPLY)**
   - ☐ Myocardial Infarction ___________
   - ☐ CABG ____________
   - ☐ Heart failure ___________
   - ☐ Angioplasty ____________
   - ☐ Arrhythmia _____________
   - ☐ Other heart surgery ________________
   - ☐ Other cardiac events _____________________________

4. Medications
   - ☐ Lipid-lowering drugs
   - ☐ Beta blockers
   - ☐ ACE Inhibitors
   - ☐ ASA
   - ☐ Hypoglycaemic (oral or injectable)
   - ☐ Nitrates
   - ☐ Diuretics
   - ☐ Cardiac Glycosides
   - ☐ Angiotension II Receptor Antagonists
   - ☐ Ca+ blocker
   - ☐ Anti-arrhythmic agent
   - ☐ Other____________

5. Smoking Status ☐ Never ☐ Former ☐ Current	6. Age: ___________________
7. Procedures:	

CHECK LIST OF PROCEDURES

- ☐ Information Brochure presented
- ☐ Informed Consent Form obtained
- ☐ Data from the Medical health record obtained

Interviewed by: ____

Appendix B.

Txt2Prevent Study Text Messages

Table B1. Text messages used in the Txt2Prevent program.

Day	Topic	Message
1	Prescription Reminder	Fill your hospital medication prescriptions as soon as possible. Make sure you know how and when to take all your medications.
2	Appointment with Family Physician Reminder	Make an appointment to see your family doctor within 2 weeks of leaving the hospital. If you need a doctor, try the tool at: http://bit.ly/findaMD
3	Physical Activity – Symptoms	If you have chest pain, stop & rest. Take nitro spray if your doctor prescribed it. Call 911 if symptoms are still there in 5 minutes.
4	Physical Activity	In the early stages of recovery, take rests and try to avoid things like lifting heavy objects.
5	Help	You can call or access Healthlink BC at 8-1-1 or http://bit.ly/findaMD to ask questions you have or to help find resources in your area.
6	Physical Activity – Cardiac Rehab	We strongly recommend that you join a cardiac rehabilitation program. Contact Healthlink BC or your doctor to find out if a program is near you.
7	Medication	If you had a stent, it is especially important to take your anti-platelet medications like clopidogrel (Plavix) or ticagrelor (Brilinta).
7	Readmission Reminder	If you are readmitted to the hospital at any point during the study, let us know at 604-682-2344 ext. 64874.
8	Smoking Cessation (Smoking Stream)	Not smoking is one of the most important things you can do for your health. For quitting resources, check out: http://bit.ly/quitnow.bc
8	Not Smoking (Non-smoking Stream)	Staying smoke-free is one of the most important things you can do for your health.
9	Medication List to Appointment Reminder	Bring a list of your medications to your appointment when you see your doctor. You can get copies from your pharmacist.
10	Resting/Taking Breaks	You may feel like you have less energy. It's okay to take breaks, ask for help, and to say no if you think some activities are too much for right now.
11	Driving	Check with your doctor about when it is safe for you to start driving again.
12	Physical Activity	Walk around and be active if you can, but make sure you go at your own pace and are within your abilities.
13	Communicating with Friends and Family	While you're recovering, you may want someone else to update friends & family about how you're doing, such as through phone calls, emails or Facebook.
14	Sex	Resuming sex: A general guide is that if you can go up a flight of stairs without symptoms, it is probably safe to restart sexual activities.
15	Specialist Follow Up	See a heart specialist (a cardiologist or internist) within 6 weeks of discharge. If this isn't set up, call their office, or your family doctor.
16	Depression 1	It is common to feel sad or depressed after a heart attack or being in the hospital. If you feel this way for 2+ weeks, contact your doctor.

17	New symptoms/side effects	You may have new and different symptoms or have side effects from your medications. If you have concerns, contact your doctor.
18	Pharmacist	If you want to go over your medications, contact your pharmacist. You can also see if your pharmacy has automatic refill reminders.
19	Work	Check with your doctor about when you may go back to work. This can depend on many factors. You may want to start part-time.
20	Help	If you have questions, write them down as they happen and bring the list to your doctor. You may want to keep a list in a small book.
21	Physical Activity	Have you done something physically active today? If you have questions, call the Physical Activity Line at 1-877-725-1149 or talk to your doctor.
22	Medication	Having a hard time remembering to take your medication? Set an alarm, use a pillbox, create a routine or ask the pharmacist for ideas.
23	Smoking – Quit Date (Smoking Stream)	Setting a quit date is an important step to stop smoking. Have you thought about setting one? If you have recently quit, enjoy your smoke-free life.
23	Second Hand Smoke (Non-smoking Stream)	Make your home, car and work place smoke-free. Second-hand smoke is harmful, so try to limit your exposure.
24	Prescription Reminder	If you have any 30-day medication prescriptions, remember to refill them
25	Air Travel	Travelling? Check with your doctor, insurance & airline. Take a list of your meds, double the amount you'll need, and put them in your carry-on.
26	Readmission Reminder	If you are readmitted to the hospital at any point during the study, let us know at 604-682-2344 ext. 64874.
27	Diet	Diet matters. Try to eat a wide variety of vegetables and fruits every day by adding them to salads, soups, stews, stir-fries and smoothies.
28	Social Support	Social support groups can be helpful. Consider joining or starting a walking group, a group on Facebook, or a group at your community centre.
29	Diet	Try to eat foods with lots of fibre in them like whole fruit and vegetables, whole grains, and oatmeal.
30	Depression 2	Have you been feeling sad, down or uninterested in life? These, among others like low energy, are symptoms of depression. Ask your doctor.
31	Diet	Talk to a dietitian about healthy eating by calling 8-1-1 from 9-5 Monday to Friday. You can also email them through the Healthlink BC website.
32	Anger	Being angry is a normal feeling after a hospitalization. Use stress management techniques like meditation, deep breathing or yoga.
33	Depression Resources	Try the Antidepressant Skills Workbook to better understand and manage depression: http://www.comh.ca/antidepressant-skills/adult/
34	Physical Activity	Have you been doing something physically active every day, like going for a walk?
35	Sex	Medications for heart conditions can affect sexual desire and bodily functions. If this is an issue, talk to your doctor.
36	Activities	What things do you enjoy doing? Set aside time to do activities you like or try something new.
37		

38	Sleep	Sleep is important. Try to have a regular wake-up time & make sure your bedroom is a comfortable temperature with minimal noise & light.
39		
40	Stress	Frequent stress can be harmful. Try to identify the cause, and find activities that help you like yoga, meditation, or deep breathing.
41		
42	Stress/coping	Try the "Positive Coping with Health Conditions" handbook to help with managing self-care and stress: http://bit.ly/positivecoping
43		
44	Diet	Try to avoid processed meats like deli meats and sausages. Try eating lean white meat, fish, lentils, beans and nuts instead.
45	Readmission Reminder	If you are readmitted to the hospital at any point during the study, let us know at 604-682-2344 ext. 64874.
46	Depression 3	Heart patients who are depressed do not recover as well as patients who aren't depressed. Get support (family, friends, doctor) if you need it.
47		
48	Diet	Try to lower the amount of salt you eat by avoiding processed foods and removing the salt shaker from the table. For flavour, try adding pepper or other spices instead.
49		
50	Anxiety	In the past 2 weeks, how much have you been bothered by feeling anxious or nervous (out of 10)? If 5+ , consider seeing your doctor.
51		
52	Physical Activity	Are you still being physically active? Add it to daily activities like walking an extra bus stop, taking the stairs, or taking a walking break.
53		
54	Diet	How many fruits and vegetables did you eat today? Try cutting them up to have as snacks during the day.
55		
56	Social Support	Try to spend time with your family and friends. Having a good social support group can be helpful and important.
57	Take Control of Health	It's important to take control of your own health. If you have questions, make sure you ask your doctor.
58	Wrap Up	Try your best to eat healthily, be physically active, take your medications, stop smoking and maintain your mental health. They all help!
59	Wrap Up	The Txt2Prevent messages will end tomorrow. If you have further questions about your condition, contact your doctor.
60	Wrap Up	This is the last text of the Txt2Prevent program. Thank you for your participation in the study! You will soon be contacted for follow-up.

Appendix C.

Txt2Prevent Study Semi-Structured Interview Guide

Participant ID___________ Date:_____________

Thank you for agreeing to participate in the Txt2Prevent participant Interview. As part of this study, we would like to learn from your experiences with the program, so we have a set of questions to get your feedback. Your comments will be kept confidential and no personal information such as name, age or birthday will be recorded. There are a total of 10 questions.

"This is the Text2Pevent participant exit interview questions for participant (participant #)]______ recorded on (date) _____________"

Can you tell me briefly a little bit about you, and the story of your heart condition?

- Probe: What concerns or worries did you have when you were in the hospital?

Can you explain to me how you have managed your heart condition over the past 2 months?

- Probe: What changes have you made to your life?
- Probe: What was your experience like making these changes?
- Probe: What challenges or problems have you encountered?
- Probe: What helps you manage your condition?

What were your reasons for joining this study?

- Probe: What did you expect from the study?

Has the text messaging program impacted your life over the past two months? If so, how?

- Probe: What aspects were the most helpful or beneficial? What aspects did you not benefit from?
- Probe: Has the program had any impacts on your sense of well being? If so, how?

- Probe: Has the program had any impacts on your confidence to manage your condition? If so, how?

Probe: Has the program had any impacts on your interest or ability in managing your own health? If so, how?

Probe: Would you recommend the program to other heart patients?

Have you learned any lessons about yourself or your condition by participating in the program?

- Probe: If so, can you give an example where you learned something?

Have you discussed the text messages with your doctor during your appointments?

- Probe: If yes, what did you share?
- Probe: If not, why?

What did you think about the text messages?

- Probe: What did you think of the topics? Were they useful?
- Probe: Were there any topics you thought were more helpful? Or less helpful?
- Probe: What did you think of the tone of the message? Was the wording OK?
- Probe: Were the messages easy to understand and clear?
- Probe: What did you think about the frequency of the messages (i.e., daily, every other day)?
- Probe: What did you think about the length of the program (i.e., 2 months)?
- Probe: Did you read all the text messages?
- Probe: Do you remember what the messages said? Did you ever go back and look at the messages in your phone or write them down?
- Probe: Do you have suggestions for other topics or improvements?

What was your experience using text messaging for health purposes?

- Probe: What did you like about the technology? What did you dislike?
- Probe: Were you comfortable using the technology?
- Probe: Would you want to use text messaging for health purposes in the future?

- Probe: Do you see text messaging being used in health care?

After having these experiences, what advice would you give to someone who has just discovered that he or she has a heart condition?

- Probe: What do you wish you had known?

Is there anything else that you feel we should know about your experience, or do you have any other comments or recommendations?

Appendix D.

Txt2Prevent Study Qualitative Analysis Codebook

Table D1. Thematic analysis code book.

Node	Description	Example
Acceptance and continuing on	Accepting the heart attack (this can be a big realization or a minor one) and continuing on. People may identify a strength they were not aware they had or highlighted that they have not made many changes (can go both ways).	"What advice would you give to someone who had just discovered that they had a heart condition? Oh, that it's not the end of the world" "I guess accepting of, you know, the fact that I now have heart disease, that I have to take pills. It's a life altering change. It's my new normal, which is quite a dramatic shift in what I had for the previous 52 years so…"
Acknowledging mortality	Having the heart attack brought up their mortality. It can include potential fears of dying, gratitude for being alive, or acknowledgment that they almost died.	"Cause here I had, I know people who have had this kind of heart attack and who are no longer here. People are longer term recovery, and here I am going for a nice stroll, and breathing deeper, fresher, longer, better than ever before. And wow, life becomes very much alive." "I mean I was scared. I was terrified. I thought I was dying. I was going to leave a family behind, and I was scared."
Advice	Advice that the participant gives for other heart patients	
Attitudes towards using technology for health purposes	Any reflections or feelings about using technology for health. This is not specifically about the text messaging program, but technology in general. Can also be about their interest in using technology in the future.	"I liked it, yeah. I mean it's relevant to how people live their lives today, right? How they are used to getting information that way?" "I don't know. I don't really, you know, it's like any other form of communication, I guess, it's not much different than picking a telephone really. Yeah, I guess, it's uh, you can get a chance to maybe make your thoughts clearer with a text, I suppose, if you take your time to write it. Yeah, that's about it."
Challenges post discharge		

Difficulties with information	Anything about if they have a hard time finding sources of information, if the information they received is not relevant, or are overwhelmed by the amount of information	
Fatigue	Mentioning needing to manage their energy levels and dealing with fatigue as a side effect	“I’m just careful about what I do. I don’t over exert myself” “But I still can’t work. I have absolutely no energy.”
Fear of another heart attack	Referring to their fear of having another heart attack, the potential uncertainty around this (such as angina symptoms after discharge), and/or the desire to avoid another heart attack as they try to figure out their new normal and get back to health	“Every pain after is “uh oh, here we go again,” “uh oh, here we go again.” “I am glad I am on the medication I am on. I am assured by my cardiologist that it is the best mixture of medication. And it makes me feel less fearful that I will have a second heart attack.”
Lack of information about their diagnosis and prognosis	Referring to not getting answers about their particular situation or knowing how they would recover. This could include lack of information at specific points in care. This can be at any point.	““They couldn’t really pin it down, and uh, I assumed it was something to do with the chemo treatments” “I always have concerns, and I always have worries, but they keep telling me my heart is fine but they can’t seem to tell me why I get chest pains”
Less confidence after leaving the hospital	Explaining that they felt less confident after leaving the hospital, especially as they were by themselves.	“say I also found that although in the hospital I felt so confident when I got home, I really didn’t feel that confident and especially cause the first week just through circumstances I was by myself… a bit, frightened isn’t quite the right word, but a little bit nervous, you know, like “oh my gosh, here I am all by myself and what if something happens.”
Loneliness	Describing how they were lonely after their heart attack (this may be if they couldn’t drive).	“Now for instance, it [the text message] coming at the same time every day, um, especially when I was alone or days that I did feel, you know, a little sad or lonely, or “nobody phoned me today” and when I couldn’t drive cause you can’t drive for a month, so that alone is, for someone that does drive, you know, I couldn’t go see the grandkids and all this stuff, so the text message coming everyday at the same time when I use the word ‘comforting’, that’s the best word.”

Loss of abilities	Describing how they were no longer able to do certain activities this as a result of their heart attack (temporarily or permanently) as well as their expectations about going forward with this new change. May include an acceptance of this or a loss of a part of their identity. Can include things that people perceive they no longer can do (or decide not to) and not only just what they are actually incapable of doing. Does not need to be explicit, but it can be them talking about their challenges (e.g., fatigue).	“Like I haven’t, I’ve been in construction all my life, [unclear] so I’m used to doing a lot of physical activity, and so I haven’t done any of that for the two months, and under, again the doctor saying now I don’t want you throwing 2 x 10s over your head and all that stuff, climbing ladders and whatever, so I’ve been avoiding that, and attempting to find different work that might be in the industry, but that’s not so hands on.” ‘So he told me I can’t drive again for a while [laughs]. That’s the worst part [laughs]. Not being able to drive, you don’t realize how inconvenient that is until you can’t drive.” “Well, I mean, I just don’t push it like I used to. Like I used to be just go, go, go, go, go, but now I’ve learned that I have to pace myself. And um, for heavy, uh, well I call it heavy, but house cleaning, I have a couple of ladies, they come in every two weeks. And they do sort of the bigger stuff. Um, and other than that, I mean, on a day to day basis, I basically, with all my husband’s help too, we basically look after ourselves and the house with no problem.”
Managing other co-morbidities or life concerns	Describing other problems that took away their time, focus or energy instead of just about their heart problems. This is often about other health issues (or spouse’s health issues), but can also include other life events (e.g., financial).	“I’m just careful about what I do. I don’t over exert myself, and uh, but, like I say, I’ve also had, there is other complicating factors in there that I’ve had in, a, um, infections for almost a year due to the diabetes, urinary tract infections off and on for almost a year, which I’d say in, since the last August when I got it first of all, I haven’t gone more than about 6 weeks to 8 weeks without an infection. So I’ve been on almost antibiotics almost continuously since that time.” “the stress level in our household, we lost my father-in-law the months previous to that so…”
Medical complications and side effects post discharge	Describing challenges that they have experienced since coming home like side effects (i.e., from meds), complications, and any ongoing symptoms they still have	“It’s just that, um, my leg where they took the veins from, um, it got infected.’ “then 3 months down the line, yeah bleed every single day, bruise, well you bruise like you would expect, but I had no internal injuries”

Current heart event description	Describing their current heart event and how it came about. It is essentially describing their symptoms and realization that something was wrong. This is often what lead up to them going to the hospital while 'treatment in hospital' is about what occurred once they arrived.	"Okay, when it initially started, I had what I presumed was a very bad flu. And I had terrible vomiting, diarrhea, and after a few days of that, my daughter said "No, enough is enough. This isn't right". And she took me to Emergency, and it turns out, according to the doctor there, that I was in the throes of a heart attack."
Experiences during hospital stay	Describing and reflecting upon their experience at St. Paul's Hospital (and other hospitals if they were transferred). Can include what happened as well as what they thought of it and any concerns they had (this is primarily from the first question or two).	"Uh, so my experience at the hospital for the next few days I was there, staff at St. Paul's were one amazing, very, very attentive, very on the ball with everything, um, and so my medical care in that space was first class." "Well, not really, I mean I guess the concern would be getting the stent, alright. But other than that, no. "
Follow up care	Describing what type of follow up care they have received (or lack thereof) and any thoughts about this care. This includes almost any contact with the medical system they had after being discharge.	"well in addition to, uh, seeking out a cardiology group that specializes in the recovery of performance athletes which is, uh, the BC Sports Cardiology clinic at UBC." "under sort of the guidance of the nurse coming around and talking with the medical stuff, lot of, started walking, um, little bit of light bike riding and sort of after a few weeks," "We have had no follow up. There has been no follow-up scheduled to follow up to check on that blood clot" "I joined the Lion's Gate program for cardiac patients and, uh, I was lucky because I was gonna have to wait until October. They were quite booked, but somebody, I got a cancellation, so I was able to start and I have been to 4 sessions now. And they are just excellent."

Gratitude for care	Expressing gratitude for the level or quality or care they received (often during their index visit). Can also include the anti-version (i.e., annoyances with care)	"in Lion's Gate Hospital, everything happened, in, I think, 30 seconds, I cannot believe it. It was perfect. How fast they, uh, treat me at that time. And then I came to St. Paul's Hospital. In the operation room, they did something to me, then later I found it was putting a stent in my heart, in one of the arteries. In the hospital, everything was great. The nurses were very kind and everything was okay." "just to get on it and get in the system because what our system is right now is too slow. You have to wait too long to get anything done and that was my biggest problem. I got lost in the system. They didn't do anything for... it took them over 6 months, 8 months or so before anything happened, so yeah, you gotta push yourself. I guess you gotta be your own doctor or whatever, and try to get on with it."
Life engagement and meaning	Anything about them taking initiative to do things that are important to them. May be as a result of their experience with their heart event to do things that are meaningful to them.	"*And what's motivating you or what are the reasons for why you've made these changes?* To having a longer life. To be with my family. My son, my daughter, my wife need me. You know, it's not a personal decision. For a family man, it's way bigger than that. Maybe, maybe if I was alone, I'd deal with this problem in other way. But these days, it's different. I cannot make any decision in my personal life. I have to keep everybody who takes advantage of this decision. You know what I mean?" "And, I've been spending a lot of time, I do a lot of container flower growing, so I spend a lot of time, just working in my flowers, watering, and cleaning, that kind of stuff. And planting. And, uh, that's been about, for quite a while, was all the activity that I could really do. But, I really have enjoyed it, you know, being out in the sunshine, and just relaxing in my, it's, it's my favourite pastime in the summertime."
Mental health and wellbeing	Talking about their mental health status post heart attack (includes, depression, anxiety, stress or lack thereof) and things people do for their mental health.	"My mental wellbeing is very good. I stay positive."

	Includes some people talking about how they did not experience depression.	"Well, I mean with my heart, it just, everything seems to kind of tie in together because when I'm having issues, like with my, not feeling in my hands when it gets really bad, I get pressure on my chest. And I know it's, it's anxiety, but you know, it's… it's scary." "I'm feeling depressed, and that was, just that little kick and a boost, even if you got family or friends try to talk to, no, that little thing just kind of give me, I mean might not work for everybody, but for me it was like a boost of 'we are still here if you need us.'" "You guys spent quite a bit of time on the depression side of things, which I guess, maybe in your guys', um, experience that that's been a bit of a factor. For me, it wasn't. So those were, it was like, you know, it almost came as a little bit too much for me."
Perceived severity of heart event	Participants discuss whether they thought their heart attack was a major or minor event.	"If I am healthy, energetic, strong, or anything, it's, it can be destroyed in 10 seconds. Still I don't have any idea, yes I don't have any idea about, about heart condition because it was the first time that I had problem with my heart, and it was very close to sending me to the other world." "You know there are heart conditions and then there are heart conditions. Like I'm not too concerned about stents. Stents are pretty common, but you know, if you get into something a lot more serious than that. I mean a stent is serious, but it's not, it's not, a valve or something like that were you get a big cut, you know, broken open and replaced, or whatever they do now."
Previous experiences with heart symptoms or newness of experience	Any previous experiences with heart condition (and how that might have affected their experience this time through) or lack of experience (i.e., that the experience is new to them).	"Umm well, I think it was 2 years ago I had pressure in my chest. Um, I went to the hospital. They said they couldn't find anything."

Progressing abilities and returning to regular life	Building back up and improving as time has gone on Talking about how people have progressed enough and returned back to their regular activities. Some people speak about not returning to regular life or their expected projection at returning.	“So I’m pacing myself in the last two months was kind of building up again, so now I’m feeling, went back to the gym and just on Friday, and it feels great. You know, I’m not pushing it hard yet but, I’m *gaining momentum* and, well we have a max climber at the house, yeah, then what started off as sort of 2-3 minutes, now I’m 8-9 minutes, and it feels great.” “Um, it’d be okay. I mean I don’t mind getting them everyday, but uh, you know, if it was every other day, it’d be fine, that they’ve now jumped to. So, yeah, I think I as progress with feeling better and better, the lesser coming in, is okay, it doesn’t have to be a daily.” “And I said feels great. It feels really like I’m back in the gym pushing something here. And basically the doctor, the cardiac specialist said you’re right back on track, so everything was checking out very normal. So I’m pacing myself in the last two months was kind of building up again, so now I’m feeling, went back to the gym and just on Friday, and it feels great.” “Plus after 2 months, you kind of get an idea of what is going on with the patient anyway, right.” “It really did, um but I mean it was, but it, you know, kind of fit the bill. You know, from start to finish, you know, when you are back to work then basically you just motor right along now.” “So then, that lifted a lot, the minute I was able to drive.”
Rural versus urban	Any mention about resources available or lifestyles due to geographic location. Not only T2P relevant.	“So he told me I can’t drive again for a while [laugh]s. That’s the worst part [laughs]. Not being able to drive, you don’t realize how inconvenient that is until you can’t drive. Yeah, I’m sure. Especially when you’re out in the country.”

		"I think, I think it's an excellent idea because obviously it's a program, in my case, from Vancouver, um, I don't that program here in [northern BC city name], right."
Seeking an explanation for their heart event	Explaining why they think they got their heart attack (or the lack of information around why they got their heart attack).	"Nobody, all my friends are going like, "you're the most fit person that we know, how did this happen," right?" "I already knew I wasn't exercising enough, like with the cardio rate getting up every day. Um, I exercise enough in a way that I run a patching crew, and shovel, and you know, I grab them all the time, so it, I knew I was getting physical activity but I knew I wasn't getting enough." "I'm not sure if it started with the cancer treatment or not because I had a drug called donarubicin as part of my treatment and, uh, it's not too good for the heart."
Self-management		
Acknowledging chronicity	Recognizing that this was not just a one-time event that you need to consider this as a chronic disease that you have to manage for a long time.	"It's a life-long program, so you know, I'll probably not delete that text string just for that fact to, you know, constantly know that this is a, it's a serious thing, and 5 years out from now, um, it still needs to be as important as it is right now as it was 60 days ago."
Changes due to past medical experiences or co-morbidities	Making changes (or already having made changes) due to co-morbidities	"I don't know. I mean, I've had it for so long, that I've been dealing with similar things, like my first stuff with the chemotherapy was back in 2003. And after that was when I started to get the heart palpitations and that kind of stuff and I really started to pay more attention."
Changing or maintaining behaviors to improve health	Any new behaviors or skills that they had implemented or tried to change in order to improve their health (e.g., diet, physical activity, mental health). It could also be continuing a certain healthy behavior (like exercise).	"I would just write stuff down, whereas I wouldn't do that before." "And, so, I did that. I attenuated my diet somewhat. And uh, and working more towards having, uh, a kind of Mediterranean style diet." "I have talked to people. I'm seeing a counselor, psychiatrist, whatever, to be able, to talk about it, just to kind of put me on the right track, I guess."
Desire to avoid a heart event in the future	The heart event was a wake up and call to action to be healthier.	"It was *just an eye opener*, so you know, you gotta watch what you're doing and take better care of yourself"

		“It reminds you that you’re like, I guess, not invincible, that you do have the heart condition and to just you know, it’s not that it’s gonna quit working tomorrow, but you still need to lay a healthy path, so that’s about all I can say.”
Learning to trust yourself and your experiences	Trusting in your own senses and your knowledge of your body to know when something is wrong. This can include the opposite version, such as not wanting to seek care because not thinking it’s important enough or wanting to take the resources.	“also, you know, keep an eye on how you’re feeling yourself, and don’t, don’t pass over some symptoms that you should be paying attention to. So, you know, ‘it’s just indigestion,’ well maybe it’s not just indigestion. Better keep better track of it. That kind of stuff.” You know in this day and age, sometimes you get a little bit funny about calling your doctor. You know, they’re really busy, and all this stuff, and you don’t want to appear like a baby, and so it was helpful that way that you never got the impression like “oh gosh, I’m just being a baby” and this sort of thing, so that part I think was so good, to give people confidence to call their doctor, not to, you know, be afraid not to if you felt a bit funny.” “‘you gotta deal with this,’” at the hospital there, and when I over making the appointment, and I was sitting there and reading it, I was like, “yeah, okay, no this is the right thing to do. This is what I need to do.”
Self-education	Explaining how they sought out information and did a lot of self-education about their condition	“Much of the information that I got through the texts were, um, fairly straightforward and I knew them. That’s just probably because I, you know, just did my own research right.” “I kept using the internet and so forth looking at different things.”
Taking control of care	Referring to taking an active role in things like seeking things out, asking the questions, or taking control of their own health (can include working as a team with a doctor, and not just solely being directed what to do). Can be about making changes or follow up care.	“Yeah, so I’m a little bit, you know, I take that under my own control and, you know, I’ve made a plan to make sure that this is all gonna be looked after and, umm, yeah, here we are today. Exercise program is going fantastic.” “You have to. Something caused it. Find it. Change it. Change your exercise, change your diet, stop smoking.”

		"So I kind of campaigned to, you know, get seen by a cardiologist there, so that was one thing I was successful at."
Social comparison	Any reference to where someone is comparing themselves to others (or their idea of a hypothetical heart patient) where their experience matched or didn't match others. It also could be if there was a reference to them feeling normal or not the only one who experienced this.	"Again not to me specifically, but it would be I think it to somebody who might not understand why they are feeling so bad, um, after a heart attack" "And so for me I had to tweak a few things, but not a lot, so I could see, you know, an individual that had to tweak, you know, quit smoking, lose 50 pounds, learn how to walk or figure out what a cardiac program even is, you know what I mean, like there is a whole gamut of things there that would be a challenge for someone, you know, I guess maybe I would just say maybe not as far advanced with the whole eating stuff and everything to start with." "And like I said to my husband though, if I had been a newly, um, operated on heart patient, it would have definitely been very, very good."
Social support	Any reference to receiving, wanting, or being reminded about the importance of social support (e.g., from a partner, managing family's feelings) or challenges with social support Can be about doing activities together or about someone else 'looking out' for them.	"my girl, is pretty finicky about making sure we're eating enough fish and veggies, and those kind of fun things rather than…" "I've been going with my husband some up to, up at our university there is a big walking track." "And um, that one, you know, there were a few like that, you know, go to a happy place or whatever make, sure you are talking to people, have a support group, you know, all that kind of stuff. And it's tough for me because I'm kind of a loner, so it's been really hard for me to reach out, so that's why I can go through those kind of in my own little head. " "If I hadn't had the support that I had, if I had to call in outside help, number one I couldn't have afforded that, and number two, living out where I do, rurally, I'd have to move to town because you have to have groceries."

Study expectations	Descriptive of any expectations people had of the study (this was asked to them directly) and why the joined the study	“Um, I wanted to help in anyway I could…kind of the advancement of recovery programs, generally.” “I just wanted to, uh, you know, be part of, you know, improving a system that is already in place and perhaps if I can share in, you know, either it’s, you know uh, good stuff or maybe I can assist in, in making a couple of changes to help other people cause a lot of people are not nearly as savvy when it comes to actually looking at their own stuff.” “but I thought, at the time, that, well you certainly seemed very earnest and very interested in your survey, and I thought “Well, I’m sure that that is something I could do and maybe I will learn something from it as well”.
T2P engagement	How people interacted with the messages. E.g., did they read them all, did the messages prompt them to do anything, *did they have any emotions about getting the text messages (excited, bored*), did they read them right when they arrived. Essentially, how did they interact with them The timing category later is more specific to the time of day they received it at. This is a parent category for the light grey categories below.	“So like I said, every night we just expected, expected it and we had the little ding, he would bring me his phone and um, you know, I would read it, and we’d just save it.” “Yes because if I’m really not having a good day, I actually will go through the text messages.” “And I honestly looked forward to them. It, it, it’s just not what I expected, and it was really nice, it really was. And I think, I hope other people felt the same way, and I hope it just wasn’t me. I thought they were great, I really did. Yeah.” “Okay, and um, did you read all of the messages? Every one of them”
T2P engagement (solo)	Anything that fits into the parent category that is not message review or sharing with others, expecting messages, or reading the messages. Essentially how people interact with the messages and their emotional responses to them.	“And I honestly looked forward to them. It, it, it’s just not what I expected, and it was really nice, it really was. And I think, I hope other people felt the same way, and I hope it just wasn’t me. I thought they were great, I really did. Yeah.”

		“So like I said, every night we just expected, expected it and we had the little ding, he would bring me his phone and um, you know, I would read it, and we’d just save it.”
T2P expecting messages	Any discussion about how they got used to the receiving the messages and would expect them.	
T2P message review	Any discussion about whether they went back to check their text messages, whether they intend to look at them after the program, or whether they deleted them.	“And I really liked having the information there, like I kept all the messages so I had it right there, you know, if I wanted to phone the pharmacist or the exercise the person.” “I deleted them all.” “I didn’t write any of them down, but I did go back to the one about depression and the one about anxiety.”
T2P reading	Any comments about whether they read all the messages or when they read the messages. This is separate from going back to read them.	
T2P sharing with others	Any discussion about sharing them with others (family members or physicians) and any associated reactions. Include if they did not share with their doctors.	“I didn’t talk to him about the messages. Yeah, I didn’t even think to talk to him about it. As I said, I can’t remember if I have been twice or 3 times but both times, as I say, they’re quite busy, and that just didn’t come up.” “I would read them off every morning on what you guys had to say. A couple of them were repeat ones, but that doesn’t matter, but yeah I kind, told him off, he thought it was a good idea too. So then, especially the ones with reminding me to take your meds and he [my husband] would look at me like, “did you take your meds?” and I said “yes I have” So yeah, but no, they were, I would tell him about them everyday.”
T2P frequency	Any discussion about how frequently the messages were sent. Could be approval, disapproval, or not noticing the frequency.	“ I mean I don’t mind getting them everyday, but uh, you know, if it was every other day, it’d be fine, that they’ve now jumped to. So, yeah, I think I as progress with feeling better and better, the lesser coming in, is okay, it doesn’t have to be a daily.” “I liked it daily.”

T2P generic versus individualization	Any discussion where the program or texts didn't seem applicable to them	"Um, well I have read all of them and a lot of them make sense. I mean, I'm not, like I knew a lot of that stuff already so…" "But because mine was a couple of years ago, a lot of the things I had already learned. So, uh, I mean, that's one thing to keep in mind. I think it would be very good for people, that this is a new aspect of their life." "If it wasn't what, like I didn't see any of them that I thought weren't kind of, you know, cause you got to think about it like I'm not the only one in the study, how many different hearts are in this study, right, so even if it doesn't pertain to me, it's probably hitting somebody else, you know. So… none come to mind anyway"
T2P impact	Coded T2P impact (solo) solo as any impact or lack of impact of the text messages on their life that is outside of the other categories (normalcy, perceived as support, reinforcement, reminder of condition). This is a parent category.	
T2P normalcy	Anything about how the messages made them feel like they were normal and not the only one who experiences this.	"This business of, you know, it is okay to feel a little bit depressed or weepy or you know this happens to other people too kind of thing. I think that was good for me to hear, I really do." "This is where I found your texts that, you, know mention stuff like that, that it was kind of normal now and then, and, you know, see the doctor if it, you know, got worse and so forth."
T2P perceived as support	Any comments or discussion about how the messages were a type of social support for them during this time (whether they knew it was a computer program or not).	"Um, I think just knowing that, to me this became my unofficial support team. [laughs] Maybe they were the official support team. Uh, but I really, yeah, we're so used to texting each other for a variety of reasons, and I think this just felt like oh, somebody's, something is telling me that I need to be reminded of this, even it's through a system, um, because it's specific to where I'm at."

		“So I found that’s what helped me a lot too, you know, it was like somebody was talking to you.” “But for me it was like a boost of “we are still here if you need us.””
T2P reinforcement	Any discussion or comments about the text messages reinforcing that they were on the right track and doing what they were supposed to do.	“All the time, just coming in, and so, just looking at one here, yeah, like something “if you have a stent, it’s important to take your anti-platelet medication”, so “oh yeah, okay, that’s why I’m taking them to make sure it’s doing what it’s supposed to do”.” “It just reinforced what I was doing saying “‘okay, no I’m on the right track here’”
T2P reminder of condition	Any discussion about the T2P messages serving as a reminder that they had a heart event and need to pay attention to their health	“A daily reminder that I am in a recovery from a heart attack.”
T2P improvements	Any suggestions for improvements (there is a specific question about this, but it could have been discussed at any point throughout the interview). Could include suggestions, or just a comment about something they didn’t like, or if they thought everything was great (i.e., no improvements needed).	“Um, no, I think they were all, I mean like I said, some of them they’re a generic part of them which kind of gives you information as to, um, and I, I mean, I think a good one, I’m just looking them up here as you’re chatting, um, if you have any questions, write them down and ask your doctor and keep a list of questions you might have.” “No, not off the top of my head. I’d have to think about that one, I guess. No, not really. Not right now anyway.” “Cause if a guy was depressed or feeling like anxious or depressed, to me it’s a no brainer, like of course someone is going to go to the doctor after just going through the event, right? So to me if there, if you added, you know, some advice. I could probably go and have a look at some cause I did make some notes.”
T2P one way versus two way interaction	Anything about whether the messages were okay being one-way only, or if they would have preferred interaction. Some people have answered this directly to a question about it, where sometimes it comes up as part of the conversation.	“It’s the nature of the service. So yeah, I was disappointed that somehow I couldn’t call somebody about, um, you know, again, I’m resourceful, so if it prompted an idea…you know, the way people work is ‘oh, well I wonder about that’ and they would Google it, and I would be one of those folks, I guess.”

		“Um, I don’t know, I suppose it might be worthwhile to have, to be able to respond to something. I don’t know if I really was, you know, anything that serious that I would have had to respond to. I guess if somebody were to find something like that, it might have been good to have the opportunity to respond, I guess.”
T2P perceived trustworthiness	People referring to T2P as a program offered by the hospital and that they viewed it as trusted content	“And you were already sending me this stuff, so um, it’s better coming from you guys, right?” “I think, I think it’s an excellent idea because obviously it’s a program, in my case, from Vancouver, um, I don’t that program here.”
T2P program length	Anything about the length of the program (whether it was the right length, too long, too short). People were asked specifically about this.	“Yeah I think it’s a good length. I wouldn’t be, um, you know, I … if you wanted to continue it, even if there was like repetition and so forth, it wouldn’t be a bad thing.” “I think that was alright , yeah, you know, I don’t know if I’d want it any longer than that. That was about right.”
T2P recommendation to other patients	Any discussion about whether they would recommend the program to other heart patients. This was a question asked directly to them, so their response to this as well as any other references.	“I would, yeah, I would recommend it to, yeah, I would recommend it to everybody.” “I’d tell them to go for it even if they thought it was a bit silly or they would think they maybe don’t need it”
T2P forgetting or misremember	When a participant commented on whether they remembered or didn’t remember certain topics. Doesn’t need to be a question specifically about them remembering, but it can just come up in an answer. It could also be when prompted for improvements, and they don’t have anything or can’t remember anything when prompted. Any instance where the person did not remember the program correctly. This often had to do with delivery of the messages (not knowing that they came every day, etc. or switched).	“Yeah, yeah, basically, I basically remember most of them, what a lot of them said, not all of them. Depends if they, what, [unclear], some meant more than others.” “Um, I think they were all, um, very good topics. Off the top my head I can’t remember all of them.” “I just can’t remember right now, what it was, because I remember thinking “Oh, that’s a good idea!” And then utilizing it. Um, oh, I just, I’m sorry.” “It’s interesting that I didn’t notice that they had gone to every other day, um, I would have sworn up and down were coming in daily.”

T2P resources	Any discussion about the resources provided within the T2P messages. Can be about ones they used or didn't use, ones they might have wanted, etc.	"I think, there were some good links in there that I could follow up on, like the HealthLink BC links or the other ones were, um, if you needed to check something from a medical… I think good medical information or links are great… cause they're, to be honest with you, I might go online for different information, doesn't matter what the subject, there is so much information you almost feel like you get lost, so it's nice having information that's pointed, directed to, like there is one here, an anti-depressant skills workbook, understanding depression, and the direct link to that, right, which, kind of, having the good information to the direct point is good." "Yeah, of course. Did you ever use any of the resources that were, um, linked in the texts, so either the phone numbers or the websites? No, I haven't. No? And was there a reason why you didn't use them? No, I'm just busy [laughs], I guess, mostly."
T2P technical delivery or access	Anything about the technical delivery of the messages or their ability to use tech to access the message. Might be about using someone else's phone too.	"Well we were away on holiday for a while, but I'm not sure if I got all of them when I came back. But there wouldn't be many that weren't read."
T2P timing in trajectory	Anything about the content of the messages in their recovery trajectory	
T2P time of day	Anything about the time of day the messages were delivered Can include their reactions it to becoming a routine.	Um, that was excellent actually. And it's so funny because it became ingrained in my system, like all of a sudden, it was like, I was expecting that *ding!* from my husband's phone at 7 o clock every evening [laughing]. We knew what it was." "No that fine about 8 o'clock, 8-9 o'clock in the morning was perfect."
T2P tone	Anything about the tone or how the messages were written	"Uh, good. Everything was clear and upbeat. Uh, I think that they were well crafted." "Um, yup, for the most, I uh, yeah, I mean, you know, texts are kind of short, sweet, to the point, you know, you don't want a lot of stuff in them anyway."

		“No, the tone was good. You guys had done...good effort on the written word and how it is portraying to a person. I wasn’t, how would you say, it was all, how would you say, neutral in its meaning.”
T2P topics	Anything about the topics or content in the Txt2Prevent messages Includes topics they thought were helpful or less helpful or topics that were missing	“I don’t think so, I just, I read them and took what I could out of them.” “Um, I think they were all, um, very good topics. Off the top my head I can’t remember all of them.” “Yeah, yeah. Yeah, that’s why I’m saying there was a little bit of everything, and I thought that was good.”
Taking responsibility for recovering	References made by the participant about their perceived level of control over their recovery	“but after the first week, you gotta start moving. You can’t just let people cater to you, and not let you do anything and just sleep and sit in the chair. Okay, yeah, for the first week, but to rebuild your energy, you have to get up.” “Just take care, take care. Every patient must take care of themselves. I think that’s it.”
Trust in healthcare providers	Reflecting on the trust that they had in the healthcare providers (the perceived quality and interactions with them or lack thereof) and their advice	“I am glad I am on the medication I am on. I am assured by my cardiologist that it is the best mixture of medication. And it makes me feel less fearful that I will have a second heart attack.” “But for the hour and approximately 20 minutes of having, when a heart attack, was hit, to being in the ICU was the most amazing hour and 20 minutes of medical help, staff, and support that one could ever ask for and I was privileged to receive that.” “Listen, listen carefully to what he says in his office. “
Unexpectedness of heart event	References to how their heart event was unexpected, a shock, there wasn’t a lot of warning, didn’t think it would happen to them.	“Which so…(laughs a little). I was very fit, and it just seemed unbelievable to me that, um, I had a heart attack. I thought that uh, basically that my physical shape was insurance against such thing.”