

Participant Experience of an Electronic Health Coaching Trial: A Qualitative Inquiry

Sarah Pludwinski

A THESIS SUBMITTED TO THE FACULTY OF GRADUATE STUDIES IN PARTIAL  
FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS OF SCIENCE

Graduate Program in KINESIOLOGY AND HEALTH SCIENCE  
York University  
Toronto, Ontario

December 2015

**Abstract**

**Introduction:** The study objective was to investigate the experience of individuals living with Type 2 diabetes (T2DM), some of who participated in a smartphone-based health coaching intervention, and, particularly, their motivations for health behaviour change. **Methods:** A qualitative investigation was undertaken with subjects from a larger T2DM self-management RCT (2011-2014) at the Black Creek Community Health Centre in Toronto, Ontario. Twenty semi- structured interviews were conducted and analyzed with a thematic analytic approach to explore relevant themes. The focus was to investigate the effectiveness of 6 months of smartphone-based health coaching versus a control group who also received health coaching but without smartphone assistance. **Results:** Data analysis resulted in four major themes (1) “Smartphone and Software” described how participants used the device in relation to health behaviour change; (2) “Health Coach” described the relationship between clients and health coaches; (3) “Overall Experience” described individuals’ perception and experience of the intervention; and (4) “Frustrations in Managing Chronic Conditions”, described the challenges of T2DM management. **Discussion:** Findings suggest that interventions with T2DM assisted by smartphone software and health coaches actively engage individuals in improved hemoglobin A1c (HbA1c) control.

**Keywords:** qualitative research, Diabetes, health coaching

**Dedication:**

This thesis is dedicated to the Black Creek Community Health Centre and its Community members.

## Acknowledgements

This thesis would not have been possible without the guidance and support of many individuals. I am extremely grateful to have worked with such a wonderful team of faculty members and students. Thank you to my graduate supervisor Dr. Paul Ritvo, who guided and supervised me throughout this process. I sincerely appreciate his patience, encouragement and the opportunity to work with him on some novel projects.

I would also like to thank my two committee members for their valuable input and involvement - Dr. Farah Ahmad for her guidance, encouragement and giving me a greater understanding of qualitative research methods; as well as Dr. Joel Katz for investing his time and feedback.

Over the course of my graduate school experience at York University, I was fortunate to have worked with Cathy Boyd -Withers Joanne Kizner, and Katherine Narraway, all of whom provided me with their time and unconditional support.

In addition, a warm thank you to Michelle Westin, the Black Creek Community Health Centre and members who shared their stories and experiences with me.

My sincere appreciation goes to my lab-mates, past and present, as well as the Health Coaches. I am so happy to have had the chance to work with all of you. A big thank you to: Abid, Arsh, Daniel, Frederyck, Jean, Neil, Noah, Meysam, Saam, and Tina for all your pep talks, motivation, moral support, and for making me smile. It has been a blast!

Last but not least, I would like to give a special thank you to my friends, for whom I cannot begin to express my gratitude and appreciation for their friendship; Fred and my family, for the consistent support and care that they have given me throughout this process.

## Table of Contents

Abstract .....	ii
Dedication: .....	iii
Acknowledgements .....	iv
List of Abbreviations .....	vii
List of Tables.....	viii
List of Figures.....	ix
<b>1.0 Introduction</b>	<b>1</b>
<b>2.0 Literature Review</b>	<b>3</b>
2.1 Epidemiology .....	3
2.2 T2DM Pathophysiology and Complications .....	4
2.3 Lifestyle factors in T2DM Management .....	6
2.3.1 Exercise.....	6
2.3.2 Diet.....	8
2.3.3 Glucose monitoring .....	8
2.3.4 Stress Management.....	9
2.4 Health Coaching in Chronic Disease Management .....	10
2.5 Theoretical perspectives.....	11
2.6 Current literature on Health Coaching interventions in T2DM management .....	12
2.6.1 Data Sources and Search Strategy.....	12
2.6.2 Randomized Control Trials.....	13
2.6.3 Quasi-Experimental Trials.....	17
2.7. Electronic Monitoring/Communication .....	19
2.8 Past Qualitative Research in Patients with T2DM .....	21
2.9. Behavioural Barriers to Chronic Disease Management: Qualitative Studies .....	23
2.10 Current Evaluation.....	25
2.11 Qualitative Paradigm .....	25
<b>3.0 Methods</b>	<b>26</b>
3.1 Study Design.....	26
3.1.1 Participants .....	27
3.2. Research Site.....	28
3.3 Qualitative Methodology .....	28
3.3.1 Coding and theme identification.....	29
3.3.2 Analysis and organization .....	30
3.3.3 Interview Process, Questions, and Transcription.....	30
3.4 Materials .....	31
3.5 Ethical approval.....	32
<b>4.0 Results</b>	<b>32</b>
4.1 Analysis of Core Themes .....	32
4.1.1 Theme 1: Smartphone and Software.....	33
4.1.2 Theme 2: The Health Coach .....	39
4.1.3 Theme 3: Overall Program Experience.....	47
4.1.4 Theme 4: Frustrations in Managing Chronic Conditions .....	54
<b>5.0 Discussion</b>	<b>58</b>
5.1 Smartphone Use and Electronic Connectivity within a Coaching Relationship.....	58
5.2 The Health Coaching Relationship in Facilitating Behavioural Change .....	60

5.3 Health Coaching Intensity and Duration.....	61
5.4 Overall patient experience and their day-to-day frustration in managing T2DM.....	62
5.5 Strengths and Limitations of study design and execution .....	64
5.5.1 Strengths.....	64
5.5.2 <i>Limitations</i> .....	65
<b>6.0 Conclusion</b>	<b>67</b>
<b>References:</b>	<b>69</b>
Apendices.....	79
Appendix A: Semi Structured Interview Questions.....	79
Appendix B: Consent Form.....	81
Appendix C : Demographic questionnaire.....	83

**List of Abbreviations**

**BCCHC - Black Creek Community Health Centre**

**BMI - Body Mass Index**

**CBT - Cognitive behavioral therapy**

**CHC - Community health centre-**

**GAD - Generalized Anxiety Disorder**

**HbA1C - Glycosylated hemoglobin OR HemoglobinA1c**

**HC - Health Coach(ing)**

**HBP - High blood pressure**

**IFG - Impaired Fasting Glucose**

**IGT - Impaired glucose tolerance**

**MS – Metabolic Syndrome**

**MI - Motivational Interviewing**

**MI - Myocardial Infarction**

**RCT - Randomized Control Trial-**

**SES - Socioeconomic Status**

**TAU - Treatment as usual-**

**T2DM - Type 2 Diabetes Mellitus**

**List of Tables**

**Table 1. Demographic Characteristic of Participants**..... 86

**Table 2. Demographic information for study participants** ..... 87

**Table 3. Changes in hemoglobin A1c (HbA1c)**..... 88

**Table 4.0. Summary of Reviewed Randomized and Cluster-randomized trials**..... 89

**Table 5.0. Summary of Reviewed Quasi Experimental Studies** ..... 92

**Table 6.0 . Representation of themes**..... 94



**List of Figures**

**Figure 1: Participant Flow Chart**..... 95

**Figure 2: Study Flow Diagram and Study Selection Process** ..... 96

**Figure 3: Number of quotations per interview** .....97

## 1.0 Introduction

With Type 2 Diabetes Mellitus (T2DM) prevalence projected to increase by ~ 33 percent by 2050, prevention and optimal management are major healthcare priorities.<sup>1</sup> With current T2DM annual spending nearing \$9 billion, <sup>2</sup> the future sustainability of the Canadian healthcare system requires innovative, cost-effective strategies to address the increasing burden of this progressive condition. T2DM is a chronic condition where the body cannot use the insulin released in the bloodstream effectively or does not make enough insulin. As a result, blood glucose levels rise to abnormal and toxic levels.<sup>3</sup>

Current T2DM prevention and disease management strategies focus on medical management and lifestyle modifications in primary and secondary prevention contexts. However, insufficient time devoted to individualized care planning during primary care visits, coupled with the absence of a robust management strategy that includes behaviour change, has left the potential of lifestyle-based strategies largely untapped.<sup>4</sup>

More effective approaches to T2DM management are therefore needed for healthcare costs to stabilize and to reduce the financial and human burdens. With electronic technologies becoming more accessible and less costly, e-health methods have the potential to improve chronic disease care delivery by improving communication between health professionals and patients, while engaging clients in behaviour change leading to improved self-care between visits.<sup>5</sup> Despite promising results, the effectiveness of supportive mobile-phone applications has not been sufficiently tested and multiple randomized controlled trials (RCTs) are needed to thoroughly establish the effectiveness of these electronic technologies.

To date, studies evaluating the impact of electronic technologies in healthcare, with or without health coaching support, indicate promise with regards to (a) improving glycemic

management in T2DM,<sup>6,7,8</sup> (b) improving physical activity and diet<sup>9,10</sup> and (c) improving quality of life and mental health status.<sup>11-13</sup> While these studies have primarily focused on quantitatively evaluating mobile applications, less attention has been paid to qualitatively evaluating interventions and, in the process, understanding responses to, and the effectiveness of, interventions on a personal, subjective level.

To address this gap, we conducted semi-structured interviews with study participants in a large randomized controlled trial (RCT) aimed at evaluating the impact of electronically-based health coaching support on T2DM management. Twenty participants were interviewed about their experiences with health coaching and how it assisted their T2DM management. The trial reported in this study involves a protocol with face-to-face health coach (HC) interactions and smartphone contacts that summate to about one contact hour per week. All HCs received intensive, continuous group training and individual supervision throughout the trial, (nearly 100 hours per coach), delivered by a registered clinical psychologist.

The objectives of this research are to explore qualitative data with a thematic analytic approach to (a) gain insights regarding the individual's experience of living with T2DM and (b) how support from a health coach along with the use of smartphone connectivity can increase (or decrease) self-management behaviours (i.e. dietary changes, blood glucose management and physical activity). We further explored whether intervention intensity was an important variable in enhancing the self-management experience. For example, in a pilot evaluation preceding the current study<sup>7</sup>, intensity and participant engagement was positively related to improved T2DM management. The current study explores this same question in more detail using qualitative methodology. Since quantitative analyses do not capture the whole range of individual experiences and given that the coach-participant relationship is central to the health coaching

experience, qualitative analyses can assist in better understandings of some aspects of patient experience.<sup>14</sup>

## **2.0 Literature Review**

### **2.1 Epidemiology**

As a progressive condition, T2DM and its associated precursor states (i.e. Impaired Glucose Tolerance IGT, Metabolic Syndrome [MS]) are projected to significantly increase in global prevalence over the next decades.<sup>15</sup> Current projections indicate an overall increase in the number of people with IGT from 344 million in 2010 to 472 million in 2030.<sup>16</sup> In addition, the prevalence of T2DM is projected to increase by an estimated 39 percent between 2000-2030.<sup>16</sup> Similar trends in T2DM prevalence are observed across North America, where in 2010, as many as 105 million Americans had pre-diabetes and T2DM (26 million T2DM and 79 million prediabetes).<sup>1</sup> A similar pattern, albeit smaller in prevalence and magnitude, is also seen in Canada where T2DM prevalence is projected to rise to 3.7 million by 2018 from 2.4 million in 2008.<sup>3</sup> Across the developing world, the burden of T2DM is increasing, with 80 percent of T2DM cases worldwide occurring in developing countries (i.e. China and South Asian countries). However, the proportion of younger to middle-aged individuals with T2DM is higher in developed countries.<sup>16</sup>

The increase in T2DM prevalence seen over the years also parallels elevations in major cardio-metabolic risk factors affecting T2DM development. These include: obesity (i.e. abdominal obesity), physical inactivity, and dietary factors (i.e. increased caloric intake).<sup>17</sup> For example, from 1988-2010, the average BMI (Body Mass Index) in the United States increased by 0.37% per year in men and women.<sup>17</sup> During the same time period, the average waist circumference increased by 0.37% and 0.27% for women and men respectively across all age

and ethnic groups. Similar increasing trends were also seen with regard to physical inactivity and energy intake. For instance, between 1988 and 2010, the prevalence of adults with no leisure-time physical activity increased by an estimated 30% in both men and women. Similar trends have also been observed in relation to an increase in caloric intake.<sup>17,18</sup>

T2DM affects individuals of different socioeconomic and ethnic backgrounds disproportionately. For instance, a MEDLINE study conducted from 1976 to 1994, found over 290 articles on T2DM in ethnic minorities.<sup>19</sup> This interest is justified as, compared to Caucasians, ethnic minorities in the U.S. have a 2 to 6 times greater risk of T2DM development.<sup>19</sup> Similarly, in Canada, recent immigrants and individuals of South Asian descent have a higher risk of developing T2DM.<sup>19</sup> In relation to socioeconomic status (SES), data from the Canadian Community Health Survey (2005) suggest individuals from the lowest income groups were 4.14 times more likely than the highest income group to have T2DM.<sup>20</sup> As Canada's population grows due to immigration and new Canadians continue to comprise an increasing population proportion, their health and health care utilization affects long-term health system costs, budgeting and sustainability.

## **2.2 T2DM Pathophysiology and Complications**

T2DM accounts for 95 percent of newly diagnosed cases of diabetes.<sup>21</sup> T2DM begins with insulin resistance, a phenomenon where peripheral tissues become unresponsive to insulin. As a result, progressively more insulin is needed to maintain the body's glucose demand. Over time, however, normal pancreatic function becomes compromised, resulting in diminished insulin production and chronic hyperglycemia.<sup>22</sup> Overall, T2DM is characterized by a combination of impaired insulin secretion and insulin resistance.<sup>3</sup> Physiologically, these dysfunctions are assessed using the Impaired Fasting Glucose (IFG) and Impaired Glucose

Tolerance (IGT) tests.<sup>23</sup>

As clinical states preceding and proceeding from T2DM diagnosis, both IFG and IGT involve elevated blood glucose levels compared to the reference blood glucose levels. Specifically, IGT refers to a stage of disordered carbohydrate metabolism assessed by an Oral Glucose Tolerance test (OGTT). IGT is defined by an elevated 2-hour plasma glucose concentration of (>140 and <200 mg/dl) after ingesting 75 grams of glucose.<sup>23</sup>

In contrast, IFG refers to consistently elevated fasting glucose concentrations that are lower than the diabetes diagnosis thresholds, but higher than the reference range of normal blood glucose levels (100-125 mg/dl). As markers of pre-diabetes, IFG and IGT provide clinicians with an opportunity to identify individuals at a higher risk of developing T2DM. For instance, nearly 25 percent of those exhibiting IFG and IGT will progress to a T2DM diagnosis, with a higher likelihood in those who are older and overweight. Moreover, those exhibiting both IFG and IGT simultaneously, have double the risk of developing diabetes compared to individuals exhibiting only one.<sup>23</sup>

If not treated, T2DM places those affected at a higher risk of developing microvascular and cardiovascular damage.<sup>24</sup> Given their severity, these complications place additional burdens on the healthcare system in addition to reducing the quality of life (QOL) of T2DM patients.<sup>25</sup> For example, diabetic retinopathy, the most common microvascular complication, can lead to blindness and glaucoma.<sup>24</sup> Similarly, diabetic nephropathy can lead to renal failure and pathological kidney changes due to an increased amount of proteinuria found in urine. T2DM patients also have a higher risk of developing and dying from cardiovascular disease, with myocardial infarction (MI) risk among diabetics equalling that of nondiabetics after a previous MI.<sup>24</sup> Possible mechanisms for this higher risk include greater platelet adhesion and

hypercoagulability, impaired nitric oxide generation, and altered calcium regulation.

### **2.3 Lifestyle factors in T2DM Management**

T2DM involves multifaceted interactions between genetic, behavioural and environmental factors.<sup>26</sup> Because behavioural risk factors like obesity and physical inactivity are modifiable, behaviour change is key to reducing complications and disease prevention<sup>27</sup> largely through changes in exercise, stress reduction and diet.<sup>26</sup> Exercise and diet modifications have each been successful in managing diabetes. Each targets a specific problem related to diabetes. Theoretically, when combined, they should deliver increased health benefits. The root of the problem in optimizing combined benefits is not a lack of awareness of the benefits of exercise or diet modification but the lack of expertise in promoting positive health behaviour changes.<sup>28</sup> Adopting positive behaviours that will lead to the individual adopting an exercise routine and/or changing their diet should be the primary focus of intervention methods. Adoptions of exercise, dietary modification and self-monitoring, through behaviour modification, will, theoretically, result in longer-lasting effects in individuals with T2DM.

#### **2.3.1 Exercise**

Exercise is a potentially effective disease management strategy in individuals with T2DM, with current guidelines suggesting 150 minutes of moderate aerobic exercise over a weeklong period, in combination with 20 minutes of resistance training each day for three days each week.<sup>3</sup> Low levels of physical activity and an uncontrolled diet can often lead to insulin resistance and glucose dysregulation<sup>29</sup> exacerbated by increased insulin production from the pancreatic beta-cells, resulting in beta-cell dysfunction and insulin deficiency. Exercise reduces insulin resistance when the glut-4 receptors are up-regulated in striated muscle and adipose tissue. The effect of physical activity on glucose regulation has been powerfully demonstrated by recent

literature illustrating both acute decreases in serum glucose levels and chronic increases in insulin sensitivity and action.<sup>30</sup> Evidence from multiple studies indicate that combined aerobic-resistance training can be very effective in improving HbA1c levels in individuals affected by T2DM.<sup>31</sup> Similarly, a recent study intervened with 251 T2DM patients over a 22- week period to assess the individual and combined effects of aerobic and resistance training. In the aerobic group, researchers found a 0.51% decrease in HbA1c (3 training days per week) and a 0.31% decrease in the resistance group (3 training days per week) compared to the control. Those who engaged in both aerobic *and* resistance exercise training demonstrated an additional decrease in HbA1c of 0.46% when compared to the aerobic only group, and an additional decrease of 0.23% when compared to the resistance only group.<sup>32</sup> To further support this finding, a meta-analysis of controlled clinical trials by Boule et al.,<sup>30</sup> investigated the effects of exercise on glycemic control. In the review, exercise was found to be an effective intervention method in glycemic control and in reducing health detriments arising from diabetes.

The benefits of physical activity have been well established for people with T2DM, yet individuals dealing with the condition report that they receive insufficient support, education and encouragement when it comes to undertaking physical activity.<sup>33</sup> Similar to the struggles individuals face when adopting new dietary habits, stress management techniques and medication adherence, it is challenging to incorporate vigorous exercise into daily routines. This further addresses a lack in cognitive and behavioral support for patients who want/need to make behavioral changes



### **2.3.2 Diet**

Diet is another modifiable risk factor for T2DM development 34 given the association between obesity prevalence and diabetes incidence 34. In addition to body mass, dietary fats and carbohydrates play a role in diabetes development 35. Changes in diet can reduce visceral adiposity, associated with insulin resistance, pro-inflammatory cytokine production, liver fat accumulation, and excess free fatty acid release into the blood. 36 A healthy diet reduces the energy richness of food intake, reducing increases in adipose tissue, particularly visceral adiposity. Excessive caloric intake is a major contributor to poor glycemic control in Type II diabetics. 37A meta- analysis by Anderson et al 37 looked at the importance of weight management in T2DM. They found that twelve weeks of an energy-restricted diet decreased fasting plasma glucose, blood triglycerides, and systolic and diastolic blood pressure. The pathophysiological condition of diabetes results in symptomatic experiences that individuals with diabetes are subjected to in their lives. For this reason, blood glucose self-monitoring brings the symptomatic experience together with management effects through the observation in blood glucose level.

### **2.3.3 Glucose monitoring**

Improved blood glucose self-monitoring is important in trying to engage and empower those diagnosed with diabetes in disease self-management. Self-monitoring can be beneficial in providing the client with feedback and in appropriately treating hypo- and hyper-glycaemia. Glucose control is a metabolic factor that is critical in the development of diabetes complications. The American Diabetes Association and the World Health Organization have used HbA1c, a measure of average glycaemia over the previous 8-12 weeks as a means of diagnoses. The cut-off HbA1c for diagnosis is 6.5%, based on the association of retinopathy. HbA1c is used in

measuring glucose control and many professional groups recommend a target of 7.0 % for most patients, particularly to reduce microvascular complications. In order to achieve optimal glycemic control, effective management is a necessity (diet, exercise, weight loss, and pharmacological therapy adherence). Currently, there is no consensual guidance suggestions on frequency of blood sugar monitoring, as it must be determined on an individual basis.<sup>3</sup> Factors, which play a role, include but are not limited to: adequacy of glycemic control, type of medication and awareness of hypoglycaemia.

In a study by Secnik et al.,<sup>38</sup> blood glucose monitoring and glycemic control were compared and it was found that the greater the number of blood glucose test strips prescribed, the lower the blood glucose levels achieved. Increasing individual awareness of symptoms and how it translates to poor glucose control is important when dealing with behaviour modification.<sup>38</sup> Providing accessible glucometers and strips is of particular importance for people associated with lower SES, who may lack access to services supportive of diabetic management. There have been studies that show the benefits of facilitating access to glucometer reagents. A prospective study by Nyomba et al.,<sup>39</sup> provided free glucometer test strips and found improved glycemic control. Another study by Karter et al.,<sup>40</sup> showed that frequent self-monitoring of blood glucose resulted in significantly lower blood glucose levels in patients with diabetes. Helping individuals with diabetes to adhere to frequent self-monitoring is important in preventing high blood sugar levels that cause health detriments over time.

#### **2.3.4 Stress Management**

As suggested in a recent meta-analysis, depression is associated with hyperglycemia and the increased risks of diabetic complications.<sup>41</sup> Stress management is an area of self-management that helps reduce such psychological co-morbidities and helps in HbA1c reduction, as

demonstrated in three RCTs.<sup>41,42</sup> In a meta-analytic study, Anderson et al. (2001) found that approximately 20% of people living with diabetes report experiencing depression. In addition, depression has been found to be a factor in diabetes prevention<sup>43</sup>, based on prospective studies that show depression increases the likelihood of developing diabetes.<sup>44</sup> Although the exact mechanisms are not fully known, the excessive worry characteristic of General Anxiety Disorder (GAD) is also correlated with diabetes diagnosis. As the prevalence of GAD in Type I and II diabetic patients is estimated to be 14%<sup>45</sup>, problems in psychological health appear to have consequences in diabetes self-management.

#### **2.4 Health Coaching in Chronic Disease Management**

As a chronic condition, individuals with T2DM are faced with day-to-day challenges regarding their self management.<sup>46</sup> This includes glycemic control and adherence to dietary and physical activity recommendations. As a result, there has been a rise in T2DM self-management programs, where individuals with T2DM receive individualized care and attention. Such programs have shown effectiveness at promoting adherence to self-management behaviours.<sup>6,7</sup> Whereas traditional approaches to care tend to be prescriptive and problem-focused, health coaching programs are process-oriented and built on behaviour-change principles (see below). To this end, within the context of a coaching relationship, the client is supported in incrementally improving performance of disease-specific lifestyle behaviours (e.g. regular glycemic control, dietary education, regular exercise, stress management, foot care). At each step, the coach assesses the degree of client adherence while monitoring relapse to facilitate better integration of disease-specific behaviours within the client's basic lifestyle.

## 2.5 Theoretical perspectives

Health Coaching (HC) is informed by a number of psychological theories, notably Motivational Interviewing,<sup>47</sup> Cognitive Behavioural Therapy,<sup>48</sup> Emotion-Focused Therapy<sup>49</sup> and Interpersonal Therapy.<sup>50</sup>

Motivation interviewing (MI) originates from Miller and Rollnick's (1983) research in the context of addiction and alcoholism. MI focuses on motivations to change and reasons for changing, and not changing. As behavioural change models, such as MI, evolved from traditional change models, which have often been fear-based, the trend has been to identify motivational levels, motivational obstacles and levels of ambivalence. As Butterworth et al.,<sup>51</sup> describe, individuals typically know elevated risk behaviours are bad for health, but they may feel helpless to change or are simply unready. A health coach helps uncover avoidant behaviours and, with the client's assistance and alliance, finds reasons for avoidance and for change. A health coach can therefore provide a skilful, consistent, supportive presence while sensitively addressing the personal obstacles to adoptions of new health behaviours.

Originating from Aaron Beck's cognitive theory of depression, Cognitive Behavioral Therapy (CBT) has received considerable attention as a model that describes a constant interaction between behaviour, emotions and cognition, while specifically focusing on how cognitions may be inaccurate and distorted, leading to disproportionate emotional reactions and impaired coping.<sup>52</sup> Individuals are supported in identifying their beliefs, testing their beliefs in real-life situations and then replacing those beliefs with more accurate and realistic beliefs. Since CBT has been successfully applied to different psychological problems, it is suited for individuals faced with chronic conditions, as they are often confronted with additional psychological problems. Furthermore, CBT is a structured process (involving mutual agenda-

setting) and provides an active platform for client participation (homework assignments). CBT is used to challenge and transform self-management related behaviours, addressing cognitive, emotional and behavioural obstacles to change and how these impact motivation.<sup>53</sup>

It is important to point out that any health care professional can undergo training in the theory and practices that, in this study, define a health coach. Examples of health coaches can include professionals from different academic disciplines such as nurses, physicians, dieticians and kinesiologists.

## **2.6 Current literature on Health Coaching interventions in T2DM management**

### **2.6.1 Data Sources and Search Strategy**

A systematic search on HC interventions in T2DM management was conducted across Web of Science, PubMed, PsychINFO, and EBSCO databases for the period of January 1990-March 2015. This included identifying interventions employing HC to better enable patients to manage their T2DM symptoms. Inclusion criteria were: quantitative studies (RCT or Quasi-experimental designs) evaluating the impact of HC interventions in T2DM management among adults (mean age > 18). Outcomes of interest were changes in physiological as well as psychological, including pre-to-post changes in HbA1C, BMI, Waist Circumference (WC), Health Related Quality of Life (HRQOL), and depressive symptoms. Overall, the search of these databases yielded 479 citations from Embase (n= 127), PubMed (n= 204), PsycINFO (n= 36), and Web of Science (n= 112) databases. Search terms included: “Type 2 Diabetes”, “Type II Diabetes”, “Diabetes Mellitus”, “Health Coaching”, “Coaching”, and “Coach\*” combined using Boolean operators. Of the 261 unique citations (after duplicate citations were removed), 201 were excluded based on the review of study titles and abstracts, leaving 60 citations for closer examination. Finally, applying our inclusion criteria, search results were further reduced to 18

citations, including 10 randomized controlled trials, 3 cluster randomized controlled trials (See Table 4.0.) and 5 quasi-experimental studies (See Table 5.0. and Figure 2.0. for a detailed review flow diagram).

### **2.6.2 Randomized Control Trials**

Changes in physiological and psychological indices, including HbA1c, BMI, WC, depression, and quality of life are important indicators of intervention impact. Overall, there were 10 RCTs evaluating the impact of HC interventions on improving T2DM self-management (see Figure 4.0). In a 10-month study undertaken by Cinar & Schou,<sup>54</sup> 176 participants (Intervention (I): 75; Control (C) 101) were randomized to HC or a formal health education (HE) condition. Intervention participants received 5 to 6 face-to-face and 3 to 4 phone call sessions over the course of the study period. The control participants received formal HE (in a less intensive life counselling format) which consisted of a baseline oral examination along with 2 face- to – face and 4 phone sessions over the study period. Overall, compared to those receiving HE, HC participants reduced their HbA1c by a clinically significant margin of 0.6% (P between groups = 0.004). However, changes in BMI, Fasting blood glucose (FBG) and High density-lipoprotein (HDL) remained unchanged or did not achieve statistical significance. Similarly, Wolever et al,<sup>55</sup> examined the impact of 6 months of HC compared to a usual care control condition in 56 older adults (I: 30 ; C: 26). Psychologists and social workers delivered HC by telephone (14 x 30 min. sessions). Phone sessions were individualized and focused on participant personal goals and values. At study completion, there was a significant reduction in HbA1c (P= 0.03) but only among those participants with a baseline HbA1c greater than 7.0, along with secondary improvements in patient activation (P> 0.001) and social support (P= 0.003). Using a culturally-tailored framework (i.e. addressing the needs of a specific population or cultural

group), Ivey et al.<sup>56</sup>, randomly assigned 92 Chinese Americans (I: 46, C: 46) to either 6 months of HC or a usual care condition. Coaching was facilitated by medical assistants in 3 follow up phone calls and 3 physician and dietician visits. Although there was no change in mean HbA1c across groups ( $p=0.36$ ), at study conclusion, a higher proportion of the intervention group achieved diabetes control (i.e.  $HbA1c < 7.0$ ) when compared to the control group ( $p=0.04$ ). However, in a similar program<sup>9</sup> evaluating the impact of a 6-month telephone-based dietician coaching, compared to usual care participants ( $n=47$ ), those randomized to the HC condition ( $n=47$ ) had statistically significant reductions in HbA1c ( $p=0.03$ ), fasting blood glucose (FBG) ( $p=0.02$ ), and diastolic blood pressure (DBP) ( $p=0.03$ ). In this study, HC involved monthly phone calls (20-45 minutes) focused specifically on improving adherence to self-care behaviours.

In another RCT, Thom et al,<sup>57</sup> observed a 6-month peer-led coaching intervention in a sample of 299 (I: 148, C: 151) economically modest English and Spanish speakers. At baseline both the HC and UC groups had similar HbA1c levels. While both groups experienced a decrease in HbA1c, the HC group experienced a greater reduction of (1.07 % vs. 0.30%, ( $P=.01$ )). This mixed-modality coaching program involved 2 or more face-to-face meetings with peer coaches in addition to telephone calls twice a month over 6 months. Despite positive reductions in HbA1C, there was no significant change in other secondary measures, including: BMI ( $P=0.65$ ).

Ruggiero et al,<sup>58</sup> investigated the impact of medical assistant coaching in a low income minority population with T2DM. Participants were randomized to the coaching group (I: 25) or a treatment as usual group (TAU: 25) or a no-contact control group (NCC: 50). The intervention was designed for participants to increase their diabetes knowledge and further equip them to reach self-management goals over a 6-month timeline. Throughout the study, interactions were

brief (less than 30 minutes face to face and less than 15 minutes telephone calls), and involved 2 quarterly visits and monthly phone calls between visits (6 visits in all). Although there was an improvement in HbA1c in the intervention group, this was not significant when compared to other control groups in this study (TAU and NCC). In another study by Ruggerio et al,<sup>59</sup> across 266 participants (140 African American and 126 Hispanics) assigned to a 12-month health coaching intervention, no change in HbA1c was seen over the course of the trial ( $p=.13$ ). Except for foot care, no significant group by time interaction was observed. The intended HC regimen in this study involved quarterly meetings with the coach along with monthly telephone contacts. However, the majority of participants did not receive the intended intervention frequency dose. Reasons for lower dosage was explained due to “no shows” and difficulty contacting individuals between visits.

In another study focused on patients from ethnic minorities undertaken by Frosch et al.<sup>60</sup> 201 African American and Latino patients (I: 100, C: 101) were randomized into a coaching group led by a diabetes nurse or usual care. The intervention consisted of a 24-minute video behaviour support and a workbook along with 5 sessions of telephone coaching with a total of 2.5 hours over a 6-month period. Both groups reduced their HbA1c throughout the program but there was no statistically significant between-group difference in HbA1c ( $p=.49$ ), blood lipid profile or blood pressure.

McKay et al,<sup>61</sup> examined the effects of an internet-based self-management and peer support intervention on diabetes self-management. Specifically, they evaluated the effects of 3 months of personal self-management coaching compared to an information only peer-support, and a combined (information + peer support) group (N=120, equally divided across groups).



While all groups reduced their HbA1c and improved their psychological distress status compared to the information only group, there was no between-group difference.

In another RCT, Whittmore et al.<sup>62</sup> examined the effectiveness of a 6-month nurse coaching intervention for women with T2DM. In total, N=26 were randomly allocated to the intervention and N=23 to the control group. The intervention involved standard diabetes care (regular appointments with primary care provider every 3-4 months) and 6 face-to-face meetings and 2 telephone calls over the 6 months period. The control condition consisted of usual care. Coach sessions followed a protocol, which entailed cognitive, behavioural and affective components. Results showed a significant improvement in dietary self-management ( $p=0.02$ ) and psychological distress ( $p=0.01$ ). Although HbA1c did improve at 3-month mark it did not reach significance ( $p=0.64$ ).

Using a cluster randomization strategy (randomly allocated by medical practices), Quinn et al.<sup>6</sup> investigated the effects of 12 months of mobile telephone feedback system and provider health coaching support. N = 163 participants from 26 practices were randomized to one of four conditions: (a) usual care (UC), (b) Coach Only (CO), (c) Coach and Portal access (CPP), and (d) Maximal Treatment (Coach + CPP) and provider decision support (CPDS). The intervention involved a patient coaching system (mobile and web-based) along with provider clinical decision support. Over the course of the intervention, compared to UC, there were statistically significant reductions in HbA1c in the CO ( $P = 0.02$ ), CPP ( $P = 0.45$ ), and CPDS conditions ( $P = 0.001$ ) when compared to UC. The CPDS patients had significantly greater HbA1c reductions across all study time points when compared to UC ( $P = 0.001$ ).

In another study using a similar randomization strategy (randomized by medical practices), Blackberry et al.<sup>63</sup> evaluated the impact of a telephone-based HC program across 59

general medical practices in Victoria, Australia (473 T2DM patients, I: 236,C: 237). The HC program involved coaching by nurses who delivered five telephone-coaching sessions at six-week intervals. A median of four coaching sessions were delivered per participant over 18-months at average durations of 30 minutes per session. However, at study conclusion, there were no significant between-group differences in HbA1C, lipid profile, weight, or Diabetes Self Efficacy. Considering the importance of fostering a sustained personal relationship between coach and participant in HC program, it is not surprising that this lower intensity program did not produce significant changes in outcomes. Similar concerns regarding the impact of HC intensity were also echoed in a RCT study by Patja et al.<sup>64</sup> where coaching delivered as monthly phone calls across 12 months failed to achieve significant change in HbA1c .

Comparable findings were also seen in a life coaching and pharmacist counselling intervention for middle aged adults.<sup>12</sup> This study focused on a multi-component intervention with 190 adults (I: 128, C: 62) who were randomized to either life coach/pharmacist counselling or the control condition (treatment as usual). Over the course of the 12-month study, participants met with coaches on an individual basis with an average of 10 sessions lasting 1 hour in length. HbA1c at 6 and 12-month follow-ups were non-significant (p=0.24) however there were small and significant changes in BMI (p=0.004), Diabetes self-efficacy (p=0.002) and QOL (p=0.01).

### **2.6.3 Quasi-Experimental Trials**

Health coaching interventions appear customize-able to multiple ethnicities and socio-economic strata (SES) as indicated in a pilot one arm trial by Wayne and Ritvo.<sup>7</sup> This one arm trial implemented health coaching with T2DM patients from multi-ethnic, diverse SES backgrounds and found significant reductions for patients with HbA1c levels > 7.0 % (N = 13)

( $p = .04$ ). Significant results were also seen in other physiological outcomes more specifically: Weight ( $p=0.02$ ), BMI ( $p=0.05$ ) and marginal significance in WC ( $p=0.06$ ).

In another one arm trial, Naik et al.<sup>11</sup> focused on outcomes of ( $N=8$ ) older adults in a telephone based coaching by non-expert mental health coaches. The intervention consisted of 10 30-45 minutes sessions delivered over a 3-month period. Sessions were collaborative and focused on self-care behaviours and barriers to such self-care. A structured patient workbook was used as a guide to help better facilitate the behaviour change process. Post intervention reductions were seen in HbA1c at 3-month ( $d=0.36$ ) and 6-month ( $d=0.28$ ) follow up. Similar improvements were reported in the Patient Health Questionnaire-9 (PHQ-9) and T2DM related distress.

Similarly, a mixed method study by Krok-Schoen et al.<sup>65</sup> examined a 24-month trial, looking at 29 older adults coached by medical students. Participants met 4 times face-to-face and corresponded by e-mail/telephone another 4 times. The results revealed no change in HbA1c ( $p=0.92$ ) but significant and meaningful improvement in the social functioning dimensions of HRQOL along with a movement toward the action/maintenance stage for physical activity ( $p=0.04$ ).

In another culturally-tailored HC intervention among 727 (I: 368; C: 359) African Americans,<sup>66</sup> coaching was delivered face to face over 36 months and designed to provide individualized office base care management and follow up as part of usual care. Sessions lasted for 30-60 minutes, which were broken down as follows: 4 sessions involving a nurse practitioner, pharmacist, dietician and traditional physician visits. For an additional 24 months patients were followed up every 3-6 months and statistically significant changes in HbA1c were observed from baseline to 18 months ( $p<0.05$ ) and 36 months follow up ( $p<0.005$ ). The proportion of patients

achieving an HbA1c less than 7.5% and/or systolic blood pressure (SBP) of less than 140 mm Hg was also significantly greater in the intervention group.

In another non-randomized trial, Navichareern et al.<sup>67</sup> investigated the effects of nurse coaching on diabetic complications, which included: HbA1c, BP, LDL. Over the course of the 12-week program 20 participants received 3 individualized face-to-face meetings along with 2 follow up telephone calls. Both groups reduced their HbA1c but with no statistically significant between group differences.

Overall several studies are supportive of HC as an approach to improved self-management. However, several have also not shown specific improvements in glycemic management. Since there is not uniform definition of HC,<sup>68</sup> a better understanding of its important components and optimal delivery strategies will greatly inform future practices. These specifically involve: a) HC dosage, b) content of sessions/intervention and most importantly c) training of intervention providers.<sup>68</sup>

## **2.7. Electronic Monitoring/Communication**

The current literature describes many approaches and different modalities to health coaching (i.e. personal, telephone and electronic). In order to help individuals make healthy lifestyle choices and to better self-manage, health-care providers require more effective methods for doing so.<sup>69</sup> Face-to-face consultations can be complemented by mobile phone and computer-based technologies with potentials to change the delivery of health messages and support. The devices and software used in electronic communication in support of health behaviour change are becoming less expensive and now, more than two thirds of the world population own mobile phones.<sup>69</sup> Facing rising costs, healthcare systems around the world are exploring innovative ways

to improve efficiency. Particular attention has been placed on the use of technology to help manage long-term health conditions.<sup>70</sup>

Technological devices can support T2DM self-management as they enable instant feedback of behaviour-change methods. Discussions regarding behaviour change can happen immediately, in contrast with weeks or months later, as often is the case with face-to-face visits with doctors and other health care providers. An increasingly large number of patients with access to mobile phones and related software can be monitored at relatively low costs. Patients can receive, share and access health information anywhere and anytime.<sup>5</sup> These forms of technology allow patients to remain in contact with health professionals via health monitoring along with instant voice, text and chart communications. Using electronic communication, HCs can monitor and detect change (lapse/adherence/relapse) immediately. This immediate type of feedback and communication results in possible discussions and interaction in the moment rather than communicating at the next visit with the health care professional, which could be days, weeks or months later.

The promise of electronically-linked health coaching involves optimizing time outside of treatment contexts through behaviour changes leading to autonomously improved glycemic control at modest costs. This was recently demonstrated in a mobile-phone health coaching intervention that improved glycemic control ( $p=0.01$ ) and patient satisfaction ( $p=0.04$ ) while saving 8.8 % in net costs<sup>5</sup>.

Several researchers have studied health coaching paired with electronically-linked remote monitoring and have reported benefits for glucose regulation<sup>5,6,55,62,715,6,62,71,72</sup>, dietary control<sup>73</sup> and medication adherence<sup>74</sup>.

## 2.8 Past Qualitative Research in Patients with T2DM

Contrasting to the wide array of quantitative research gathered surrounding T2DM, there have been few studies using a qualitative approach (interviews) with the patients as their data source.<sup>75</sup> In this effort, we follow colleagues who have used qualitative methods to investigate health-coaching with other chronically-ill populations. In the past decade, a vector of qualitative research has explored diabetes care and self-management practices, with findings suggesting adherence to targeted health behaviours is impeded in individuals with low or modest socioeconomic status (SES) because of demanding schedules with limited flexibility.<sup>76</sup> Nonetheless, the promotion of patient empowerment with culturally-specific sensitivity supports effective behaviour change in these populations.<sup>76</sup> Self-management is hard work and due to personal and situational barriers, some individuals with T2DM may find it difficult to actively manage their condition. Contrary to popular belief, an increase in knowledge of diabetes does not simply improve glycemic control.<sup>77</sup>

For example, a 30-day, patient-centered intervention was aimed at empowering patients and caregivers with coaches trained in education/advocacy for older, chronically ill, adults. The intervention focused on: 1) medication self-management, 2) follow-up communications with health care providers, and 3) knowledgeable self-management with the aim of patient mobilization<sup>78</sup>. Upon completion of the intervention (30-45 days after), 32 participants were contacted about participating in an individual interview or focus group. Participants discussed their experiences of the intervention and emphasized that their coach instilled them with increased confidence and encouragement re: their health management skills. Individuals also reported that their interactions with their coach assisted them with medication management and what to look for when experiencing adverse affects. Another qualitative study examined the

experience of 3 T2DM patients with 2-hour interviews after a health coaching intervention.<sup>14</sup> The intervention involved education, peer support, and one-to-one coaching at a frequency determined by the participant's relative adherence level with target behaviours. Participants described health coaches as assisting in more autonomous and confident self-management<sup>14</sup>. In a similar study, Urowitz et al.<sup>79</sup> evaluated the experience of patients and providers using an online diabetes management portal, one of a number of investigations that produced encouraging results in terms of internet-based tools, which facilitate diabetes self-management. The participants were recruited from a large sample of 887 of which 854 utilized an online diabetes management portal for a 6-month period. Out of the 854 patients who consented, 17 individuals agreed to participate in an exit telephone interview. The goal of this study was to demonstrate the effectiveness of an online chronic disease management portal along with increasing patient engagement in diabetes self-management. Four themes were identified through the analysis: 1) patient awareness of their disease, 2) barriers to portal use, 3) patient- provider communication and relationship and 4) recommendations for portal improvement. (See Results Section).

Results from another study by Dufour et al.<sup>80</sup> showed similar findings in terms of program evaluation. This mixed method study evaluated (N=16) participants in 1 of 3 focus groups. The intervention of the study included face-to-face sessions with a registered physiotherapist and certified health coach. Participants were enrolled into bi-weekly group programs that included: HC sessions, exercise training and mindfulness-based stress reduction (MBSR) classes. Findings uncovered 6 major themes discussing the group dynamic of the program, the comprehensive care offered, and the perceived control of health status.

Another study by Ralston et al.<sup>81</sup> focused on diabetes self-management program based on an interactive medical record. As with the previous studies, communication between patients and

their health coach is an essential part of enhancing patient security in terms of their health. Participants had the ability to access their medical record, secure e-mail, and had the ability to upload glucose, diet, exercise and medication. In the examination of the data, 6 themes emerged, however the study was limited to discussing 3 of the most important/relevant themes. 1) Valuing non-acute concerns-participants expressed how much they appreciated an environment where any ongoing medical conditions were valued. 2) Feeling secure- participants further identified that they felt a “virtual presence” and that the practitioner was watching them, and 3) Disappointment from unmet expectation- participants described their frustrations when the program failed to work. Overall, the literature places emphasis on the importance of the design and evaluation of the program. In order to achieve optimal symptom resolution further understandings of patient ‘ease of use’ and satisfaction with use are crucial.

## **2.9. Behavioural Barriers to Chronic Disease Management: Qualitative Studies**

To achieve optimal disease management, barrier identification is critical<sup>82</sup> and a recent meta-synthesis<sup>27</sup> evaluated all literature involving qualitative analyses aimed at understanding the self-perceived challenges of individuals coping with T2DM. Qualitative articles relevant to self-care and/or self-management in adult patients with diabetes were included. Ninety-five articles were categorized from twenty-one articles and further categorized into barrier-themes of stress, frustration, social isolation, interpersonal conflict, depression, and fear<sup>27</sup>.

In a systematic review by Nam et al.<sup>83</sup> researchers looked at various cross-sectional studies, randomized controlled trials (RCTs), observational studies, and qualitative studies examining several perspectives on patient and health care providers’ barriers for diabetes management. Eighty studies met inclusion criteria and were included in analyses. Researchers concluded that poor self-management, specifically inadequate glycemic control, is reflected as



challenging for patients and clinicians. In order to address barriers of self-management such as adherence, beliefs, attitudes, knowledge, ethnicity/culture, language ability, financial resources, comorbidities, and social support, a collaborative relationship between practitioner and patient must be developed. Due to the complex nature of diabetes, studies suggest a need to further understand how patient barriers are related to each other <sup>83</sup>.

A similar study explored patients' perceptions about diabetes self-management and reasons for poor health outcomes. Four focus groups were conducted, consisting of predominately African-American patients. Findings suggest an association between non-adherence to diabetes self-care recommendations and poor communication with providers, a lack of understanding/knowledge of their condition, sub-optimal blood glucose self-monitoring, and psychosocial factors such as depression.<sup>82</sup> Analyses further suggest clinicians can influence patients' perceptions through effective communication skills in an integrated healthcare approach.<sup>82</sup>

Onwudiwe et al.<sup>82</sup> further discussed the increased prevalence of T2DM in ethnic minorities and emphasized the interaction of minority ethnicity and socioeconomic factors (SES) in the exponential increase of diabetes incidence and related complications. The burden of diabetes disproportionately affects minorities with a prevalence of 11% among African-Americans vs. 8% among Caucasians. Research involving individuals with T2DM at lower SES is thus particularly important because low SES levels predict T2DM complication.<sup>19</sup> A qualitative study<sup>76</sup> published in 2010 with 60 participants with T2DM sampled at regional community-based health centres in Ontario demonstrated that T2DM becomes appreciably more challenging while living in poverty. This study emphasized a significant need to provide a client-centered approach, emphasizing four themes: 1) Resilient struggle amidst hardship; 2)

Balancing competing priorities; 3) Making best use of support systems, specifically Community Health Centres; 4) Using knowledge and bodily knowing in diabetes self-management, especially bodily cues to recognize if blood sugar levels were in control.

In another study by Furler et al.<sup>84</sup> examined four focus groups (N=52), within a socioeconomically and culturally diverse location of Melbourne in Australia. This study was aimed at identifying how health professionals (coaches) can support individuals with self-management strategies. Results suggested that the relationship between a health professional and their patient was important, however it is vital to take into account the context of the patient (e.g. looking at the cultural, emotional and psychological factors).

## **2.10 Current Evaluation**

In summary, T2DM is an increasingly prevalent condition with substantial personal and economic burdens. In order to reduce these burdens, early identification and intervention using effective preventive strategies, along with better self-management in those affected, have shown to prevent T2DM complications. What follows will be a qualitative evaluation of a HC program in an economically modest population.

## **2.11 Qualitative Paradigm**

Research paradigm and determining one's theoretical orientation is a central aspect of qualitative research. Paradigm, or theoretical framework, is widely defined as a set of values and philosophical assumptions guiding investigation.<sup>85</sup> Specifically, these include: beliefs about ontology (e.g. the nature of reality) and epistemology (e.g. the nature of knowledge and the relationship between the researcher and the object of study).<sup>86</sup> Research paradigms often take contrasting ontological and epistemological positions. According to Krauss,<sup>87</sup> central to qualitative research is the study of phenomena in context. In contrast to quantitative research,

where quantification of aspects of phenomena is important, qualitative research takes a holistic approach to understanding phenomena from multiple perspectives or multiple realities. For example, under a constructionist framework, multiple perspectives converge to explain phenomena under investigation.<sup>88</sup> The constructivist paradigm can thus be employed to address a wide range of perspectives, including the positivist positions often linked with RCT methodology. In the present study specifically, individual experiences of diabetes management, along with the role of health coaching in facilitating diabetes management, was studied under a constructivist framework.

### **3.0 Methods**

#### **3.1 Study Design**

The current study is a qualitative evaluation of the larger Type 2 Diabetes Mellitus (T2DM) self-management randomized controlled trial (RCT) undertaken at Black Creek Community Health Centre (BCCHC) in Toronto, Ontario, Canada. Over the study period (December 2011-April 2014), 105 participants with T2DM were recruited and randomized into either the full intervention (6-month health coaching program) or the enhanced usual care groups. From these randomized participants, 11 interview participants had been randomized to the full intervention and 9 to the enhanced usual care group.

The study assessments took place at baseline, and at 3- and 6-month follow-ups. The primary outcome of the trial was change in HBA1c along with changes in anthropometrics (e.g. Weight, Body Mass Index (BMI), Waist Circumference (WC), and psychological characteristics. The intervention arm of the study received electronically-based health coaching (HC), which entailed unlimited interactions with a personal health coach through either personal interactions or smartphone and related health software. In the enhanced usual care of the study (control arm),

individuals received health coaching with limited participant-initiated interactions without smartphone support. The rationale for an enhanced group was to reduce attrition through personalized care that did not make use of the potential unlimited connectivity.

In addition, since the formation of a personal relationship is a central aspect of health coaching, upon completion of the research trial, participants were invited to take part in an exit interview to address specific questions regarding their personal experience and perspectives on the role of health coaching and electronic connectivity in enhancing self-management.

### **3.1.1 Participants**

Participants included residents of the Jane-Finch community and those receiving services at the BCCHC between the ages of 18 to 70 years who were all diagnosed with T2DM and expressed interest in participating in the research trial. Participants ranged in age between 32 and 69 years, with an HbA1C greater than 7.3. All of the participants were enrolled in a health coach study that compared individuals who received a mobile device with a self-management application versus those who did not. Inclusion criteria for both the health coaching and interview study were 1) Confirmation of T2DM; 2) between the ages of 18 to 70 years; 3) an HbA1c > 7.3(uncontrolled diabetes). In total twenty individuals participated in qualitative interviews conducted from June to November 2013. (See Figure 1.0)

Participants were from diverse educational and ethnic backgrounds. Tables 1 and 2 outline the demographic characteristics of participants. Overall, N =11 intervention participants agreed to be interviewed along with 9 control participants. Of the 20 participants (4 males and 16 females), 10 participants (50% percent) were Black Caribbean and 3 were Caucasian (15% percent), 2 were Hispanic (1%) and 1 of each South Asian, Latin American, Filipino and Guyanese backgrounds (.05%). Another important demographic characteristic is that of

employment: 6 participants (30%) were unemployed, 6 participants (30%) were employed full-time and the rest of the participants were self-employed, retired or worked from home (see Tables 1 and 2).

### **3.2. Research Site**

The study took place in collaboration with the BCCHC located in a low-income neighbourhood of Toronto, Ontario. Community health centres (CHCs) employ inter-disciplinary professionals and offer both medical and social care services. BCCHC's catchment area serves a high number of recent immigrants, from a variety of ethnic backgrounds, many of whom otherwise face barriers in accessing quality health care.

### **3.3 Qualitative Methodology**

In relation to qualitative methodology, we chose thematic analysis to explore relevant themes surfacing during participant interviews. Thematic analysis provides a systematic approach in identifying patterns and logically organizing qualitative data into broader common and representative themes. It aims to logically organize data into broader recurring themes (e.g. data reduction) to better explain aspects of the phenomena under examination.<sup>89</sup> Our analytic strategy of constant comparison included: code-development (SP and FA) as the basic analytic unit capturing important aspects of data, and, based on codes, the derivation of broader themes (team discussions) illustrating a coherent picture of collected data<sup>89</sup>. In addition, all participant perspectives and T2DM self-management experiences were explored in the context of the changes in HbA1C levels achieved, an index of long-term glucose control<sup>3</sup>. Given the diversity across content analytic methods, it is important to examine their assumptions prior to formulating an analytic strategy. These include: An exploratory (content-driven) approach vs. a confirmatory (hypothesis-driven) approach and inductive vs. deductive analysis.<sup>86</sup> In this project, we

specifically focused on inductive analysis, which is an exploratory process in nature, meaning that themes and codes are not predetermined; rather, they are driven by the data.<sup>90</sup>

In summary, the thematic analysis process includes: (a) systematic and uniform transcription of the gathered interviews, (b) developing codes as the basic analytic unit capturing relevant aspects of data, (c) summarizing codes into broader themes, and (d) creating an organized and coherent picture to illustrate major themes within the data.<sup>89</sup> Specific to our analysis, this included looking at the interconnections between participant, their health coach, and the role of electronic facilitation in establishing and maintaining new health behaviours.

Specifically, within thematic analysis, initial questions are open-ended, allowing for the participant to describe how they feel towards a specific issue. Questions become more specific with probes, whereas quantitative research begins with closed-ended questions looking for a more specific response. Having open-ended questions allows for individuals to speak openly and freely, further allowing for multiple perspectives to be taken into account. A thoroughly comprehensive understanding of participant perceptions of the intervention will help refine the intervention when deployed in the future.

### **3.3.1 Coding and theme identification**

All coding and analyses were performed using Nvivo (v. 10)(QSR International) using a thematic analytic approach<sup>86,89</sup> exploring relevant themes surfacing during participant interviews. Coding and theme identification are central elements of qualitative data.<sup>91</sup> In this way, once coherent patterns arise and are identified, they are further categorized under larger themes.<sup>91</sup> Specific to our analysis, this includes looking at the interconnections between participant, their health coach, and the role of electronic facilitation in establishing and maintaining new health

behaviours. Once convergent themes, reflecting a range of distinct participant experiences, were identified, they were organized under broader core themes.

### **3.3.2 Analysis and organization**

Analytic coding and theme identification are central elements of qualitative data. Using semi-structured interviews, participants were asked to reflect on their experience and challenges within the program. The questions were developed using previous research and practical on-site experience and were designed to be open-ended, accompanied by probes for more specificity, which are closely related to the participant's experience.

### **3.3.3 Interview Process, Questions, and Transcription**

Upon completion of the six-month trial, individuals were invited by phone or face-to-face contact to participate in a 30-45 minute semi-structured interview. This interview technique allowed for flexibility in participants' self-report style, allowing them to elaborate on specific information openly and at their own pace. This level of flexibility may not always be achieved in focus group studies. Furthermore, semi-structured interview allows for the interviewer to pursue ideas/responses in more detail. All participants were asked to come to BCCHC, where interviews were conducted by a member of the research team (SP) trained in interviewing techniques. Interviews ran between 30-45 minutes in length. Written informed consent was obtained (Appendix B). We projected to interview as many participants as possible prior to reaching. Presently, there are no uniform criteria in defining saturation; rather, the marker of sufficient sampling in a study will depend on particular study goals, namely accurate and in depth ranges of participant responses.<sup>92</sup> Although saturation was judged to be achieved at 12 interviews, the research team opted to analyze all 20 interviews, to further ensure that no new information was obtained.

Interview questions (Appendix A) were developed by the lead investigator (PR) from prior research evaluating health-promoting interventions, and then modified and further developed with other team members (SP and NW). Interviews were conducted, reviewed, and transcribed verbatim by a graduate student (SP) specializing in qualitative research and reviewed for accuracy by all members of the investigative team (FA, NW, PR, SP).

Given the opened-ended nature of the questions, participants were encouraged to elaborate on initial responses, providing further clarification when this was requested by the interviewer. Interviews were transcribed verbatim, with the researcher listening to recordings several times to gain a comprehensive understanding of information communicated by the client and to become further familiar with the data. It must be acknowledged that there was an outsider transcriber, therefore to avoid bias in the diversity of opinion amongst the transcription, all records were re-checked by (SP) for accuracy and consistency.

The collection of data occurred over a period of approximately 5 months (June 2013- November 2013). The RCT had randomized 105 participants, 48 of whom were eligible at that time to be recruited for qualitative interviews. All eligible participants were contacted (either by phone or face to face) to participate. 28 individuals could either not be reached (n =27) or declined (n=1). In total 20 individuals participated in the qualitative interviews (Intervention n= 10, Control n= 9). (See figure 1.0.)

### **3.4 Materials**

The materials used in the study included a tape recorder to increase accuracy for transcription at a later date. Nvivo (v. 10.0, QSR International) program was used to organize and code data. Qualitative work also acknowledges the trained interviewer and interview question guide as vital research instruments.



### 3.5 Ethical approval

This study received ethical approval from York University's Human Participants Review Subcommittee (HPRC #2013-095). Accordingly, participants were provided with an informed consent and verbal clarifications. To maintain confidentiality, personal information was removed from transcripts (e.g. name, age, education level, income). Audio recordings were kept in a locked cabinet in the researcher's office and once transcripts were transferred to a computer, all files were placed on a password-protected USB Key. The research had no anticipation of risk in harming individuals but perhaps had some minor benefits increasing client awareness surrounding their experience of diabetes self-management.

## 4.0 Results

### 4.1 Analysis of Core Themes

Thematic analysis identified four major themes. The theme of **Smartphone and Software** pertained to phone utility and self-activation through self-awareness, self-feedback, self-management and monitoring. The **Health Coach** theme focused on HC's overall qualities, supportive role, working style and focal activities around diet, medications, blood glucose and exercise. The cross-cutting themes were participants' **Overall Experience and General Frustrations in Managing Chronic Conditions**.

Findings from the intervention group are presented below. The relevant control group findings are described following each theme when applicable. Key points regarding similarities and differences between the groups will be highlighted and discussed (See Table 6.0. for a Representation of Themes)

#### 4.1.1 Theme 1: Smartphone and Software

Two themes emerged with regards to the smartphone and the health monitoring software. These were (1) **Smartphone Utility** – which refers to direct and indirect experience of use. Direct experience refers to: tracking with the smartphone and the usefulness of the smartphone as a visual cognitive aid. Indirect experience refers to the ease of use of the smartphone and how the smart phone served as a reminder. (2) **The Activation of Self** explores mechanisms of self-awareness, self-feedback, self-management and self-monitoring.

##### 1) Smartphone Utility

The utility of the mobile phone and its application emerged as a dominant theme across interviews. Smartphone utility describes participants' perception and/or experience with how various functions of the application were useful or not. These discussions had two underlying concepts: direct functions and indirect functions.

##### Direct Functions

The discussed direct functions refer to the technical features of the smartphone. This included discussions on its features of tracking health behaviours, including the photographing of meals and communicating with the health coach. Individuals described using these technical features for multiple aspects of managing diabetes and lifestyle modifications.

*I had liked it because it was a way of sending all the information to (my health coach). I didn't have to tell her ... (referring to blood sugar and walking steps) all this thing was good. (Intervention participant #11-Change in HbA1c: -2.0%)*

*(My health coach) tells me (to) put all my food on it (the smartphone). And...sees whatever I put there. (Intervention participant #8- Change in HbA1c: -1.1%)*

Participants agreed that when logging photographs of food, those pictures were helpful as a visual aid for providing feedback. Having the image saved to the device and the ability to go back and review with the health coach was helpful in terms of food portion control, co-

monitoring, and self-management. It was the immediate moment modification that was helpful.

Participants used the smartphone at different times and places. Most agreed that they logged their food, sugar and their exercise in the device at least twice daily.

*I could just take a picture and see (the) ...picture (which) is worth a thousand words... So that was extremely helpful, it has a visual record of what I have done and all I needed to do. (Intervention participant #1-Change in HbA1c: -0.6%)*

*I...use the one (tracker) with the glucose, the one (tracker) with the food and the one for exercise. You do any exercise; you put it on (the smartphone). (Intervention participant #8-Change in HbA1c: -1.1%)*

*All the time, I would use Blackberry for my breakfast, for my blood sugar, for my exercise recording, and for my lunch for my snacks, for my dinner, all the time! (Intervention participant #9- Change in HbA1c: -0.4%)*

### **Indirect Functions**

Indirect experiences refer to more general and non-technical features of the smartphone leading to perceptions of utility. These included discussions surrounding the smartphone's ease of use and how it served as a reminder tool for individuals. Participants discussed their learning curve to use the smartphone. They learned how to use the device with prompts from their health coach and most had little difficulty afterward. However, some individuals had trouble with the size of the font and others took more time to adjust to the new technology, as they had never used a smartphone in the past. Only one person interviewed refused to use the smartphone but still engaged and communicated regularly with the health coach.

*For me it became easy. Initially when learning it, it was a... learning curve...it had...a lot of different options and functionalities... I didn't try to get familiar with all those functions, I just (tried) to learn what...(was) directly related to what I was doing... When it came time to actually do the exercises I actually consulted (health coach), and said. "Okay fine explain to me what I do with this." (Intervention participant #1-Change in HbA1c: -0.6%)*

*No it's not (hard to use) (health coach) go through, explain, show me and everything how to use it. So I understand clearly how I was supposed to use it. (Intervention participant #7-Change in HbA1c: -1.7%)*

*No, I leave it (cell phone) at home. I never (had) a cellular phone...Yeah, (the health coach) (had) to teach me how to use it because I'm allergic to those. No, no, I don't want it. I am the old-fashioned guy. (Intervention participant #10- Change in HbA1c: +0.2%)*

The smartphone served as a tool reminding individuals to “stay on top of things”, and helped participants track their behaviours. The presence of the Blackberry was beneficial in terms of reminding individuals to self-manage and be agents of their own health. Individuals discussed how the Blackberry served as a prompt, reminded them not only to check on their self-management behaviours but also to continue to log and track further with the application.

*It was a helpful reminder of keeping a check on my blood, my blood work. Keeping a check on what I eat, my meals what I shouldn't eat, what portion or whatever. (Intervention participant #4-Change in HbA1c: -1.1%)*

*It's helpful because...I remember I have the BlackBerry, I have to eat, I have to do the things that I have to do, right. So BlackBerry came (as a) reminder. (Intervention participant #7-Change in HbA1c: -1.7%)*

*The phone is helpful because at least it reminds you -when I'm about to eat, better have the food near (me) (to) take the (picture). I have one slice of bread when I (could) have three. (Intervention participant #8-Change in HbA1c: -1.1%)*

Among control group subjects, despite regular face-to-face health coach contact, some expressed the desire to have additional contact enabled by the smartphone devices. Others felt it would be too complicated to track behaviour via smartphone when already tracking by pen and paper, with help from dietitians and nurses. Also, individuals perceived how it could be too much of a personal and financial commitment, which may be a deterrent to continue the study.

*Using the blackberry and... seeing the dietician at Black Creek... I have to do so much checking for them. I have to do a lot a lot of checking with the strips. The government only (allows a) certain amount of strips so...if I use too much of the them you can't get them back until the end of the month. (Control participant #1-Change in HbA1c: - 0.5%)*

*For people like me ... I don't think I needed that (the smartphone)...I (wouldn't) have continued. (Control participant #7-Change in HbA1c: -1.5%)*

Some participants described nervousness about using new technologies and using them properly. Upon study completion, one individual received the smartphone application on his personal phone device. He experienced difficulty using the app, but enjoyed that he could now take photographs of his meals and keep better track of his portion sizing.

*I'm scared of those things (smartphone)... I didn't want (it). . (Control participant #3-Change in HbA1c: -1.3%)*

*(The smartphone) helps... Remember you tell me about the portion? I have it but I don't know how to use (it). (I use it with my doctor)... I have picture(s) of it (my food). (Control participant #8-Change in HbA1c: 0.4%)*

## **2) Self-Activation**

The mechanisms through which participants achieved an activation of self were: self-awareness, self-coach feedback loop, and heightened sense of responsibility for self-management and self-monitoring. The presence of the smartphone and its applications motivated individuals in various ways including enhancing self-monitoring behaviours.

### **Self-Awareness**

Participants recalled that the smartphone increased their self-awareness of particular habits, notably dietary-related behaviours. Having taken pictures of their plate was described as helpful in terms of becoming more aware of portion control and carbohydrate intake. Many expressed how the application was valuable in terms of current behaviour and how they could move forward in the behaviour change process. Many participants also described it as a tool to connect blood sugar and food choices.

*I have this food to eat and it's like measuring, whereas I wouldn't measure my food before...The talk was then that I had to be able to manage what I'm eating, what I'm putting in my (mouth). So when I take a picture of it... when I have to take a picture then it's like well... you can't eat that... So it made me think. Had to be thinking all the time what I'm going to eat. This is the right way and this is the wrong way. And up to now it trained me. So it helped me. It helped me a lot. (Intervention participant #11-Change in HbA1c: -2%)*

*You have instant feedback, not only in terms of actually punching all of the information but being able to go back and see the meals, and may even question yourself, “did I eat that?” “Lord, was that me? (Intervention participant #1-Change in HbA1c: -0.6%)*

*Yeah I would say in between because the phone you have to use it every day and you have to do things in it every day so you’re much more aware. (Intervention participant #6-Change in HbA1c: -0.1%)*

*You know, you kind of question yourself on getting feedback... you can also look back “So, here is what my blood sugar reacts to that kind of meal, at that time, therefore, if I’m going do that I need to reduce the portion of that.” So you are not only questioning yourself, (but) you look at patterns and ask how do I change that pattern to better in the future. (Intervention participant #1-Change in HbA1c: -0.6%)*

*(The information) is always there so you can go back and look at it, so that was a great feature for me. It did help me to know that I have a system and I have use it because I have to come here, it helps self motivation. (Intervention participant #1-Change in HbA1c: -0.6%)*

### **Self-Coach Feedback Loop**

The phone allowed for a feedback mechanism to a supportive individual (health coach) who was directly interested in helping the client. Participants shared how they could see their meals and then receive instant feedback from their coaches on where improvements could be made. They felt the smartphone was an effective tool for providing feedback, and enabled communication with their health coach. Being able to look back at previous history was beneficial in terms of identifying where changes could be made when discussing with health coaches.

*When I come you guys can check it and see what you know and tell me if I’m doing good or ...bad. The phone is very good because it motivates me more. (Intervention participant #4-Change in HbA1c: -1.1%)*

*You’re seeing what it is and can criticize it more. You shouldn’t have this or that is too much of what you have there and give an idea (where you) must cut. (Intervention participant #8-Change in HbA1c: -1.1%)*

*So that is I think very important thing... you can get feedback right away (Intervention participant #9-Change in HbA1c: -0.4%)*

### **Responsibility towards Self-Management and Self-Monitoring**

Participants expressed a sense of responsibility about their self-management. The smartphone was supportive in the role of self-management, as individuals explained how they used it to monitor their dietary, exercise and/or blood glucose patterns and modification in behaviours. Participants stated that, regardless of the specific design, the actions of recording and reviewing records of their eating habits were inherently motivating, important facets of diabetes management and a mechanism to help ‘keep yourself honest about what you eat’ via self-monitoring of eating behaviours. However, they also acknowledged that generating these records required work and to achieve sustained use of these tools, the tools should be designed so that each act of recording a meal is coupled with some form of reward at the time of data entry.

*(With the) BlackBerry I had, (I would put in) the (food) that I eat... the picture, and then when I poke myself, I (would) put how high the sugar is. (Intervention participant #7-Change in HbA1c: -1.7%)*

*It was a helpful reminder of keeping a check on my blood, my blood work. Keeping a check on what I eat, my meals what I shouldn't eat and (portion size). (Intervention participant #4-Change in HbA1c: -1.1%)*

*And the phone helped me in everything... It encouraged me and I still keep on doing it now. (Intervention participant #11-Change in HbA1c: -2%)*

Individuals expressed gains in awareness of self and responsibility to their behaviours. Control clients also tightly self-managed and were self-aware of their newfound behaviour patterns. Many changed their diet, exercise and blood glucose testing habits. Patients discussed attending workshops run by providers in order to further increase their knowledge surrounding specific areas of interest. More than half also described how their A1c had changed throughout the study, that they had made specific changes to their diet and exercise and they could feel a difference in their energy level and overall health. Few participants described how they saw changes in their diabetic symptoms though they felt the need to have better control on their

management techniques. It seems like participants in the control group had partially unmet expectations.

*(I have made changes) with the food and exercising. The diabetes itself I (feel it) still (needs) control... (if my sugars could) settle, like instead of having three high days, if I could lessen it down (to) like maybe four or five (days) (and avoid it going) up high when I'm eating. (Control participant #1-Change in HbA1c: -0.5%)*

*Since I started...coming to ...Black Creek (I am) managing it (my diabetes) better...I go to the (Diabetes) Workshops...and (Healthy cooking) classes. (Control participant #5-Change in HbA1c: -0.2%)*

*When I exercise...my blood sugar goes down...when I continuously do the exercise and I can see it goes down like four notches sometimes, which is really nice. (Control participant #7-Change in HbA1c: -1.5%)*

*I couldn't bend my knees, I couldn't do exercise, and now I feel ...I active...and have little pain. (Control participant #8-Change in HbA1c: 0.4%)*

#### **4.1.2 Theme 2: The Health Coach**

All participants shared positive experiences about their health coach, and views about being supported in the behaviour change process, with understanding and encouragement. Analysis of these discussions revealed four sub-themes: **(1) Overall Qualities; (2) Supportive Role; (3) Working Together; and (4) Focal Contact Activities.**

##### **1) Overall Health Coach Qualities**

Participants discussed several qualities of health coaches, which laid the foundation of their relationship. They were perceived as: hardworking, persistent, prompt, confident, and culturally sensitive. Most agreed that their health coach was hardworking and provided consistent monitoring along with immediate feedback. Some described the gradual approach as one step at a time as a meaningful quality in their learning to use smartphones and modify behaviours.



*She's ... confident in what she's doing, serious about what she's doing. I think she look(s) like she love(s) her job. (Intervention participant #2-Change in HbA1c: -2%)*

*(All) people have some kind of reservation or some kind of necessities, and I love that when I shared with (Healthcoach) about fasting the whole month (for Ramadan) how much he supported (me), how much he was positive, it was wonderful (Intervention participant #9-Change in HbA1c: -0.4%)*

These general qualities of the health coach were appreciated by all participants. In the words of a participant, “*She did her utmost best so I think she did an excellent job in coaching me and I’m very grateful for that*” (Intervention participant #6-Change in HbA1c: 0.1%). Appreciation was discussed in multiple forms; some of the words used by participants were: best, nice, positive, generous, supportive and dedicated.

*(Health coach) is the best, yes, the best of all the coaches. She's the best, she knows everything (Intervention participant 10-Change in HbA1c: 0.2%).*

*Health coach) monitor(ed) what I ate, having regular interviews with me, calling me all the time to discuss how I was feeling, to ensure that I took my blood tests when I come here. (Intervention participant #5-Change in HbA1c: --0.5%).*

*She's a nice person, that's all I know (Intervention participant #2-Change in HbA1c: -2%).*

Several participants described their health coach as “helpful”. In one participant’s words, “*(Health coach) did a lot, (health coach) couldn’t have helped me more. I mean I appreciate all her help.*” (Intervention participant #4-Change in HbA1c: -1.1 %).

Individuals in the control group further described similar general qualities of the health coach. These perspectives were alike to the intervention group as described above. One participant even thought of telling his physician he received “more care” from his health coach.

## **2) Health Coach’s Supportive Role**

A key component described by participants was that the health coach was “always by their side”. This assessment helped alleviate the feeling of being alone and misunderstood. Trust was also important in the strengthening of the relationship. Not only were individuals able to discuss their situation surrounding diabetes, but also felt comfortable revealing their daily and personal struggles, as coaches were described as “easy to talk to”. Some of the participants were more explicit describing their emotional support as it went beyond their diabetes and body health. This emotional support was provided via phone and face-to-face communication.

*It was easy for me to (talk to) her. We talked about everything...how I’m feeling, my kids, my grandkids... We also talk about the sugar...she listened. (Intervention participant #11 – Change in HbA1c: -2.0%)*

*When I'm stressed, I call her. She talk to me...and it was helpful, you know. So she helped me in every way. (Intervention participant #7-Change in HbA1c: -1.7%).*

*I think this study helped me emotionally a lot, more than physical, I feel emotionally happy. So that is very... important for me. (Intervention participant #9-Change in HbA1c: -0.4%).*

Another supportive role discussed by some participants was the reminders made by the health coaches. These included not only verbal reminders (such as for appointments, smartphone use, etc.) but also served as an indirect reminder to carry out healthy behaviours.

*Well it's helpful to me because like (Healthcoach) keep(s) calling and remind(ing) me that I have something to do ...Working with (a) (Healthcoach), I get reminded that okay... you have to have something in the morning. (Intervention participant #7-Change in HbA1c: - 1.7%).*

Other supportive roles included filling out applications, providing support, explaining when unclear, providing extra materials and encouragement.

*So (Health coach) was quite helpful... in walking me through the report (and) application I had to fill out ...and helping me to understand the blackberry, and to plug into your website portal. He was very clear in explaining all of that to me... if I needed some... exercise material (he would provide it) so I could do a little practice at home. (Intervention participant #1-Change in HbA1c: - 0.6%).*

*Because they were very persistent (with) monitoring what I have been eating, as soon as I sent a picture they would call back immediately to tell me that I was doing okay and if there was something that they were not satisfied with they would let me know immediately. They didn't wait until after a week or so. (Intervention participant #5-Change in HbA1c: 0.5%).*

Similar supportive roles were discussed by the control participants (being helpful, easy to talk to, etc.). Although receiving various degrees of support from their health coach, control participants expressed how they communicated intermittently and sparingly over the course of the program. Individuals noted that they would have liked to have seen their health coach more frequently and have had more times available for them to use the exercise facilities.

*Well (we did not communicate much)... only when I (had) the interview with her (Health coach) or only if I needed to get an appointment. (Control participant #1-Change in HbA1c: - 0.5%).*

*I guess (I met with Health coach) every two weeks or every month, I don't remember. (Control participant #9-Change in HbA1c: -0.3%).*

### **3) Working Together**

Participants and health coaches worked as a strong team using various techniques such as ongoing communication and active listening. Good listening skills of the health coach were mentioned by half of the participants and they felt that being heard further opened communication channels to work together. Teamwork was further facilitated by feedback loops. For example, the behaviors that were logged into the device provided a platform for participants and health coaches to communicate and work together via phone or in person. This particular feedback was valuable in terms of making changes and meeting personal goals. On the participant's side, taking a picture of a plate of food allowed them to pause, think and reflect on their food consumption. On the health coach side, the coaches referred to specific meals (via image), blood glucose levels or exercises to discuss possible patterns and appropriate modifications. Through these teachable moments, a strong tie was developed between health coaches and participants. Such an example of teamwork was discussed in relation to program-specific activities (diet, exercise, glucose monitoring, medication): *see more details in the following section.*

*(Health coach) ...was teaching me how to exercise and she was pushing me to hard work...and it was good for my diabetes. (Intervention participant #10-Change in HbA1c: 0.2%).*

*(Health coach) asked me "what did you have... for breakfast?"... "what is this?". We had a lot of typical South American foods...so I tried to explain to (her). (Health coach) (evaluated) the food and... told me no, no, don't take two of (these), next time take one. She told me about that. (Intervention participant #10-Change in HbA1c: 0.2%).*

*After I took the pictures of what I ate and sent them in, (Health coach) would either call me on the phone or ask me to come in person to discuss my eating habits. (Intervention participant #5-Change in HbA1c: 0.5%).*

Some participants discussed becoming more critical of their own behaviour, such as food and exercise leading to rich discussions with health coaches. The participants were activated to the extent that they became co-monitors. Through this experience, some felt that health coaches were always watching them despite them not being physically present.

*So I can ... have a plate of spaghetti ... but then I'll say no I have to take a picture of the portion... and just focus on what ...my portion is that I have to take. (Intervention participant #4-Change in HbA1c: -1.1%).*

*It was like the doctor looking at you. I have to do this, I have to test my blood sugar, I have to test my pressure, how much exercise well that you do at the end of the day or if you do it you come in you record it. Your meal, what you eat it's like you have this eye looking at you on the phone. (Intervention participant #6-Change in HbA1c: 0.1%).*

*Yeah, the phone is helpful because ...it reminds you.... Somebody else is seeing it. So the phone is like a spy. (Intervention participant #8-Change in HbA1c: -1.1%).*

A few participants explained that they felt somewhat uncomfortable in the beginning that someone was watching their diet and blood glucose levels through the smartphone. However, with time they realized the benefits and became comfortable with the health coach observing their behaviours. One participant even shared that the whole family was engaged when taking pictures of food. A few mentioned that a little bit of a push from the health coach was helpful at times.

*This is... sometime(s) uncomfortable. "Oh my goodness somebody is going to judge you" ... sometimes when you(r) repeatedly eating the same foods... you feel, " Oh somebody can see like how repeatedly you are (eating) leftovers" ... (Healthcoach)... normalized and (explained that)" ...it's okay ...So that's why I was comfortable.*

*Blackberry was my watcher. Somebody is watching you through your eyes. Because at the time, it was so interesting, (my) whole family was involved in... the study. (Intervention participant #9-Change in HbA1c: -0.4%).*

*I realized that she is doing (it) (pushing me) because she loves what she's doing and she wants the best... for me. And I have to accept it. (Intervention participant #10-Change in HbA1c: 0.2%).*

*Working with (health coach) was a great help, he was always that support for me, again encouraging, doing a little you know rear kicking ...when he (had) to in order to get me going again. (Intervention participant #1-Change in HbA1c: - 0.6%).*

The control group participants talked about working together but the emphasis was weak compared to the intervention group. However, it can be concluded that the participants from this group did work with their health coach in order to establish closeness and to achieve desired health behaviour results.

#### **4) Focal Activities**

All participants agreed that their health coach had assisted them in specific areas related to diet, glucose testing, medication and exercise. Individuals discussed the various ways in which their health coach helped improve their forms of self-management.

#### **Diet**

Individuals described that they worked on dietary-related behaviours with their health coach, specifically on: portion control, monitoring, carbohydrate intake, and ethnic- specific food choices.

*I think we met and she asked me what did you have this day for breakfast, what did you have for...what is this? We had a lot of typical foods, South American, tortillas...I tried to explain...what this is.... what is that...she evaluate the food...told me no, don't take two of this, next time take one. (Intervention participant #10 – Change in HbA1c: +0.2%)*

*...she teach me how to eat, what I had to eat. (Intervention participant #3 – Change in HbA1c: - 7.1%)*

*I have my carbohydrates...Jamaican dumplings...I had three one day. He (would say) “you gotta eat less than that...” ...I stick to rice or bread, potatoes...those are my carbohydrates...in moderation... (Intervention participant #8 - Change in HbA1c: -1.1%)*

### **Medication**

When participants discussed the role of the health coach and medication, few went into detail. Many individuals spoke about their medication briefly with their health coach at the beginning of the intervention, and some had difficulty remembering if medication ever came up as a topic of conversation. Other participants identified that they changed medications over the course of the study.

*Well we talk(ed) about it, and then (the Healthcoach) (told) me to talk to the doctor. (Than the doctor) (gave) me another (Diamicron). (Intervention participant #7-Change in HbA1c: -1.7%).*

*We never discussed medication, but I had to let the (Health coach) know what I was taking at home. I brought them in but we never discussed them further. (Intervention participant #5-Change in HbA1c: 0.5%).*

### **Blood glucose**

The majority of participants described their days coming into the health centre and testing their blood glucose before and after exercise and witnessing changes in their blood sugar levels. Some started testing before the study began while others started upon study commencement. The health coach and participant would converse over blood glucose readings and provide advice on the interpretation.

*When I come we talk about everything that is going on in my life, what happened, why (my sugar) was a little bit higher (or) lower. (Intervention participant #11-Change in HbA1c: -2%).*

*(If) My sugar (is) high, (Health coach) will explain ... There can be things to eat or something to drink to make sure it's okay. ((Intervention participant #2-Change in HbA1c: -2%).*

### **Exercise**

Exercise was also part of participant conversations with their HCs. Participants described how their health coach encouraged and motivated them by teaching them various techniques to perform particular exercises tailored to their personal needs. With this in mind, individuals

discussed how they were able to take what they had learned and put it into everyday practice at home.

*Well (Health coach) ...was teaching me how to exercise and she was pushing me to hard work...to work, and it was good for my diabetes. Every time that I say to (Health coach), (she knows) special exercise for my knees or for my back. (Intervention participant #10-Change in HbA1c: 0.2%).*

*So it's not only the medicine or only the food; the exercise has an important part of the treatment, so (Healthcoach) was very aware that I'm doing the right exercise, how many times... how long, how many minutes in a week. I remember that (Healthcoach gave me a pedometer). (Intervention participant #10-Change in HbA1c: 0.2%).*

*He assisted me with ... (the) exercise bands, (and) at home so I could do a little bit. One (band) is a basic. and one the red one was a little more taught... I was able to do some of that at home. So these are some of the ways, that he has really... assisted me (Intervention participant #1-Change in HbA1c: - 0.6%).*

Members of the control group also worked with their health coach on the specific focused activities mentioned above (diet, exercise, medication and blood glucose). However, several of them described working closely with their registered dietician compared to health coach. Similarly, medication was not a topic commonly discussed between the health coach and participant.

*Health coach was always asking me about (my diet), and I was always asking him questions. But it was my dietician (from the centre) that had been giving me (diet) advice. (Control participant #7Change in HbA1c: -1.5%).*

One activity, which was further discussed by control clients, was the topic of stress management. Their emphasis on stress management was much more than participants in the intervention group. Many described that their health coach educated them about the importance of stress management, how to cope with life stressors and suggested mindfulness meditation as a specific practical technique.

*Healthcoach even helped me because I have a lot of stress in my life...he told me... stress is not good for your body and stuff like that. (He told me) how it affects all your organs and raises your*

*sugars...he is trying to tell me to cut my stress down. (Control participant #5 Change in HbA1c: -0.2%).*

Unlike the intervention group, almost all the control group members participated in at least one or more of the mindfulness meditation sessions offered. Many attended sessions on a weekly basis using meditation as a form of stress reduction and relaxation. Some individuals further expressed that they were able to take the lessons learned and practice in their own home. Others explained how they wanted to come in for sessions, yet found it challenging to come in more regularly due to life stressors, difficulty of the practice and other commitments.

*I did it (meditation) once a week for a few weeks...but after a while it was hard to squeeze every thing in ...I have other appointments and a sick relative. (Meditating) on my own I can't do it as good as with the (meditation leader), with him I can concentrate, at home (I can't). (Control participant #5 Change in HbA1c: -0.2%).*

#### **4.1.3 Theme 3: Overall Program Experience**

Overall experience highlights factors that influenced participants after completion of the intervention. This theme reflects what participants 'took away' from the program. They described increased control and confidence in dealing with their condition and a substantial gain of knowledge about diabetes management. Four sub-themes emerged from the broader theme of the program, which included, **1) Joining the program 2) Program Facility for exercise 3) Participant experience.**

##### **1) Joining the Program**

The majority of participants described their motivation for joining the study as a desire to gain better control of blood sugar levels. Others joined to gain increased professional support with their diabetes. Participants heard about the study through multiple sources: health practitioners, community outreach, flyers and word of mouth.



*When I first came here ... I was in really bad shape. (My) sugar was very high. The A1c was high too. My goal was to really get everything ... down to normal and I think that's what we achieved. (Intervention participant #11 Change in HbA1c: -2%).*

*I went to the doctor and my sugar was so high...and then (she told) me about the study...(and that)...it could help...with your sugar. (Intervention participant #7 Change in HbA1c: -1.7%).*

*I usually get community announcements (of) community events that are occurring...I think somebody from the city sent me this... poster or flyer, in a pdf form about the ...program. (Intervention participant #1 Change in HbA1c: -0.6%).*

*In my building I saw a sign posted from the Black Creek Community Health Centre and it mentioned about helping seniors so I attended the meeting and there was someone who came to talk about the diabetes and referred us to come here. So I called him immediately because I knew that I was not getting any support, all the doctors were doing just giving me the tablets, they did not advise me sufficiently. (Intervention participant #5 Change in HbA1c: 0.5%).*

*One of my girl (friends) in the class with me... gave me this number... And that's how I heard (about it) (Intervention participant #8 Change in HbA1c: -1.1%).*

### **Adherence and Program Commitment**

Participants reported varying levels of commitment. Some individuals expressed commitment through adherence, where others felt they needed the program to maintain their current self-management behaviours. Commitment to completing the program as initially planned was also expressed as a form of adherence. On the other hand, some individuals showed dependency upon which they became reliant on the program. They described feelings of anxiety as to what would happen to their monitoring once the program was complete. One participant was critical of the various activities and perceived it as “lots of work”.

*Well, see, I'm a person of habit.... If I have to do it... I keep on doing. (Intervention participant #11 Change in HbA1c: -2%).*

*It makes you feel very dedicated, you know you have to do this ...it's like a commitment you make and ...it's important for you and your health. (Intervention participant #7 Change in HbA1c: -1.7%).*

*It's a commitment. ... It's kind of a burden too. You are doing (it) for yourself and you are learning massive benefits, but it is a commitment. You are taking pictures, even when you are (in) massive... hung (er) you... have to wait, you are taking picture, and you pricking blood*

*sugar and then you recording. Its lots of work to do. (Intervention participant #9 Change in HbA1c: -0.4%).*

*I know (the Blackberry is) there each day to show exactly what I am doing, whether I was improving, I was adhering to the rules and so. (Intervention participant #5 Change in HbA1c: 0.5%).*

Participants expressed how they felt too reliant on their coach and their newly formed routine. They described their fear of relapse to less vigilant health behaviours upon intervention completion. Individuals also discussed their worries concerning their exercise regimen, and how they would be able to continue without the help and support from their health coach.

*I think people really get dependent on (program). And that's the truth because it was like I can't go (anymore). That's how you feel. As though you're ... in a letdown stage because you had everything set up to go and you were going every day and now ... It's like withdrawal. You have to go, do something. You know you're not doing it anymore. You don't want to get too (dependent). (Intervention participant #11 Change in HbA1c: -2%).*

*I have to be a little more organized on my exercise, because I was relying a lot on the Exercise Room. I love to come here, and... get support and (check) if I'm doing (the exercises) right, you can say reassurance. ...I don't want to hurt myself, I don't want to damage (myself) with the wrong moves. (Intervention participant #11 Change in HbA1c: -0.4%).*

Control participants identified reasons similar to intervention clients for joining the study (re above: weight loss and health concerns) but differed in adherence and commitment styles. For example, several asserted the program was a major commitment, preferring the control group over the intervention, as there was room for flexibility.

*I wish I (could) come (exercise) but I don't have time. (Intervention participant #5 Change in HbA1c: -0.2%).*

*If I wanted to be more motivated or forced I could go (to the intervention group). For people like me I don't I needed that. (Intervention participant #7 Change in HbA1c: -1.5%).*

## 2) Program Facility for Exercise

In relation to the program exercise facility, participants expressed that it was convenient to have a program in their local area, making it accessible (no transportation was required) and accommodating.

*(Other providers)... are quite far away, you guys are actually walking distance from me. (Intervention participant #1 Change in HbA1c: -0.6%).*

*I'll do everything... to be around the area... I don't drive. I don't have (anybody) to depend on to take me. I have my family doctor all the way down Finch and Bathurst, for me to go there I have to get transportation and I'm not in a position of getting (that)...If I can just walk across the road to Black Creek, (or)...walk across the road to Jane and Finch Mall (Intervention participant #4 Change in HbA1c: -1.1%).*

All participants voiced concern about the size of the exercise room. Due to the lack of space, individuals felt it would affect their program attendance, leaving them less days to participate. Another concern, which was discussed, was the exercise equipment. Participants explained how having additional equipment would be beneficial, as most individuals enjoyed the treadmill, leaving little time for all participants to use it. Individuals also expressed that it was important that the program offer an in-clinic component, meaning that the purely remote program was not desired.

*The space ...is the most important thing. (Intervention participant #10 Change in HbA1c: 0.2%).*

*I... used to (come to the exercise room) three times a week, but then lately it was very busy so I was (going) two times a week... and one time ...(to the) exercise class. (Intervention participant #9 Change in HbA1c: -0.4%).*

*That would be nice... getting one more treadmill, 'cause we got (one) treadmill for the entire (group)... and everybody wants to go on it. (Intervention participant #2 Change in HbA1c: -2%).*

Like the intervention group, control participants accessed the exercise facility and appreciated the exercise facility at a similar level of intensity. Some explained that they went to

the exercise classes while others simply enjoyed the layout and ambiance of the exercise room facility. One client did not use the facilities and explains as follows:

*“I’m busy at home, I go out Monday, and I’m busy at home on Tuesday, and Wednesday I’m out shopping. So I don’t have time to come up here for exercise”.* (Control participant #4 Change in HbA1c: -0.1%). This quote also relates back to the idea, that exercise in itself is a time commitment and requires significant behavioural change.

### **3) Participant Experience**

In addition to the specific benefits associated with the smartphone and health coach described earlier, participants also discussed their overall learning experience, social support and the program qualities. Most individuals described their experience as positive, associating it to the relationships developed not only with the health coach, but also with participants of the project, and coupled with motivational factors. In terms of overall learning experience, participants expressed that they felt better educated on self-management skills and the symptomology of their conditions.

*Confidence, emotional support, physical fitness, and feeling great about myself. (I) Feel very much... in control and (feel like a) role model for others, these are the values of the study.* (Intervention participant #9 Change in HbA1c: -0.4%).

*The thing that I like most (was that) what I have learned so far I’m able to practice... at home.* (Intervention participant #5 Change in HbA1c: 0.5%).

#### **Value of Education**

The value of education was described as to how participants gained knowledge regarding their self-management. For example, one participant explained how she not only gained a foundation of diabetes management, but she is now able to cope with the condition and can help others:

*During the time of the six months I had learned a lot that I didn't know about diabetes and I can help other people with whatever ... I know about diabetes and how to cope with diabetes. (Intervention participant #4 Change in HbA1c: -1.1%).*

*The program (gave) me some knowledge of ... diabetes that I didn't know before. It helped me a lot about how to take care of (my) food and ...exercise. I appreciate that. (Intervention participant #10 Change in HbA1c: 0.2%).*

*You have to learn a habit. I mean to say (the program is) like teaching you what to do and I think I learned tremendously. The habit was formed within (a) month. (Intervention participant #11 Change in HbA1c: -2%).*

*I know how to cleanse my fingers before (testing sugar), doctors did not tell me that and here I learned all that. (Intervention participant #5 Change in HbA1c: 0.5%).*

In terms of social support, the majority of participants emphasized the value of the relationships they built through the support of social networks. Supportive relationships were described by participants as strong connections with health coaches, volunteers and community members. This one-on-one connection and the ability to communicate with someone regularly was also discussed.

*You meet friendly people here... I do appreciate that a lot and I value that. (Intervention participant #11 Change in HbA1c: -2%).*

*What I value really is that there was someone you can speak to. You weren't just given a directive and left ...by yourself. Do it or don't do it, that's your business. But there was someone you could speak to all the time. (Intervention participant #8 Change in HbA1c: -1.1%).*

*So the benefit of coming here established a connection... developing some partnerships that have assisted me to remain consistent, and committed...I think was a great benefit. (Intervention participant #1 Change in HbA1c: -0.6%).*

Lastly, in terms of program qualities, participants expressed how the program was helpful, a good reminder and, above all, individuals were particularly motivated to participate in a program where the financial costs/burdens were non-existent.

*Yeah because (the program) is a big motivation in my life, I don't know about anybody else's life but it's a very positive thing for me and... and with all that's going on in my life I need positive things. (Intervention participant #6 Change in HbA1c: 0.1%).*

*Before I couldn't say well yes I'm taking my medication. I'm taking everything I am still feeling the same way right but now. With this program I know I'm feeling better, I know I'm better with whatever is going on with me. (Intervention participant #4 Change in HbA1c: -1.1%).*

*I've been very grateful (for) the program and it has helped me a lot, especially because of the exercise and the diabetic dieticians... cost a lot of money. You have to pay private, it's very expensive and here you find the same level of (professionalism) in all the trainers, the coaches, and the dieticians. Very good program. (Intervention participant #10 Change in HbA1c: 0.2%).*

The control group participants also similarly described the overall program experience.

One participant stated, “ *(The program) was flexible...I didn't feel forced at all. It was like I volunteered and everything that was being done was voluntary...It's a friendly environment as well*”. (Control participant #7 Change in HbA1c: -1.5%). Another individual discussed a more negative experience in relation to blood sugar assessment offered at the exercise classes before and after exercise. She said, “*That's why I don't come back...some people... are too noseey...they want to see it (your blood sugar reading) or your (blood pressure reading.*” (Control participant #9 Change in HbA1c: -0.3%).

Although the control group participants had an overall positive experience with the program, their discussions in the interviews focused heavily on health coaches, contrary to the intervention group. This is possibly related to having no smartphone and less time involved in the exercise program.

### **Program Length**

When asked about the length of the study, answers were varied. Some participants expressed how they wanted to continue the program for a longer period of time, approximately up to 12 months. They felt this would be beneficial in order to keep up their newly adopted behaviours and also reach goals, which may have not been obtained. Others agreed that six months was an appropriate amount of time to make changes in their self-management. Overall, individuals agreed that the six-month time frame went by very quickly.

*I want to continue (the study) longer...The changes are very ... slow. And I don't know if I have too many (things to change)... my blood (sugar)... my weight, my pressure. (Intervention participant #10 Change in HbA1c: 0.2%).*

*If the only thing that can be managed properly is reduction of your A1c and getting your diabetes under control at least getting your grips in management, then you have to stick to that...I certainly know that six month can do it, it did for me, it started out as three months and I was committed to that. But six months is good for me. (Intervention participant #1 Change in HbA1c: -0.6%).*

*If it goes on for longer, it would be good too...It seems short, but the time is there. So, well, maybe some people would like it longer... It didn't matter to me whether (it goes on) for a year. Six months was good for them to note your behaviour . (Intervention participant #8 Change in HbA1c: -1.1%).*

*Yeah because (the program) is a big motivation in my life, I don't know about anybody else's life but it's a very positive thing for me and... and with all that's going on in my life I need positive things. (Intervention participant #6 Change in HbA1c: 0.1%).*

*I've been very grateful (for) the program and it has helped me a lot, especially because of the exercise and the diabetic dieticians... cost a lot of money. You have to pay private, it's very expensive and here you find the same level of (professionalism) in all the trainers, the coaches, and the dieticians. Very good program. (Intervention participant #10 Change in HbA1c: 0.2%).*

*During the time of the six months I had learned a lot that I didn't know about diabetes and I can help other people with whatever ... I know about diabetes and how to cope with diabetes. (Intervention participant #4 Change in HbA1c: -1.1%).*

In terms of program length, participants in the control group also had similar reactions to the intervention. Due to the study design (both groups receiving 6 months in trial) the differences in participants' perspectives were not expected to be different.

#### **4.1.4 Theme 4: Frustrations in Managing Chronic Conditions**

Both the intervention and control group participants expressed general frustration in terms of managing their conditions with a particular focus on: **1) Medication and blood glucose levels, 2) Diet/ Weight loss, 3) Co-morbidities**. Participants in the intervention group also referred to the smartphone, health coach and general program and are presented in subsequent themes. Overall, it seems that in the control group, more individuals were noted as moderately or

severely frustrated, compared to the intervention group, where most participants were mildly frustrated. Individuals spoke more openly about their stressors and sought support from their health coach. In doing so, many from this group participated in weekly mindfulness meditation sessions. Stressors described included family/home, financial, social and mental concerns

### **1) Medication and Glucose Measurement**

All participants in both groups discussed taking medication as a particular type of frustration. Both injection and oral medications were noted as a combined adherence challenge and the self-administration of several medications was difficult to track and complete. There was a common pattern of aversion to medications, as well as some honest disclosure of lapses in adherence.

*I used to feel weak and (wondered why I felt this way)...(Medication) is helpful to me, but to tell you the honest truth sometimes, I don't take it. I (I see how I am feeling)... and I eat a lot of celery. (Intervention participant #7 Change in HbA1c: -1.7%).*

*I'm working to get rid of all medicine, period... I don't think medicines a good thing for you so I'm trying to eat right (and) exercise. (Intervention participant #11 Change in HbA1c: -2%).*

*I sleep for eight, nine hours straight with my medication because they interact. (Intervention participant #6 Change in HbA1c: 0.1%).*

*(I want to) stop the diabetes...I don't want to get into the insulin. (Intervention participant #10 Change in HbA1c: 0.2%).*

Individuals discussed the challenges of sticking to their medication regime. As one participant stated *“I'm supposed to take my medication before I eat but I was taking it after... sometimes I forget...I take four (pills) and I can't even remember the name.” (Intervention participant #4 Change in HbA1c: -1.1%).*

It seems as though poor adherence to medication is common among participants, however with the support of the health coach, adherence improved over the course of the intervention.



Participants were further frustrated by having to check blood sugar levels and did not always feel confident about the consistency of their regulation reflected in readings. Participants discussed reasons for the lack of consistency in normal levels of glucose, for example, sensitivity to diet and emotional/physical stressors.

*Just the other day I find myself (not) eating a lot. And you know why? The doctor changed my medication, Diamicron, Jenuvia. I don't remember it doing anything for me. Two months my sugar was just sky (high). Up and down, the lowest it would go is eight. I would have half of a sandwich and (my sugar) would double to 22. (Intervention participant #8 Change in HbA1c: -1.1%).*

## **2) Diet/weight loss**

Over the course of the program participants expressed specific modification to their dietary regime. Both intervention and control group participants struggled with their weight and weight-loss goals. Changes included but were not limited to, reduction in carbohydrate intake, increase in fruits and vegetables, limiting portion sizing and eating more frequently. These changes in diet were expressed as difficult, especially in following what were perceived as strict rules that conflicted with cultural factors and strained financial resources.

*I should have been having more vegetables ... I couldn't afford more. (Intervention participant #5 Change in HbA1c: 0.5%).*

*I don't cook. My wife is the (cook)... all my life (its has) been that way. I don't know, in my culture ... men are not allowed to go into the kitchen. If I have a special diet, my wife is going to have the same and I don't want to deprive (her) so it's not fair. So I think it's very difficult to follow the rules of the dieticians. (Intervention participant #10 Change in HbA1c: 0.2%).*

Although weight loss was the goal of many participants, and some indeed lost weight over the course of the study, most remained at the same weight. Individuals expressed frustration with diets and weight-loss struggles. Three participants working with a weight loss specialist explained how their experience was not successful due to extremely low carbohydrate and low calories. They suffered hypoglycaemia, and upon resuming “normal” eating they gained back

weight immediately. Similarly, weight was also attributed to social norms and cultural background, to which individuals strongly associated their diet and weight concerns.

*(I was sent) to this (doctor)... what he wants you to eat is murder, just leaves and egg white...But I couldn't handle it because my sugar was just dipping all the time. ((Intervention participant #8 Change in HbA1c: -1.1%).*

*I wanted to lose weight, I wanted to lose like 20 pounds, that was my objective in my head I was thinking okay six months 20 pounds is good but I think (I) only lost two. (Intervention participant #6 Change in HbA1c: 0.1%).*

### **3) Co-morbidities**

All individuals in the intervention and control group suffered co-morbidities, which further hindered diabetes management. Examples include: high cholesterol levels, chronic pain, arthritis, lupus, mental health difficulties and hypertension. These co-morbidities made diabetes self-management more challenging, with most noting that they could not attend their scheduled appointments and were unable to meet exercise goals because of other health appointments.

Some individuals also expressed apprehension regarding their health status, explaining how they were always worried something was going to happen to them.

*In terms of the benefits I would have loved to have more but due to my chronic illnesses it prevented me from doing most of what I wanted to do. I have type 2 diabetes, high cholesterol, I have a pituitary tumour, I have macular degeneration, I'm taking the injection in the eyes, I have carpal tunnel in both hands. I have a lot on my plate but that shouldn't like affect me in terms of my physical thing except for those three, those three is are killers (very) painful. (Intervention participant #6 Change in HbA1c: 0.1%).*

Analogous to the intervention participants, individuals within the control group described their experience of being on several medications and how it was difficult to stay on track with them.

## 5.0 Discussion

The current study was a qualitative evaluation of an HC program designed to support self-management in poorly managed T2DM patients, which was aimed at investigating participant experience in a highly detailed manner within a larger RCT focused on quantitative assessment. Our specific aims were to gain a better understanding how patients experienced the health coaching relationship and other aspects of the intervention. We wanted to understand program elements from the participant-user perspective, particularly focusing on the electronic (smartphone) support, which were integral to program delivery and participant engagement. Overall, our findings can be summarized by referencing three themes: (1) use of the smartphone and software in participant engagement (2) role of the health coach in facilitating behavioural change, and (3) overall patient experience and day-to-day frustrations with managing T2DM.

### 5.1 Smartphone Use and Electronic Connectivity within a Coaching Relationship

From review of the qualitative analyses, it appeared the interventions were most effective when the smartphone operations *and* personalized health coaching interactions were perceived as independently functional and optimally coordinated. Positive opinions were expressed about the impact of smartphone uses on health coach alliances, with most discussion that focused on each frequently including mention of the other. In particular, use of the smartphone was critical in teaching self-management skills, especially in enhancing awareness of habits, and in establishing rapport with coaches: the positive impact of the smartphone appeared substantially increased by positive health coach interactions and vice versa.

Interview findings pointed to the relevance of multiple self-report trackers (on the smartphone) and multiple health coach characteristics. For example, participants viewed the food photo-journaling smartphone function as important but only when coordinated with positive

characteristics of the health coach (hard-working, persistent, helpful) and the therapeutic alliance (supportive, always by their side). Specifically, the direct exposure of food selections enabled by the photo-journaling function was only useful when the health coach was viewed as highly supportive and sensitive during co-monitoring activity. It was unclear whether participants would maintain the photo-journaling and related benefits without the support of the health coach, and whether the health coaches would be as effective in counselling the intervention group without the photo-journaling.

Findings regarding connectivity and software use were present in a similar study that discussed how the use of tracking and communicating through a web-based system regularly with the HC was effective in increasing patient support <sup>81</sup>. Contrary to *our* findings, many participants in the aforementioned study described disappointment with the software <sup>81</sup>, whereas in the current study there was found positive appreciation. It was further emphasized that having a health care provider with a constant presence (24 hours a day) (when compared to episodic connections) was helpful in engaging participants in behavior change. It is also important to note that positive views of smartphone functionality in our study were expressed by individuals who seemed to be unsatisfied with program benefits, while less positive views of smartphone uses were expressed by individuals who appeared more satisfied with the program support. These findings provide some confirmation that participants were not biased by the overall glucose regulation achieved. Most of the subjects interviewed had significant HbA1c benefits from the intervention. For the present sub-sample the average change in HbA1c in the intervention group was a mean reduction 1.38% (SD=2.08) while it was 0.84% (SD=1.78) for the entire sample (See Table 3.0.)

## 5.2 The Health Coaching Relationship in Facilitating Behavioural Change

Another major theme that emerged was the role of the health coach in facilitating behaviour change. For individuals living with T2DM, successful disease management requires consistently carrying out several self-management tasks. The health coach plays an important role in bridging the gap between traditional medical care and personalized care, taking the unique life circumstances of participants into account and assisting them in navigating episodes of ambivalence and relapse, while enhancing adherence to personal goals. The importance of the role of health coach has also been discussed across other investigations (see literature review section). In particular, data suggest that having another individual to be accountable to and related social support are important aspects of successful management programs<sup>72,93</sup>. In our investigation patients consistently reported positive interactions with their health coach and many provided specific examples of how the intervention contributed to enhanced self-management knowledge and skills. Our data further suggest the health coach was consistently referenced as 'strength' of the program, as the HC relationship provided participants with direction and support throughout their engagement. The combination of perceived competence and a caring relationship appeared to elicit behaviour change. Similar findings have been reported in the broader literature. For example, a study evaluating HC intervention by Parry et al.<sup>94</sup> investigated methods of improving care transition in chronically ill older adults. Patients reported positive interaction with the coaches, and many provided specific examples of how the intervention contributed to improved self-management. Whittemore et al.<sup>62</sup> further elaborated on how HC helped identify patient's motivation for change. Thorne and Paterson<sup>95</sup> explored how understanding the emotional needs of a patient helped ensure the health provider provided the appropriate amount of support. Parallels can be further drawn to a recent study by Howard and

Hagen <sup>14</sup> in which three individuals living with T2DM were interviewed and asked about their experience and perspective in relation to their health coach. Study results reflected the effectiveness of the role of the health coach and the process by which the participant and health coach developed a caring and supportive relationship.

### **5.3 Health Coaching Intensity and Duration**

As indicated previously, there exists controversy in the health coaching literature regarding the intensity required to achieve positive health benefits; intensity refers to duration and frequency of coach-client interactions. As intensity translates proportionally as intervention costs, it is instructive for trials to demonstrate the relative benefits of lesser vs. greater levels of intensity. In this trial the focus was on a relatively high intensity of coaching (averaging 40 minutes per week for a 24 week span) with continuous smartphone monitoring compared to no smartphone use. Simply put, the intensity range was purposefully set at a higher range to explore what intensity levels appear optimal per subject in relation to results achieved. In distinction with some psychotherapeutic interventions, subjects did not demand more time from the health coaches than deemed appropriate (by study coaches). This finding is notable as there were no exclusions of subjects on the basis of psychiatric diagnosis, nor psychological distress. Nor were discussions between health coaches and subjects solely focused on diabetes management. Instead, discussions ranged to include: psychological contexts as how the participant was managing life stressors which often interacted with how he/she could engage in adopting/adhering to health-related behaviours.

A key interactive feature described was the 24-hour/7 day per week ‘tether’ maintained via electronic connectivity between client and coach. In their own words, despite the geographically defined distance between them, clients appeared to never feel alone on the

journey to better health. As well, with real time access to health monitoring data, there were few interactions where the participant could express frustration or dissatisfaction without an additional opportunity (and obligation) to engage in personal behaviour change. Thus, there was minimal cognitive space for participants to imagine or desire health coach support that did not also involve self-activation. Even when the health coach led the subject in personal exercise sessions, directly or electronically, there was the subject's immediate experience of 'doing' in addition to discussing.

#### **5.4 Overall patient experience and their day-to-day frustration in managing T2DM**

This last area of examination focuses on overall patient experience with the program and their day-to-day challenges and success experiences over the course of the program. The majority of participants indicated their primary motive for joining the program was better control of symptoms and blood sugar levels. Participants became engaged in the majority of program elements including, but not limited to, exercise classes, meditation sessions, and one-on-one support. In summary, the program met the objectives originally set out, as it was found helpful to patients in providing them with social support in the process of behaviour change and lifestyle management. Participants also identified that at times they felt too reliant on their health coach and expressed fear of relapse.

In order to gain a greater understanding of the complexity of the experiences of participants, it is necessary to understand their struggles. Frustration with their chronic conditions appeared to have a profound effect on many participants. Individuals not only related to their diabetes, they also struggled with other comorbidities and low SES stressors, which exacerbated health problems. As our data suggest, participants faced difficulties in self-management while living on a low income. Results revealed that many of our participants

described struggling with a combination of comorbidities, transportation difficulties and food accessibility. Similar results were seen in a study by Ritholz et al.<sup>96</sup> where many study participants identified the struggles they faced with regards to multiple stressful conditions which further hindered their ability to better self-manage.

As Pilkington et al.<sup>76</sup> describes, living with diabetes under low-income conditions makes self-management a constant struggle. The stress of poverty predisposes people to not only developing chronic conditions but, in many cases, is the most important determinant of their health. This study explores the theme of ‘competing priorities’, described by individuals having to contend with self-management behaviours and concerns associated with poverty, like paying for food.

Onwudiwe et al.<sup>82</sup> reported on barriers to self-management, including health literacy. In our study health literacy was not thoroughly addressed in the interview, yet it could be deduced that many participants improved their health literacy knowledge over the course of the intervention. Numerous issues were described by Onwudiwe et al.<sup>82</sup> that hindered participants’ ability to successfully self-manage their diabetes (stress, fear, and co-morbidities, and low SES).

Over the course of our study some participants described feeling better physically and emotionally. Many conversations with the health coach not only focused on self-management but also on psychological distress. Self report and observed changes in mental health can be attributed to the emphasis on non-prescriptive interactions (MI) with the health coach, along with the use of mindfulness meditation being linked to CBT.



## 5.5 Strengths and Limitations of study design and execution

### 5.5.1 Strengths

Our study adds important elements to the literature while also re-examining components requiring further analyses. Three unique aspects of this study are: (1) evaluation of both the intervention and control group participants' experience, (2) a view of the role of a health coach in a community health centre, and (3) including individuals from diverse ethnicities and lower socioeconomic status (SES) with poorly controlled T2DM ( $HbA1c \geq 7.3$ ).

This was one of the first qualitative studies to look at  $N = 20$  participants who received a diabetes health coaching intervention; a previous study by Howard and Hagen<sup>14</sup> focused on only three individuals. Conducting both qualitative and quantitative research assessments of this trial is unprecedented, and ensures meaningful contributions from clinicians and researchers aiming to improve the overall quality of life of individuals living with T2DM.

This research contributed to achieving a greater understanding of the benefits of electronic monitoring, the difficulties of individual self-management, and the positive role of a health coach in a community health setting; health coaches were seen as identifying areas of change that corresponded to patient identified symptoms and goals. The study provided data that can assist patients and clinicians in making informed decisions that help them make better management choices that reduce or prevent health complications.

Other strengths of the study include in-depth and detailed analyses of the interview process, in that it allows for a further understanding of the participant's individual experience in the program. Results from qualitative studies are not typically used for generalizability, but rather for exploratory purposes (i.e. to help explain *why* people behave the way they do), yet few

existing studies have focused specifically on both the role of the health coach and the experiences faced by individual participants.

Another strength of the study is its exploration of conducting health coaching interventions at a community health center, which can provide important information on facilitating access to exercise and other services. Moreover, the power of affordable activity options for underprivileged persons cannot be overestimated. As the literature suggests, a group of underserved ethnically diverse individuals with poorly controlled diabetes represents a population at higher risk for diabetic complications known to have difficulty accessing adequate medical care <sup>57,97</sup>.

### **5.5.2 Limitations**

There are inherent study limitations in any qualitative investigation. The specificity of verbal articulation reported cannot be equated with quantitative outcomes, nor with the actual mechanisms that might have been useful in explaining associations between experience and outcome. Nonetheless, the qualitative approach provides a very detailed outline of what some participants experienced during interventions. These particular participants are distinguished by their willingness to partake in two studies (the RCT and this interview study), which differentiates them from other patients enrolled in the study.

Another limitation relates to the sampling procedure. We used convenience sampling, which is commonly used in qualitative analysis studies, but may involve multiple biases. For example, there is a chance of over- or under- misrepresentation of particular groups within the sample, and since the participant choice was not random, the ability to generalize about the given population was severely limited. Additionally, we must consider the participant dropouts from

the larger RCT trial since, once again, valuable and possibly distinct information on their experience can no longer be incorporated within the results.

Only participants in the larger trial who agreed to participate were interviewed; these were people who were more likely to have a positive outlook on the study from its inception. This leads to the potential for social desirability bias to affect participant responses. Social desirability bias can be described as a respondent's tendency to answer questions in a way they think is more communally coveted and to further alter their interview responses to exhibit a more positive self-presentation; this is in order to self-protect and impress others<sup>98</sup>. There may not be a way to specifically identify *how* participants' answers were biased, but it is possible to speculate. Similarly, capturing a participant's experience may be difficult if he/she feels uncomfortable about being open and honest. All the collected information is closely related to the rapport the researcher established with the participant during the interview process. In general most participants seemed forthcoming in divulging specific details about their experience such as cheating on a diet, not adhering to exercise guidelines, or neglecting to use smartphone tracking. The outcomes of some discussions surrounding co-morbidities and financial barriers suggest high comfort levels with participants' disclosure to interviewers.

Throughout the study, precautions were taken to reduce the potential for social desirability biases in the interview responses. All interviews were conducted face to face in private offices, which may have helped build interviewer/participant rapport, and all participants were assured both verbally and in writing that all personal and pertinent information would remain confidential and not linked to their personal identity. Furthermore, each participant's interviewer was not his or her health coach, which allowed more open dialogue.

Another limitation is the enhanced usual care group; as the study was held in a community setting it could be perceived as unethical to withhold smartphone access in the interest of research fidelity. Arguably, all participants should have, in some way, received maximal support (including smartphone access). This control group, however, allowed us to gain further understanding of how both the program and health coach support worked with and without smartphone/electronic communication. Despite different intensities of health coaching, both groups demonstrated significant reductions in their A1c.

One more limitation to qualitative studies is dependency on a researcher's skills, which can be further influenced by his or her unintentional biases, introduced during the collection and analysis of interviews. Qualitative methodology acknowledges researcher subjectivity. Interview questions and wording were revised as data collection progressed to gain and document a full description of phenomena. As well, analysis progressed using constant comparison, with the consultation of PR and FA.

In the future it may be possible to better identify and recruit appropriate groups of patients for the interview process, and in doing so, derive results more representative of the general population of diagnosed patients.

Research investigating self-management of T2DM and health coaching is growing, but additional studies are needed not only to confirm our findings but also further explore new areas in clinical benefit, exercise maintenance, and participation.

## **6.0 Conclusion**

Smartphone usage represents a new range of exploration for health interventions as each client-coach relationship leaves a detailed digital record of their endeavour. While digital data analyses require participants to use the smartphone with accuracy and frequency, intensity of

smartphone/software use itself provides information about procedures and benefits. In another study we use data mining tools to quantitatively explore tracker use in association with benefit. This, like the current study, helps us further understand subgroups and intervention experiences.

From the data of rich and detailed interviews, it appears that health coaching clearly plays an important role in helping individuals to improve self-management. In this qualitative study it is evident that patients in both the intervention and control groups held their experiences with coaches in high regard, and that the smartphone monitoring software substantially enhanced their connective relationships with coaches while making them more effective.

It appears that smartphone based methods may be useful in reaching out to and effectively engaging underserved populations. Accordingly, smartphone interventions may be applied with these populations and the subsidization of phones is a possible cost-effective option if significant modifications of diabetes risk are achieved.

In order to gain further understandings of the key variables that influence self-management, it is important to examine relevant theoretical models, applicable behaviour change strategies, and how the use of technology can assist in developing and maintaining the positive habits associated with long-term self-management.

**References:**

1. Seaquist. Addressing the Burden of Diabetes. 2014;311(22):2267–2268.
2. Jaakkimainen. L, Shah. B KA. *Diabetes in Ontario Practice Atlas*.
3. Expert Committee. *Clinical Practice Guidelines.*; 2013.
4. Moran J, Bekker H, Latchford G. Everyday use of patient-centred, motivational techniques in routine consultations between doctors and patients with diabetes. *Patient Educ Couns*. 2008;73(2):224–231. doi:10.1016/j.pec.2008.07.006.
5. Nundy S, Dick JJ, Chou C-H, Nocon RS, Chin MH, Peek ME. Mobile Phone Diabetes Project Led To Improved Glycemic Control And Net Savings For Chicago Plan Participants. *Health Aff*. 2014;33(2):265–272. doi:10.1377/hlthaff.2013.0589.
6. Quinn CC, Shardell MD, Terrin ML, Barr EA, Ballew SH, Gruber-Baldini AL. Cluster-randomized trial of a mobile phone personalized behavioral intervention for blood glucose control. *Diabetes Care*. 2011;34(9):1934–42. doi:10.2337/dc11-0366.
7. Wayne N, Ritvo P. Smartphone-enabled health coach intervention for people with diabetes from a modest socioeconomic strata community: Single-arm longitudinal feasibility study. *J Med Internet Res*. 2014;16(6):125–135. doi:http://dx.doi.org/10.2196/jmir.3180.
8. Wayne N, Perez DF, Kaplan DM, Ritvo P. Health Coaching Reduces HbA1c in Type 2 Diabetic Patients From a Lower-Socioeconomic Status Community: A Randomized Controlled Trial. *J Med Internet Res*. 2015;17(10):e224. doi:10.2196/jmir.4871.
9. Varney J, Weiland T, Inder W, Jelinek G. The effect of hospital-based telephone coaching on glycaemic control and adherence to management guidelines in type 2 diabetes, a randomised controlled trial. *Intern Med J*. 2014:Epub ahead of print. doi:10.1111/imj.12515.
10. Sorkin DH, Mavandadi S, Rook KS, et al. Dyadic collaboration in shared health behavior change: the effects of a randomized trial to test a lifestyle intervention for high-risk Latinas. *Health Psychol*. 2014;33(6):566–75. doi:10.1037/hea0000063.
11. Naik AD, White CD, Robertson SM, et al. Behavioral health coaching for rural-living

- older adults with diabetes and depression: an open pilot of the HOPE Study. *BMC Geriatr.* 2012;12(1):37. doi:10.1186/1471-2318-12-37.
12. Nishita C, Cardazone G, Uehara DL, Tom T. Empowered Diabetes Management: Life Coaching and Pharmacist Counseling for Employed Adults With Diabetes. *Heal Educ Behav.* 2012;40(5):581–591. doi:10.1177/1090198112465088.
  13. Moskowitz D, Thom DH, Hessler D, Ghorob A, Bodenheimer T. Peer coaching to improve diabetes self-management: Which patients benefit most? *J Gen Intern Med.* 2013;28(7):938–942. doi:http://dx.doi.org/10.1007/s11606-013-2367-7.
  14. Howard LM, Hagen BF. Experiences of persons with type II diabetes receiving health coaching: an exploratory qualitative study. *Educ Health (Abingdon).* 2012;25(1):66–9. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/23787387>.
  15. Lipscombe LL, Hux JE. Trends in diabetes prevalence, incidence, and mortality in Ontario, Canada 1995-2005: a population-based study. *Lancet.* 2007;369(9563):750–6. doi:10.1016/S0140-6736(07)60361-4.
  16. Chen L, Magliano DJ, Zimmet PZ. The worldwide epidemiology of type 2 diabetes mellitus—present and future perspectives. *Nat Rev Endocrinol.* 2011;8(4):228–236. doi:10.1038/nrendo.2011.183.
  17. Ladabaum U, Mannalithara A, Myer P a, Singh G. Obesity, Abdominal Obesity, Physical Activity, and Caloric Intake in U.S. Adults: 1988-2010. *Am J Med.* 2014;127(8):717–727. doi:10.1016/j.amjmed.2014.02.026.
  18. Briefel RR, Johnson CL. Secular trends in dietary intake in the United States. *Annu Rev Nutr.* 2004;24:401–431. doi:10.1146/annurev.nutr.23.011702.073349.
  19. Stryer D. Diabetes Disparities Among Racial and Ethnic Minorities. *Agency Healthc Res Qual.* 2001:1–6.
  20. Dinca-Panaitescu S, Dinca-Panaitescu M, Bryant T, Daiski I, Pilkington B, Raphael D. Diabetes prevalence and income: Results of the Canadian Community Health Survey. *Health Policy (New York).* 2011;99(2):116–123. doi:10.1016/j.healthpol.2010.07.018.
  21. Facts F, Diabetes ON. National Diabetes Fact Sheet , 2011. *Centers Dis Control Prev US Dep Heal Hum Serv.* 2011;CS217080A(Division of Diabetes Translation):1–12.

- doi:Centers for Disease Control and Prevention. National diabetes fact sheet: national estimates and general information on diabetes and prediabetes in the United States, 2011. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Con.
22. Scheen a J. Pathophysiology of type 2 diabetes. *Acta Clin Belg.* 2004;58(6):335–41. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/15068125>.
  23. Nathan DM, Davidson MB, DeFronzo R a., et al. Impaired fasting glucose and impaired glucose tolerance: Implications for care. *Diabetes Care.* 2007;30(3):753–759. doi:10.2337/dc07-9920.
  24. Fowler MJ. Microvascular and macrovascular complications of diabetes... 6th in a 12-part series. 2008;26(2):77–82.
  25. Ali A, Iqbal F, Taj A, Iqbal Z, Amin MJ, Iqbal QZ. Prevalence of microvascular complications in newly diagnosed patients with type 2 diabetes. *Pakistan J Med Sci.* 2013;29(4):899–902. doi:10.12669/pjms.294.3704.
  26. Tuomilehto J, Lindström J, Eriksson JG, et al. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Engl J Med.* 2001;344(18):1343–50. doi:10.1056/NEJM200105033441801.
  27. Stiffler D, Cullen D, Luna G. Diabetes Barriers and Self-Care Management: The Patient Perspective. *Clin Nurs Res.* 2014. doi:10.1177/1054773813507948.
  28. Collins MM, Bradley CP, O’Sullivan T, Perry IJ. Self-care coping strategies in people with diabetes: a qualitative exploratory study. *BMC Endocr Disord.* 2009;9:6. doi:10.1186/1472-6823-9-6.
  29. Colberg SR, Sigal RJ, Fernhall B, et al. Exercise and type 2 diabetes: the American College of Sports Medicine and the American Diabetes Association: joint position statement. *Diabetes Care.* 2010;33(12):e147–67. doi:10.2337/dc10-9990.
  30. Boulé NG, Haddad E, Kenny GP, Wells G a, Sigal RJ. Effects of exercise on glycemic control and body mass in type 2 diabetes mellitus: a meta-analysis of controlled clinical trials. *JAMA.* 2001;286(10):1218–27. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/11559268>.
  31. Church TS, Blair SN, Cocreham S, et al. Effects of Aerobic and Resistance Training on



- Hemoglobin A 1c Levels in Patients With Type 2 Diabetes. 2014;304(20):2253–2262.
32. Sigal RJ, Kenny GP, Boulé NG, et al. Effects of aerobic training, resistance training, or both on glycemic control in type 2 diabetes: a randomized trial. *Ann Intern Med*. 2007;147(6):357–69. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/17876019>. Accessed May 6, 2014.
  33. Gornall A, Lévesque L, Sigal RJ, Bphe AG, Frcpc MPH. A Pilot Study of Physical Activity Education Delivery in Diabetes Education Centres in Ontario. *Can J Diabetes*. 2008;32(2):123–130. doi:10.1016/S1499-2671(08)22009-5.
  34. Salas-Salvadó J, Martínez-González MÁ, Bulló M, Ros E. The role of diet in the prevention of type 2 diabetes. *Nutr Metab Cardiovasc Dis*. 2011;21 Suppl 2:B32–48. doi:10.1016/j.numecd.2011.03.009.
  35. Hu FB. Globalization of diabetes: the role of diet, lifestyle, and genes. *Diabetes Care*. 2011;34(6):1249–57. doi:10.2337/dc11-0442.
  36. Borghouts LB, Keizer H a. Exercise and insulin sensitivity: A review. *Int J Sports Med*. 2000;21(1):1–12. doi:10.1055/s-2000-8847.
  37. Anderson JW, Kendall CWC, Jenkins DJ a. Importance of weight management in type 2 diabetes: review with meta-analysis of clinical studies. *J Am Coll Nutr*. 2003;22(5):331–339. doi:10.1080/07315724.2003.10719316.
  38. Secnik K, Yurgin N, Lage MJ. Patterns of blood glucose monitoring in relation to glycemic control among patients with type 2 diabetes in the UK. *J Diabetes Complications*. 2007;21(3):181–186. doi:10.1016/j.jdiacomp.2006.04.003.
  39. Nyomba. G., Berard.L. ML. Facilitating access to glucometer reagent increases blood glucose self monitoring frequency and improves glycaemic control: a prospective study in insulin-treated diabetic patients. *Diabet Med*. 2004;21(2):103–113. doi:10.1046/j.1464.
  40. Karter AJ, Parker MM, Moffet HH, et al. Longitudinal study of new and prevalent use of self-monitoring of blood glucose. *Diabetes Care*. 2006;29(8):1757–1763. doi:10.2337/dc06-2073.
  41. Anderson RJ, Freedland KE, Clouse RE, Lustman PJ. The Prevalence of Comorbid Depression in Adults With Diabetes: A meta-analysis. *Diabetes Care*. 2001;24(6):1069–

1078. doi:10.2337/diacare.24.6.1069.
42. Lustman P, Griffith L, Freedland K, Clouse R. Fluoxetine for Depression in Diabetes. 2000.
  43. Knol MJ, Geerlings MI, Egberts ACG, Gorter KJ, Grobbee DE, Heerdink ER. No increased incidence of diabetes in antidepressant users. *Int Clin Psychopharmacol.* 2007;22(6):382–386. doi:10.1097/YIC.0b013e3282202c0e.
  44. Eaton WW, Armenian H, Gallo J, Pratt L, Ford DE. Depression and risk for onset of type II diabetes. A prospective population-based study. *Diabetes Care.* 1996;19(10):1097–1102. doi:10.2337/diacare.19.10.1097.
  45. Grigsby AB, Anderson RJ, Freedland KE, Clouse RE, Lustman PJ. Prevalence of anxiety in adults with diabetes a systematic review. *J Psychosom Res.* 2002;53(6):1053–1060. doi:10.1016/S0022-3999(02)00417-8.
  46. Bodenheimer T, Lorig K, Holman H, Grumbach K. Patient self-management of chronic disease in primary care. *JAMA.* 2002;288(19):2469–2475. doi:10.1001/jama.288.19.2469.
  47. Miller, William R., Rollnick S. *Motivational Interviewing: Helping People Change.*; 2012.
  48. Sheldon B. *Cognitive- Behavioural Therapy: Research and Practice in Health and Social Care.*; 2011.
  49. Greenberg LS. *Emotion- Focused Therapy: Coaching clients to work through their feelings.*; 2002.
  50. Weissman, M., Markowitz, J., Klerman G. *Comprehensive Guide to Interpersonal Psychotherapy.*; 2000.
  51. Butterworth S, Linden A, McClay W, Leo MC. Effect of motivational interviewing-based health coaching on employees' physical and mental health status. *J Occup Health Psychol.* 2006;11(4):358–365. doi:http://dx.doi.org/10.1037/1076-8998.11.4.358.
  52. Ven N Van Der, Weinger K, Snoek F. Cognitive Behaviour Therapy : How to Improve Diabetes. 2002;47(3):10–13.

53. Murphy, R., Straebler, S., Cooper, Z., Fairburn C. Cognitive behavioral therapy for eating disorder. *Psychiatric Clin North Am.* 2010;33(3):611–27.
54. Basak Cinar A, Schou L. Health promotion for patients with diabetes: Health coaching or formal health education? *Int Dent J.* 2014;64(1):20–28. doi:10.1111/idj.12058.
55. Wolever RQ, Dreusicke M, Fikkan J, et al. Integrative health coaching for patients with type 2 diabetes: A randomized clinical trial. *Diabetes Educ.* 2010;36(4):629–639. doi:http://dx.doi.org/10.1177/0145721710371523.
56. Ivey SL, Tseng W, Kurtovich E, et al. Evaluating a Culturally Competent Health Coach Intervention for Chinese American Patients with Diabetes. *Diabetes Spectr.* 2012;25(2):93–102. doi:10.2337/diaspect.25.2.93.
57. Thom D, Ghorob A. Impact of Peer Health Coaching on Glycemic Control in Low-Income Patients With Diabetes: A randomized Controlled Trial. *Ann Fam ...* 2013;11(2):137–144. doi:10.1370/afm.1443.INTRODUCTION.
58. Ruggiero L, Moadsiri A, Butler P, et al. Supporting diabetes self-care in underserved populations: a randomized pilot study using medical assistant coaches. *Diabetes Educ.* 2010;36(1):127–131. doi:10.1177/0145721709355487.
59. Ruggiero L, Riley BB, Hernandez R, et al. Medical Assistant Coaching to Support Diabetes Self-Care Among Low-Income Racial/Ethnic Minority Populations: Randomized Controlled Trial. *West J Nurs Res.* 2014;36(9):1052–1073. doi:10.1177/0193945914522862.
60. Frosch DL, Uy V, Ochoa S, Mangione CM. Evaluation of a Behavior Support Intervention for Patients With Poorly Controlled Diabetes. *Arch Intern Med.* 2011;171(22):2011–2017. doi:10.1001/archinternmed.2011.497.
61. McKay HG, Glasgow RE, Feil EG, Boles SM, Barrera MJ. Internet-based diabetes self-management and support: Initial outcomes from the Diabetes Network project. *Rehabil Psychol.* 2002;47(1):31–48. doi:10.1037/0090-5550.47.1.31.
62. Whittemore R, Melkus GD, Sullivan A, Grey M. A nurse-coaching intervention for women with type 2 diabetes. *Diabetes Educ.* 2004;30(5):795–804. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/15510531>. Accessed May 28, 2014.

63. Blackberry ID, Furler JS, Best JD, et al. Effectiveness of general practice based, practice nurse led telephone coaching on glycaemic control of type 2 diabetes: the Patient Engagement and Coaching for Health (PEACH) pragmatic cluster randomised controlled trial. *BMJ*. 2013;347(September):f5272. doi:10.1136/bmj.f5272.
64. Patja K, Absetz P, Auvinen A, et al. Health coaching by telephony to support self-care in chronic diseases: clinical outcomes from The TERVA randomized controlled trial. *BMC Health Serv Res*. 2012;12:147. doi:10.1186/1472-6963-12-147.
65. Krok-Schoen JL, Shim R, Nagel R, et al. Outcomes of a Health Coaching Intervention for Older Adults With Uncontrolled Type 2 Diabetes. *Gerontol Geriatr Educ*. 2015;(March):150220222806002. doi:10.1080/02701960.2015.1018514.
66. Bray P, Morrissey S, Thompson D, Holbert D, Wilson K, Lukosius E. Improved Outcomes in Diabetes Care. 2013:145–150. doi:10.1370/afm.1470.INTRODUCTION.
67. Navicharearn R, Aunguroch Y, Thanasilp S. Effects of multifaceted nurse-coaching intervention on diabetic complications and satisfaction of persons with type 2 diabetes. *J Med Assoc Thai*. 2009;92(8):1102–1112.
68. Wolever, R., Eisenberg M. What is Health Coaching Anyway?: Standards Needed to Enable Rigorous Research: Comment on “Evaluation of Behavior Support Intervention for Patients With Poorly Controlled Diabetes.” *Arch Intern Med*. 2011;171(22):2017–2018. doi:0.1001/archinternmed.2011.508.
69. Free C, Phillips G, Galli L, et al. The effectiveness of mobile-health technology-based health behaviour change or disease management interventions for health care consumers: a systematic review. *PLoS Med*. 2013;10(1):e1001362. doi:10.1371/journal.pmed.1001362.
70. Steventon A, Bardsley M, Doll H, Tuckey E, Newman SP. Effect of telehealth on glycaemic control: analysis of patients with type 2 diabetes in the Whole Systems Demonstrator cluster randomised trial. *BMC Health Serv Res*. 2014;14:334. doi:10.1186/1472-6963-14-334.
71. Walker EA, Shmukler C, Ullman R, Blanco E, Scollan-Koliopoulus M, Cohen HW. Results of a successful telephonic intervention to improve diabetes control in urban adults: a randomized trial. *Diabetes Care*. 2011;34(1):2–7. doi:10.2337/dc10-1005.
72. Wolever RQ, Dreusicke M, Fikkan J, et al. Integrative health coaching for patients with

- type 2 diabetes: a randomized clinical trial. *Diabetes Educ.* 2010;36(4):629–39. doi:10.1177/0145721710371523.
73. Arsand E, Tufano JT, Ralston JD, Hjortdahl P. Designing mobile dietary management support technologies for people with diabetes. *J Telemed Telecare.* 2008;14(7):329–32. doi:10.1258/jtt.2008.007001.
74. Melko CN, Terry PE, Camp K, Healey ML. Diabetes Health Coaching Improves Medication Adherence: A Pilot Study. *Am J Lifestyle Med.* 2009;4(2):187–194. doi:10.1177/1559827609351131.
75. Brown JB, Harris SB, Webster-Bogaert S, Wetmore S, Faulds C, Stewart M. The role of patient, physician and systemic factors in the management of type 2 diabetes mellitus. *Fam Pract.* 2002;19(4):344–349. doi:10.1093/fampra/19.4.344.
76. Beryl Pilkington F, Daiski I, Bryant T, Dinca-panaitescu M, Dinca-panaitescu S, Raphael D. The Experience of Living with Diabetes for Low-income Canadians. *Can J Diabetes.* 2010;34(2):119–126. doi:10.1016/S1499-2671(10)42008-0.
77. Delamater a. M. Improving Patient Adherence. *Clin Diabetes.* 2006;24(2):71–77. doi:10.2337/diaclin.24.2.71.
78. Parry C, Kramer HM, Coleman EA. A qualitative exploration of a patient-centered coaching intervention to improve care transitions in chronically ill older adults. *Home Health Care Serv Q.* 2006;25(3-4):39–53. doi:10.1300/J027v25n03\_03.
79. Urowitz S, Wiljer D, Dupak K, et al. Improving diabetes management with a patient portal: a qualitative study of diabetes self-management portal. *J Med Internet Res.* 2012;14(6):e158. doi:10.2196/jmir.2265.
80. Dufour SP, Graham S, Friesen J, Rosenblat M, Rous C, Richardson J. Physiotherapists supporting self-management through health coaching: a mixed methods program evaluation. *Physiother Theory Pract.* 2014;3985(1):1–10. doi:10.3109/09593985.2014.930769.
81. Ralston JD, Revere D, Robins LS, Goldberg HI. Patients' experience with a diabetes support programme based on an interactive electronic medical record: qualitative study. *BMJ.* 2004;328(7449):1159. doi:10.1136/bmj.328.7449.1159.

82. Onwudiwe NC, Mullins CD, Winston RA, et al. Barriers to self management of diabetes: A qualitative study among low income minority diabetics. *Ethn Dis*. 2011;21.
83. Nam S, Chesla C, Stotts N a, Kroon L, Janson SL. Barriers to diabetes management: patient and provider factors. *Diabetes Res Clin Pract*. 2011;93(1):1–9. doi:10.1016/j.diabres.2011.02.002.
84. Furler J, Walker C, Blackberry I, et al. The emotional context of self-management in chronic illness: A qualitative study of the role of health professional support in the self-management of type 2 diabetes. *BMC Health Serv Res*. 2008;8:214. doi:10.1186/1472-6963-8-214.
85. Mackenzie.Noella KS. Research Dilemmas,Paradigms, Methods and Methodology. *Issues Educ Res*. 2006;16(2):193–205.
86. Guest.G, MacQueen. K NE. *Applied Thematic Analysis*. Sage Publications; 2012.
87. Krauss SE, Putra U. Research Paradigms and Meaning Making : A Primer. *Qual Rep*. 2005;10(4):758–770. doi:10.1176/appi.ajp.162.10.1985.
88. Denzin. N, Lincoln Y. *Collecting and Interpreting Qualitative Materials.*; 2003.
89. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol*. 2006;3(2):77–101. doi:10.1191/1478088706qp063oa.
90. Maxwell JA. *Qualitative Research Design: An Interactive Approach.*; 2013.
91. Diccico-Bloom B, Crabtree BF. The qualitative research interview. *Med Educ*. 2006;40(4):314–21. doi:10.1111/j.1365-2929.2006.02418.x.
92. O’Reilly M, Parker N. “Unsatisfactory Saturation”: a critical exploration of the notion of saturated sample sizes in qualitative research. *Qual Res*. 2012;13(2):190–197. doi:10.1177/1468794112446106.
93. Huffman MH. Health coaching: a fresh approach for improving health outcomes and reducing costs. *AAOHN J*. 2010;58(6):245–50; quiz 251–2. doi:10.3928/08910162-20100526-02.

94. Parry O. Patients in waiting: a qualitative study of type 2 diabetes patients' perceptions of diagnosis. *Fam Pract.* 2004;21(2):131–136. doi:10.1093/fampra/cmh203.
95. Thorne, S. Paterson B. Health care professional support for self-care management in chronic illness: insights from diabetes research. *Patient Educ Couns.* 2000;42(1):81–90.
96. Ritholz MD, Beverly E a, Weinger K. Digging deeper: the role of qualitative research in behavioral diabetes. *Curr Diab Rep.* 2011;11(6):494–502. doi:10.1007/s11892-011-0226-7.
97. Frosch DL, Uy V, Ochoa S, Mangione CM. Evaluation of a behavior support intervention for patients with poorly controlled diabetes. *Arch Intern Med.* 2011;171(22):2011–7. doi:10.1001/archinternmed.2011.497.
98. Fisher RJ. Social Desirability Bias and the Validity of Indirect Questioning. *J Consum Res.* 1993;20(2):303. doi:10.1086/209351.

## **Apendices**

### **Appendix A: Semi Structured Interview Questions**

#### **Questions about Health Coaching**

1. In the program, you were given a smartphone with special programming and assigned a health coach. Were you influenced in ways you found important? Please describe positive and negative experiences you had while participating in the program?

Probe: During the time you have been working with the smartphone program and the health coach, have you noticed positive or negative changes in your experience of diabetes? Did you find that you felt healthier or less healthy? Did you notice any positive or negative changes during your program participation?

2. What were your goals while participating? How much was your goal selection influenced by the smartphone used and/or the health coach you communicated with?

Probes: How did the smartphone and the related programming on it influence your progress towards or away from goals? How much did your smartphone experience help or hinder you in achieving goals? How did your health coach influence you in achieving or moving closer to goals or away from goals?

3. How could your health coach have helped you more?

4. If you were planning a new program where health coaches were involved, what would you train them to do better? What did your health coach do well? Did you feel respected by your health coach? Was there any point where you felt disrespected?

5. If you were planning a new program, how long do you feel the intervention approach should last? 6 months? 9 months? 12 months? Longer?

#### **Questions about the Health Coach Software – If intervention group.**

1. On the smartphone you received, it was suggested you log your food intake, blood sugar and exercise. Did you use the device in these ways? How did you use the device?

Probes: Were there problems using the device that stopped you from using it? Did it ‘work’ every time or most of the time? Not enough of the time for your satisfaction? Enough of the time for your satisfaction?

2. Was the device easy to use? Hard to use? Sometimes an inconvenience? Sometimes an interruption? Sometimes a helpful reminder to do something in a healthier way?

3. What are your thoughts about the self-tracking software? How important was the smartphone in the progress you made?



Probes: Was it easy to use? Hard to use? How many functions did you use? Please describe how you used the smartphone and what you did with it when using it? Did it help with your diabetes management?

### **Questions about the Exercise Education Program**

1. Did you have a chance to use the exercise education room? If so how often? Did you attend exercise classes?
2. Have you made exercise a part of your daily life outside of the exercise program? If yes, how so?
3. Did you have a chance to participate in the meditation classes? If so how often?
4. Have you made meditation a part of your daily life outside of the classes? If yes, how often?

### **Questions about your Diet + Medication**

1. How has working with your health coach affected your diet affected your diet?
2. How has working with your health coach affected how and when you take your medication?

### **Questions about the Program as a whole**

1. If planning a new program, how would you improve the program you participated in? What changes would you make?
2. What did you value most about being in this study? Do you feel you're healthier or not as healthy? About the same? How do you know?

**Appendix B: Consent Form**

**TITLE: Experience with the  
Health Coaching and Electronic Engagement Study**  
**PRINCIPAL INVESTIGATOR: Dr. Paul Ritvo**



You are being asked to take part in a research study. Before agreeing to take part in this study, it is important that you read and understand the following explanation of the proposed study procedures.

The following information describes the

- Purpose
- Procedures
- Benefits
- Discomforts
- Risks and
- Precautions associated with this study

It also describes your right to refuse to participate or to withdraw from the study at any time. In order to decide whether you wish to participate in this research study, you should understand enough about it to make an informed decision.

This is known as the informed consent process. Please ask the researcher to explain any words you don't understand before signing this consent form. Make sure all your questions have been answered to your satisfaction before signing this document.

**PURPOSE:**

You have been asked to participate in an interview designed to help us better understand your experience participating in the research study "Investigating Improved Self Management in Type 2 Diabetes".

**PROCEDURES:**

Your participation in this interview will entail a time commitment of **30-45 minutes**. If you agree to participate in this study, you will be asked a set of questions that help us understand your experience while in the health coaching study. The questions we will ask you will include asking about your preference between the various groups, factors that affected your participation and adherence, and your general experiences throughout the program. The interview will be recorded and transcribed by research personnel.

**RISKS AND BENEFITS**

There are no known personal risks or benefits associated with taking part in this research study.

**CONFIDENTIALITY**

Everything you say during this interview will be held in strict confidence. You will be identified by a study number only. Names or identifying information will not be used in any publication or presentation. **Your assigned health coach will not be made aware of the things you say in this interview.**

The recording will be safely stored in a locked facility and only research staff will have access to this information. Data will be retained for five years after publication of the study results.

**PARTICIPATION:**

Your participation in the study is voluntary. You may withdraw from the study at any time, and you can also choose not to answer any questions that you do not feel comfortable answering. This will not affect your care. Your refusal to participate or your withdrawal from the study will not affect your relationship with the researchers, York University or impact the services you receive from Black Creek Community Health Centre. If you decide to withdraw from the study and you wish us to destroy the information and data you provided, we will do so upon your request.

**QUESTIONS:**

If you have questions about the research in general or about your role in the study, please feel free to contact Dr. Paul Ritvo (York University) by telephone at [REDACTED] or by e-mail [REDACTED] or Michelle Westin (Black Creek Community Health Centre) by telephone at [REDACTED] or by email [REDACTED]. This research study has been reviewed and approved by the Human Participants Review Committee (Certificate #: **2012-033**), York University's Ethics Review Board and conforms to the standards of the Canadian Tri-Council Research Ethics guidelines. If you -have any questions about this process, or about your rights as a participant in the study, please contact Ms. Alison Collins-Mrakas, Manager, Research Ethics, **Office of Research Ethics, 5<sup>th</sup> Floor, York Research Tower**, York University (telephone [REDACTED] or e-mail [REDACTED], or Ms. Cheryl Prescod, Executive Director, Black Creek Community Health Centre (telephone [REDACTED] or email [REDACTED]).

**Legal Rights and Signatures:**

I \_\_\_\_\_, consent to participate in. I have understood the nature of this project and wish to participate. I am not waiving any of my legal rights by signing this form. My signature below indicates my consent.

\_\_\_\_\_  
Name of Participant

\_\_\_\_\_  
Signature of Participant

\_\_\_\_\_  
Date

\_\_\_\_\_  
Name of Person  
Obtaining Consent

\_\_\_\_\_  
Signature of Person  
Obtaining Consent

\_\_\_\_\_  
Date

**Appendix C : Demographic questionnaire**

- Sex
  - What is your gender?
    - Male
    - Female
- Age
  - What is the year of your birth? \_\_\_\_\_
- Ethnicity
  - Which of the following racial or ethno-cultural groups best describes you?
    - Aboriginal (Inuit, Métis, North American Indian)
    - West Asian (e.g., Armenian, Egyptian, Iranian, Iraqi, Lebanese, Moroccan)
    - Black - African (e.g., African, Somali, etc)
    - Black – Caribbean (e.g. Haitian, Jamaican, etc)
    - White (Caucasian – European/American)
    - Hispanic
    - Latin American
    - Chinese
    - Filipino
    - Japanese
    - Korean
    - South Asian
    - South East Asian
    - Other (Fill in): \_\_\_\_\_
- Language
  - What language(s) do you speak?
    - English
    - French
    - Do you also speak another language (s)  
\_\_\_\_\_
- Time-in-country
  - How many years have you lived in Canada?
    - # of years or “Since birth”: \_\_\_\_\_
- Educational Status
  - What is the highest level of education you have completed?

- Elementary School
- Middle School

- High School
- Some College, or  
University or Trade/  
Vocational Training,
- Trade, Vocational Training  
or Certificate
- College Diploma
- University Degree
- Post-Graduate Degree

- Employment Status
  - What is your employment status?
    - Unemployed
    - Student
    - Part-Time
    - Full-Time
    - Retired
    - Self-Employed
    - Work in the home (take  
care of children, etc)
- Income Status
  - What is your annual income status?
    - \$0 – \$9999
    - \$10,000 – \$25,000
    - \$25,000 – \$50,000
    - \$50,000 – \$75,000
    - \$75,000 – \$100,000
    - \$100,000 – Up
- Car ownership
  - Do you own or have access to a  
car?
    - Own
    - Have access
    - No car access

Table 1.0. Demographic Characteristic of Participants

<b>Characteristic</b>	<b>Intervention (n=11) (E-HC)</b>	<b>Control (n=9) (EC)</b>	<b>All (n=20)</b>
<b>Age, mean (SD)</b>	57 ( $\pm$ 8.59)	58 ( $\pm$ 11.15)	57 ( $\pm$ 13,4)
<b>Gender, n (%)</b>			
Female	9 (82%)	7 (78%)	16 (80%)
Male	2 (18%)	2 (22%)	4 (20%)
<b>Ethnicity, n (%)</b>			
Black Caribbean	7 (64%)	3 (33%)	10 (50%)
White (Caucasian)	-----	3 (33%)	3 (15%)
Hispanic	2 (18%)	-----	2 (10%)
Latin American	-----	1 (11%)	1 (5%)
Filipino	-----	1 (11%)	1 (5%)
South Asian	1 (9%)	-----	1 (5%)
Other	1 (9%)	-----	1 (5%)
No Answer	-----	1 (11%)	1 (5%)
<b>Education, n (%)</b>			
High school or less	5 (45%)	6 (66%)	11 (55%)
Some College	1 (9%)	N/A	1 (5%)
Trade/ vocational training	2 (18%)	2 (22%)	4 (20%)
College or University degree	3 (27%)	1 (11%)	4 (20%)
<b>Employment Status, n (%)</b>			
Unemployed	3 (27%)	3 (33%)	6 (30%)
Student	1(9%)	-----	1 (5%)
Part-time	-----	-----	-----
Full-time	4 (36%)	2 (22%)	6 (30%)
Retired	1 (9%)	2 (22%)	3 (15%)
Work in the home/Self employed	2 (18%)	2 (22%)	4 (20%)
<b>Time in Country, n (%)</b>			
<5 yrs.	-----	-----	-----
5-10 yrs.	1 (9%)	1(11%)	2(10%)
>10 yrs.	10 (90%)	8 (88%)	18 (90%)
<b>Income, n (%)</b>			
\$0-9999	5 (45%)	2(22%)	7 (35%)
\$10,000-25,000	3 (27%)	4(44%)	7 (35%)
\$25,000-50,000	3 (27%)	1 (11%)	4 (20%)
\$ 50,000- 75,000	-----	-----	-----
\$ 75,000-Up	-----	-----	-----
No Answer	-----	2 (22%)	2 (10%)

Table 2.0. Demographic information for study participants  
I: Intervention C: Control

Participant ID	Age	Gender	Ethnicity	Education	Employment	Time in country	Income
I : 1	60	Male	Black Caribbean	College or University Degree	Self employed	27 years	\$10,000-\$25,000
I : 2	52	Female	Black Caribbean	Middle School	Unemployed	21 years	\$0-\$9999
I : 3	58	Female	Hispanic/Latin American	Trade/vocational training or certificate	Full time	40 years	\$10,000-\$25,000
I : 4	60	Female	Guyanese	Middle School	Work in the home	37 years	\$0-\$9999
I : 5	61	Female	Black Caribbean	Some College or University or trade/vocational training	Student	41 years	\$0-\$9999
I : 6	47	Female	Black Caribbean	High school	Full time	36 years	\$25,000-\$50,000
I : 7	37	Female	Black Caribbean	High School	Unemployed	10years	\$0-\$9,999
I : 8	60	Female	Black Caribbean	College Diploma	Unemployed	41 years	\$10,000-\$25,000
I : 9	54	Female	South Asian	University Degree	Full time	14 years	\$25,000-\$50,000
I : 10	66	Male	Hispanic	Trade, vocational training or certificate	Retired	29 years	\$0-\$9,999
I : 11	67	Female	Black Caribbean	Middle school	Full time	45 years	\$25,000-\$50,000
C: 1	53	Female	Black Caribbean	Middle school	Unemployed	20 years	\$0-\$9,999
C: 2	57	Female	Latin American	Trade/ vocational training or certificate	Self employed	39 years	
C: 3	62	Female	White (Caucasian. European/American)	Elementary school	Work in the home	Born in Canada	\$10,000-\$25,000
C: 4	68	Female	White (Caucasian. European/American)	Elementary school	Retired	68 years	\$10,000-\$25,000
C: 5	60	Female	White (Caucasian. European/American)	Elementary school	Unemployed	55 years	\$0-\$9,999
C: 6	55	Female	White (Caucasian. European/American)	High school	Full time	Born in Canada	\$10,000-\$25,000
C: 7 53		Male	Filipino	College diploma	Fulltime	5 years	\$25,000-\$50,000
C: 8 51		Male	Black Caribbean	Trade/vocational training or certificate	Unemployed	28 years	\$10,000-\$25,000
C: 9 39		Female	Black Caribbean	Elementary school	Retired	31 years	

Table 3.0. Changes in hemoglobin A1c (HbA1c)

<b>Changes in HbA1c</b>					
<b>Participant ID</b>	<b>Baseline HbA1c</b>	<b>Six month HbA1c</b>	<b>Change in HbA1c</b>	<b>Gender</b>	<b>Age</b>
<b>Intervention</b>					
I1	7.5	6.9	-0.6	Male	60
I2	9.3	7.6	-2.0	Female	51
I3	12.5	5.4	-7.1	Female	58
I4	9.1	8.0	-1.1	Female	59
I5	7.7	8.2	+0.5	Female	61
I6	8.2	8.3	+0.1	Female	46
I7	9.0	7.3	-1.7	Female	37
I8	8.0	6.9	-1.1	Female	60
I9	7.3	6.9	-0.4	Female	58
I10	7.7	7.9	+0.2	Male	67
I11	9.5	7.5	-2.0	Female	67
<b>Control</b>					
C1	9.3	8.8	-0.5	Female	53
C2	7.9	10.2	+2.3	Female	57
C3	8.5	7.2	-1.3	Female	62
C4	8.1	8.0	-0.1	Female	68
C5	7.8	7.6	-0.2	Female	69
C6	7.3	6.9	-0.4	Female	55
C7	10.0	8.5	-1.5	Male	32
C8	7.9	8.3	-0.4	Male	63
C9	7.8	7.5	-0.3	Female	69
<b>Mean- I</b>	8.7	7.35	-1.38		
<b>Mean -C</b>	8.3	8.11	-.177		
<b>Overall Mean</b>	8.98	7.69	-0.84		



Table 4.0. Summary of Reviewed Randomized and Cluster-randomized trials

<b>Trial</b>	<b>Study Participants</b>	<b>Intervention</b>	<b>Comparison</b>	<b>Coaching Modality and Intensity</b>	<b>Major Findings</b>
Blackberry et al. (2013) (Cluster RCT)	451 (I: 225; C: 226)	18 months nurse- led telephone coaching	UC	Telephone sessions 5x within the first 6 months and 2 x for the remainder of the study	<ul style="list-style-type: none"> <li>No significant between group differences in HbA1c (<b>p=0.84</b>) and other clinical outcomes (e.g. blood pressure, lipids, and depressive symptomology)</li> </ul>
Cinar et al. (2014)	176 (I: 75; C: 101)	10 months of HC by dental professionals (assessments at 16 months)	Less intense lifestyle counselling	<b>Mixed Modality</b> (Face to face meetings 5-6x and 4 telephone sessions)	<ul style="list-style-type: none"> <li>Significant reductions in HbA1c (<b>p=0.004</b>) and stress scores (<b>p= 0.01</b>)</li> </ul>
Frosch et al. (2011)	201 (I: 101; C: 100)	6 months of HC by diabetes nurses	Diabetes educational brochures	5 Telephone coaching sessions	<ul style="list-style-type: none"> <li>No significant between group differences in HbA1c (<b>p=0.49</b>) and other clinical outcomes (e.g. blood pressure and lipids)</li> </ul>
McKay et al. (2002)	137 across all 4 conditions	3 months of Personal coaching, peer support, and a combined coaching-peer support conditions	Information only	Internet based	<ul style="list-style-type: none"> <li>No significant between group difference in HbA1c, depressive symptoms and QQL</li> </ul>
Nashita et al. (2012)	190 (I: 128; C: 62)	12 months of HC by coaches and pharmacists	UC	Face to Face meetings (10 x 60 minute sessions)	<ul style="list-style-type: none"> <li>No significant between group differences in HbA1c at both 6 and 12 month follow up (<b>p=0.24</b>)</li> <li>Significant improvements in QQL (<b>p=0.01</b>) and Diabetes self-efficacy (<b>p=0.02</b>)</li> </ul>

Quinn et al. (2011) (Cluster RCT)	163 across all 4 conditions	12 months of HC supplemented by a patient coaching system and clinical decision support	UC	12 month access to a web based patient portal and receiving and action plan every 2.5 months	<ul style="list-style-type: none"> <li>• Significant reductions in HbA1c at 12 months for the coaching group (<b>1.6%</b>; <b>p=0.003</b>) with comparable</li> <li>• reductions across other enhanced intervention conditions</li> </ul>
Ruggerio et al. (2010)	50 (I: 25; C: 25)	6 month HC by Medical assistants	UC	<b>Mixed Modality</b> (Face to Face meetings at baseline and 3 months and 4 telephone sessions)	<ul style="list-style-type: none"> <li>• No significant between group differences in HbA1c (<b>p=NS</b>) at 6 month follow up</li> <li>• Significant improvement in diabetes empowerment (<b>p&lt;0.01</b>)</li> </ul>
Ruggerio et al. (2014)	172 (I: 91; C: 81)	12 month HC by Medical assistants	UC	<b>Mixed Modality</b> (Face to Face meetings every 3 months and monthly telephone calls)	<ul style="list-style-type: none"> <li>• No significant between group difference in HbA1c (<b>p=0.54</b>)</li> <li>• No significant reduction depressive symptomology (<b>p=0.22</b>) and self-confidence (<b>p=0.60</b>)</li> </ul>
Sacco et al. (2004)	48(I: 21; C:27)	6 months of HC by undergraduate Psychology students	UC	Telephone based coaching (weekly calls for 3 months and bi-weekly for the remainder of the program)	<ul style="list-style-type: none"> <li>• No significant between group difference in HbA1c (<b>p=NS</b>)</li> <li>• Significant improvements in self-efficacy (<b>p&lt;0.05</b>) depressive (<b>p&lt;0.005</b>) and diabetes symptoms (<b>p&lt;0.01</b>)</li> </ul>
Thom et al. (2013)	236 (I: 122; C: 114)	6 months of HC by peers	UC	<b>Mixed Modality</b> (Face to Face sessions 2 or more; 2x a month telephone contact)	<ul style="list-style-type: none"> <li>• Significant reduction in HbA1c (p=0.01)</li> <li>• No change in SBP, LDL, BMI</li> </ul>

Varney et al. (2014)	71 (I: 35; C: 36)	6 months of HC led by Dieticians	UC	Telephone-based coaching	<ul style="list-style-type: none"> <li>• Significant reduction in HbA1c (<b>p=0.03</b>)</li> <li>• Significant reductions in FBG (<b>p=0.02</b>)</li> <li>• Significant reductions at 6 month follow up in physical activity (<b>p=0.02</b>)</li> </ul>
Whittemore et al. (2009)	49 (I: 26; C: 23)	6 months HC by Nurses	UC	<b>Mixed Modality</b> (Face to Face meetings 4 x and telephone session 2x)	<ul style="list-style-type: none"> <li>• No between group difference in HbA1c (<b>p= 0.64</b>)</li> <li>• Significant improvements in diet (<b>p=0.02</b>) and QOL (<b>p=0.01</b>)</li> </ul>
Wolever et al. (2010)	56 (I: 30; C: 26)	6 months HC by Psychologists and social workers	UC	Telephone coaching (14 x 30 minute sessions)	<ul style="list-style-type: none"> <li>• Significant reduction in HbA1c (<b>p=0.03</b>) among those with HbA1c &gt;than 7%</li> <li>• Significant improvements in patient activation (<b>p=0.001</b>), social support (<b>p=0.003</b>)</li> </ul>

Table 5.0. Summary of Reviewed Quasi-Experimental Studies

Trial	Study Participants	Intervention	Comparison	Coaching Modality and Intensity	Findings
Bray et al. (2014)	772 (I: 368; C: 359) African Americans	12 months of HC by allied healthcare professionals	UC	Face to Face meetings (4x 30-60 minute sessions) with follow ups every 3 to 6 months for the remainder of the program	<ul style="list-style-type: none"> <li>• Significant reductions in HbA1c at both follow ups in the intervention group; P= <b>P &lt;0.05</b> at 18 and <b>P&lt;0.005</b> at 36 month follow ups)</li> <li>• A significantly greater proportion of the intervention group had SBP of &lt;140 mmHg at follow ups</li> </ul>
Ivey et al. 2012	92 (I: 46; C: 46) middle aged Chinese Americans	6 months of HC by Medical Assistants	UC	3 physician visits, 3 dietician visits and 3 follow up phone calls	<ul style="list-style-type: none"> <li>• No significant change in HbA1c (<b>p=0.14</b>)</li> </ul>
Krok-Schoen et al. (2015)	29 older adults (Mean age= 72.2 years)	24 months of HC by trained medical students	N/A	<b>Mixed Modality</b> (Face-to Face meetings 4 x during the first year and 2x during the second year; Phone and E-mail communication 2x per year)	<ul style="list-style-type: none"> <li>• No change in HbA1c (<b>P = 0.92</b>)</li> <li>• Significant improvements in Role Limitations (<b>P= 0.02</b>) and Social Functioning Subscales (<b>P= 0.04</b>) of HRQOL</li> </ul>

Naik et al. (2012)	8 older adults (Mean age= 62.1 years)	3 months of HC by Psychology and Public Health graduate students	N/A	Telephone coaching (10 x 30-45 minute sessions)	<ul style="list-style-type: none"> <li>• Significant reductions in HbA1c at 3 (<b>d= 0.36</b>) and 6 month follow up (<b>d= 0.28</b>)</li> <li>• Significant reductions in PHQ-9 at 3 (<b>d= 1.48</b>) and 6 month follow up (<b>d= 1.67</b>)</li> <li>• Significant reductions in PAID at 3 (<b>d= 1.50</b>) and 6 month follow up (<b>d= 1.06</b>)</li> </ul>
Navichareern et al.(2009)	40 (I: 20; C: 20) middle aged adults	3 months of HC by nurses	UC	<b>Mixed Modality</b> 3Face- to Face sessions (for 2 months) and 2 follow-up phone calls	<ul style="list-style-type: none"> <li>• Significant reductions in HbA1c (<b>P ≤0.05</b>)</li> <li>• No change in LDL, SBP, and DBP (<b>P &gt;0.05</b>)</li> </ul>
Wayne et al. (2014)	19 adults (Mean age= 55.6 years)	6 months of HC by a Health Sciences graduate student	N/A	<b>Mixed Modality</b> (Regular Face- to Face meetings, Telephone, E-mail and Smartphone web based contact)	<ul style="list-style-type: none"> <li>• Significant reductions in HbA1c (<b>P= 0.05</b>) among all, and in those with HbA1c&gt; 7.0% (<b>P= 0.04</b>)</li> <li>• Significant reductions in Weight (<b>P=0.02</b>), BMI (<b>P=0.05</b>), marginally significant reduction in WC (<b>P= 0.06</b>)</li> </ul>

Table 6.0. Representation of themes

<b>THEMES</b>	<b>SUB-THEMES</b>	<b>FURTHER CODES</b>
<b>THEME 1: Smartphone and Software</b>	i) Smartphone Utility	i) Direct functions ii) Indirect Functions
	ii) Self Activation	i) Self Awareness ii) Self Coach feedback loop iii) Responsibility towards self management
<b>THEME 2: The Health Coach</b>	i) Overall Qualities	
	ii) Supportive Role	
	iii) Working together	
	iv) Focal Activities	i) Diet ii) Medication iii) Blood glucose iv) Exercise
<b>THEME 3: Overall Program Experience</b>	i) Joining the program	i) Adherence and program commitment
	ii) Program facility for exercise	
	iii) Participant Experience	i) Value of education ii) Program Length
<b>THEME 4: Frustrations in managing chronic conditions</b>	i) Medication and blood glucose levels	
	ii) Diet and weigh loss	
	iii) Co-morbidities	

Figure 1.0. Participant Flow Chart

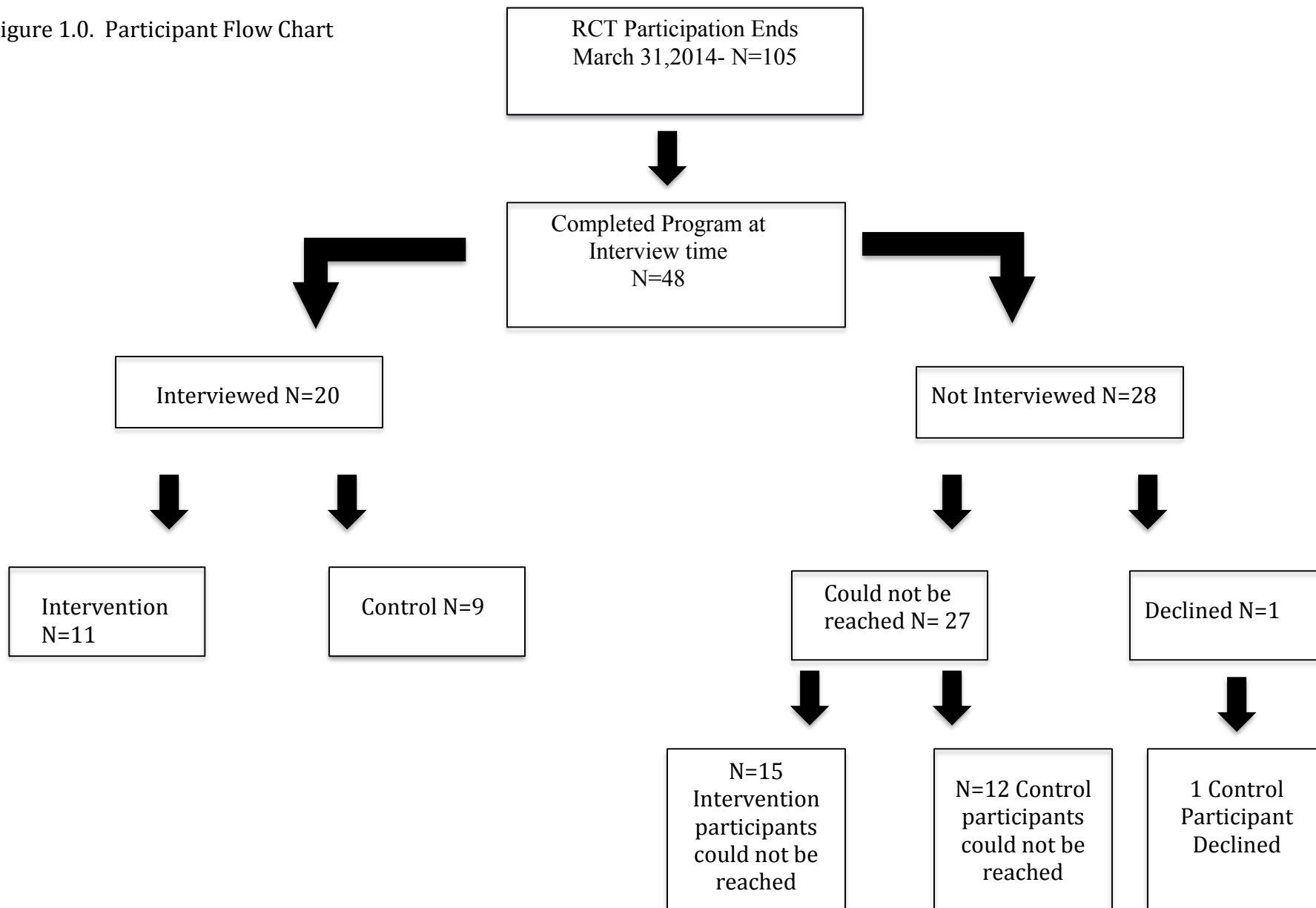


Figure 2.0. Study Flow Diagram and Study Selection Process

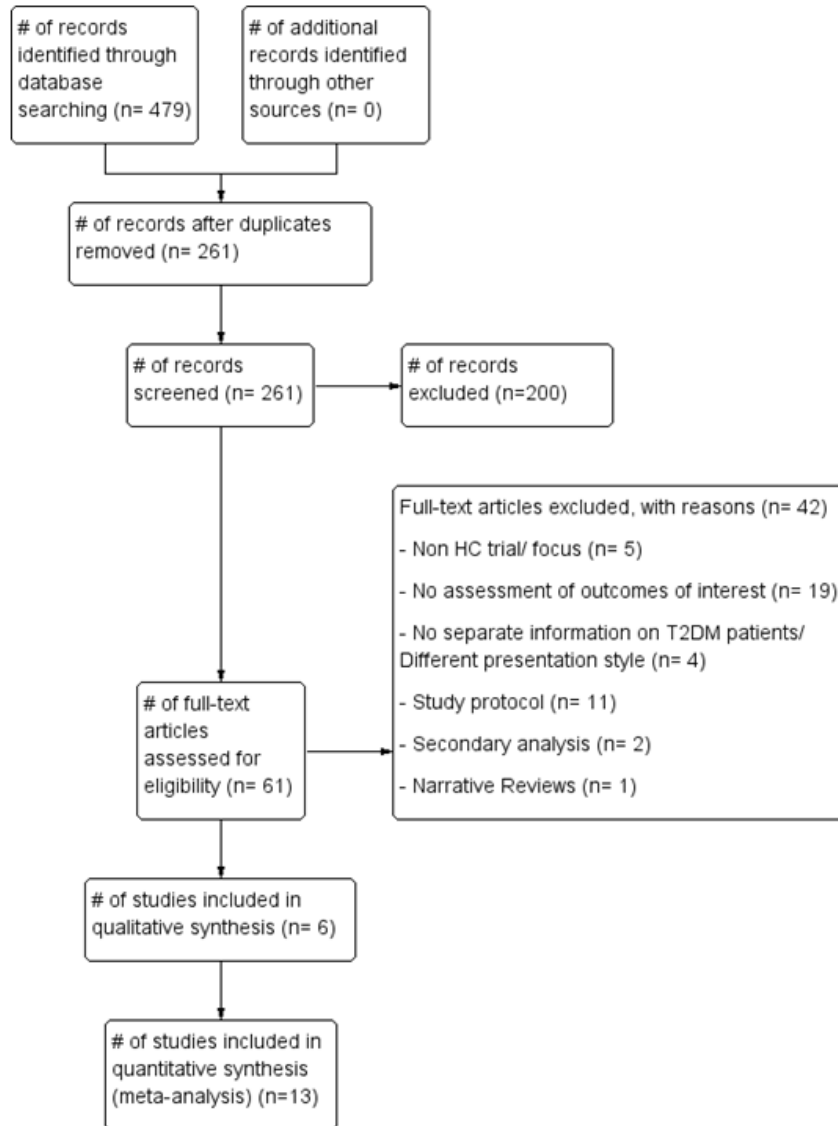




Figure 3.0 Number of quotations per interview

