The Role and Effectiveness of Diabetes Coaches in British Columbia

Submitted to

The Lawson Foundation

By

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January, 2018

Table of Contents

Executive Summary

This two-year pilot project, funded by the Lawson Foundation, investigated the effectiveness of telephone-delivered peer coaching to persons with type 2 diabetes who were experiencing difficulty in managing their condition. The project was a partnership between the 11 Diabetes Health Centres in the Fraser Health Region of BC and the University of Victoria, Institute on Aging and Lifelong Health.

The research investigated four major aspects of peer coaching, specifically: 1) the feasibility and viability of recruiting, training and pairing peer coaches with patients; 2) whether peer coaching brought about improved outcomes; 3) whether patient characteristics (i.e., sex, age, education level and number of chronic health conditions) influence program effectiveness; and 4) the process of peer coaching.

The findings relating to feasibility and viability clearly demonstrated that peer coaches can be recruited, trained, and paired with persons with type 2 diabetes for a 26-week period. The quantitative study which examined changes in health outcomes from baseline to 6 and 12 months found statistically significant improvements at both six and twelve months. At 12 months the mean participant A1C level had decreased by 9%; patient activation had increased by 15%; diabetes empowerment had increased by 10%; diabetes self-efficacy had increased by 23%; depression level had decreased by 24% and communication with physician had increased by 22%. Regarding the question whether patient characteristics of sex, age, education level and number of chronic health conditions influenced program effectiveness, the analysis found that the fourteen outcomes were not influenced by these covariates.

The grounded theory qualitative research investigated the interactions between the coaches and participants and summarized the main categories and themes of interactions that contributed to the behavioural improvements experienced by participants. Participants shared how having a coach positively impacted their daily management of diabetes.

In summary, this study found that a pragmatic low-cost telephone peer coaching intervention assisted persons with type 2 diabetes to improve healthy behaviours and better self-manage their diabetes. The central feature of the program is that persons who have a chronic condition themselves can acquire training and then help other persons with chronic conditions. This is a key component of BC's Patient as Partners Initiative, particularly, involving volunteer peers in the spectrum of care is a cost-effective way of providing additional support and continuity of care.

The research and analysis were officially completed in the spring of 2017 and demonstrated that involving peers in providing telephone peer coaching was both pragmatic and effective. Slight modifications were incorporated into the program (i.e., provincial access for persons with other types of chronic conditions, intervention period of three months with possibility of extension to six months) and support for ongoing provincial implementation was provided by the BC Ministry of Health under the Provincial Patients as Partners Initiative.

Project Team

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The Role and Effectiveness of Diabetes Coaches in British Columbia

Background

During the last decade research studies have consistently found that individual management and outcomes of type 2 diabetes are enhanced through the use of self-management strategies. [1-5] One model of self-management delivery, the Stanford programs, are delivered by either health professionals or trained peer leaders, and have consistently shown positive results in a number of settings. [6-12] Using another mode, telephone coaching, both diabetes clinicians [13-15] and peers [14, 16-22] have also demonstrated effectiveness in bringing about improved outcomes. As well, a recent pilot [23] has investigated the acceptability and feasibility of involving health professionals as health coaches in Primary Care. The effectiveness of involving peer coaches with persons with type 2 diabetes in a Canadian context has not been thoroughly examined, and there is little research which describes the interactions between coaches and participants. This project is innovative because it examines the process and effectiveness of trained peers in providing weekly telephone coaching to persons with type 2 diabetes for a six-month period. In addition, the study also examines the sustainability of such changes at 12 months.

Project purpose

The primary purpose of this project was to evaluate the feasibility, viability, effectiveness, process and sustainability of using peer health coaches to assist persons with type 2 diabetes who were experiencing challenges managing their diabetes. Four main areas of research were investigated, namely:

1) The feasibility and viability of a telephone peer coaching program;
2) Effectiveness of peer coaching for persons with type 2 diabetes;
3) The influence of gender, age, education level and number of chronic conditions on program effectiveness; and
4) The process of peer coaching.

Target population

The target population was adults with type 2 diabetes attending a Diabetes Health Centre in the Fraser Health region of BC. This is BC's largest health region, encompassing 20 communities and containing over one third of BC's total population. It is the fastest growing health region of BC, has the highest age-standardized prevalence rate of diabetes mellitus in BC, and 38% of all British Columbians with diabetes live in this region. Two communities, Surrey and Abbotsford, have the largest proportion of persons with diabetes among all these communities. In the eastern part of the region, significant proportions of the communities are in the lowest quintile of socioeconomic circumstances (i.e., Hope >75%, Mission, Abbotsford, Chilliwack >35%). Surrey has 25% in the lowest socioeconomic quintile, while New Westminster has 21%. Between 2001 and 2006 the immigrant population in Fraser Health grew by 82,405. Nearly 50% of the region's population report overweight or obese BMIs. In Fraser Health, there is a steadily growing waitlist and wait time for people to access Diabetes Health Centres, and only 49% of those with type 2 diabetes have two or more A1C tests.

Description of project

Fraser Health Diabetes Health Centres provide client care through three visits. The first visit usually involved a comprehensive assessment and in subsequent visits clients received diabetes education. On average, half the clients attended all sessions, and referral to community resources and follow-up care with diabetes staff was rarely arranged. Diabetes education staff do not have the time nor resources to provide ongoing behaviour change counselling and support. The result is that clients did not have the knowledge, skills, confidence, or supports required to manage diabetes and the situation is accentuated when they are from a variety of cultural communities or are of lower socioeconomic status. An episodic six-hour provision of knowledge-based education did not prepare clients to effectively manage the ongoing and complex behaviours required to manage diabetes. As well, the health care system is not designed to provide an extended period of support due to a shortage of time and resources and an entrenched system design.

Peer coaches can assist clients to implement and sustain the behaviours they need to manage on an ongoing basis beyond or outside of formal diabetes education. Involving peer coaches is innovative as it "taps" the largely untapped resource of community peer support and can be cost-effective. This concept is important because new models of health care delivery are needed to meet the growing demand for diabetes services in a cost-effective way. Fraser Health diabetes clinicians acknowledged the need for this extended continuum of service and endorsed the peer diabetes coach initiative.

This pilot project was a partnership between the 11 Diabetes Health Centres in the Fraser Health Region of BC and the University of Victoria - Self-Management BC Office. The Regional Manager of Diabetes Services, the study co-PI, had an instrumental role securing staff participation and continuing support for the initiative. Ethical approval to conduct the research in the Fraser Health Region was acquired from The Joint Fraser Health and University of Victoria Research Ethics Board. The initial plan was for the university to recruit and train 100 coaches from their roster of persons who had completed self-management program(s) in Fraser Health. Coaches would have type 2 diabetes or have family members with diabetes. One hundred and fifty subjects with type 2 diabetes would be recruited mainly by the diabetes educators. Eligibility criteria for clients included: adults with type 2 diabetes, currently attending a Diabetes Health Centre, ability to speak English, and disclosure to educators that they were experiencing difficulty managing.

As Fraser Health diabetes educators and administration had participated in the planning and implementation of the project, there were only a few challenges. The first challenge was that the team could not use RCT methodology to create an experimental and control group for analysis. Diabetes educators did not feel ethically comfortable recruiting clients experiencing difficulty with a chance they would not receive a coach. Subsequently, the project team decided to modify the methodology to a one-way repeated-measures analysis of variance with outcome measures obtained at baseline, 6 months, and 12 months. The second challenge related to proposed client eligibility of having A1C over 8% within the past 6 months, as clients' records were not accessible. Again, the team deleted this criterion. In retrospect the baseline mean for clients was 8.35.

Coaches were required to complete a three-day training workshop provided by the university and community partners. The university partner developed a Diabetes Coach Handbook that explained and reviewed how to use self-management support strategies, provided an explanation of core elements that coaches would need to discuss with participants during each call and the use of a tracking method. Using the standard diabetes patient booklet entitled "On the Road to Diabetes Health" *(http://www.fraserhealth.ca/media/201605_On_The_Road_Diabetes_Health.pdf).* A diabetes educator delivered a one-day session on type 2 diabetes. After completing the training workshop, each coach was paired with a participant and commenced weekly 30-minute telephone calls for a period of six months (26 weeks). Every two weeks a researcher would telephone the coaches to provide support, problem solve and ensure program fidelity.

A 40-member community advisory committee was established and met fifteen times to guide the project and offer community perspective. Committee membership consisted of diabetes educators, research team members from the university and Fraser Health, coaches, community health leaders and members of the pharmaceutical community.

Project timeline

This two and one-half year project, funded by the Lawson Foundation, began in September 2014 and was completed in March of 2017.

Research Questions, Methods and Results

Feasibility and viability of peer coaches

The foci of this research were to ascertain: 1) whether recruiting and training peer coaches feasible and viable; 2) if persons with type 2 diabetes accept a peer coach; and 3) if diabetes educators would recruit and refer their patients to the coaching program.
Different research methods were used to investigate each question. The first major question related to the feasibility and viability of recruiting and training peer coaches and then pairing them with persons with type 2 diabetes who were experiencing difficulty managing their condition. Process recording was used to address this question.

When the project was being planned the team estimated that 100 coaches were required. Coach recruitment was primarily through contact with persons who had led or participated in community self-management programs and through ads in community newspapers. The inclusion criteria included; a diagnosis of type 2 diabetes, being over 19 years old, being able to communicate in English and living in the Fraser Health Region. Those with serious kidney disease and mental illness were excluded from the study.

During the two-year project 224 persons expressed interest in becoming a coach. Of these, 109 completed baseline questionnaires and consent forms and completed one of 15 three-day coach training workshops delivered by the university and diabetes educators. Forty-one of these coaches had either taken or led a Stanford self-management program through University of Victoria, 60 had type 2 diabetes, 17 had family members or close friends with diabetes and 32 had experiences with other types of chronic conditions.

Over three days coaches were trained on using self-management and coaching skills. The self-management techniques were modeled after the 5As and Stanford approaches. Coaches were given a coaching manual, a community resources guide and a Fraser Health patient booklet entitled *"On the Road to Diabetes Health"* that provided general information on diabetes. Coaches were supported at several stages throughout their six-month coaching period, namely: in the training, during the bi-monthly coach check-ins and through participation in the advisory committee meetings. This insured the self-management values were reinforced throughout the coaching period which enhanced intervention fidelity.

Coaches and participants were matched by sex and as close proximity to age as possible. The research coordinator and research associate paired coaches and participants by discussing personality types and on what coaching style participants preferred (e.g., pushy or laid back). Coaches were instructed to contact their participant once a week for 6 months and engage in a weekly 30-minute telephone-delivered coaching session. The Coaches were also invited to attend quarterly Advisory Committee Meetings. Coaches were given a $100 honorarium for their participation.

Meetings were held with staff at the 11 Diabetes Health Centres to discuss the initiative and acquire support. A total of 316 persons requested a coach; 200 were referred by diabetes

educators. One hundred fifty-five persons completed the questionnaire and consent form and 115 were paired with a coach. Only three participants had led or taken a Stanford self-management program prior to their involvement in the study.

Eighty-five of the 109 coaches were then paired with participants and provided weekly coaching for a period longer than four weeks. The average number of weeks of the pairings was 23 weeks (SD=6). Over the project period, of these 85 coaches:

- 67 were paired with one participant,
- 13 with two participants,
- 3 with three participants, and
- 2 with four participants.

Analysis of this experience demonstrates that peer coaches can be recruited, trained, and paired with persons with type 2 diabetes for a 26-week period.

Effectiveness of peer coaching

Quantitative research was used to investigate effectiveness. Both clients and coaches completed questionnaires at baseline, and at six and twelve months. Questionnaires contained 14 outcome measures (i.e., A1C, Patient Activation Measure [25], Diabetes Empowerment Scale [25], self-efficacy to manage diabetes [26], self-reported health [27], fatigue and pain [28], depression [29], communication with physician [28], medication adherence [30], health literacy [31], emergency department visits and nights in hospital in the previous six months [28]. All measures have been previously tested for reliability and validity. In addition to the 14 outcome measures, five demographic variables (age, sex, race/ethnicity, years of education, and number of chronic conditions) were obtained for each participant and were used to assess any potentially differential effects of the program across time for different subgroups. For assessing these effects, factorial mixed analyses of variance with groups (e.g., based on sex … etc.) as the between-subjects factor and time as the repeated measures factor were employed. Participants and coaches received $25 each time they completed the questionnaires.

For the main hypothesis, that the coaching program would improve the outcomes of the study participants from baseline to 6-month and 12-months, the two groups – i.e., the program participants and coaches – were treated separately, and therefore these hypotheses were tested using one-way repeated measures analyses of variance (ANOVAs). Because there were 14 outcome measures that were assessed for each group, to maintain an overall Type I error probability at or below .10, the statistical significance level of .007 was adopted for each null hypothesis test (using the Bonferroni correction, i.e., 10/14=.007). Note that we were not testing for any interaction effects with the group variables, hence, we did not use the two-way factorial ANOVAs for these hypotheses.

Results

The description of the 109 coaches and 115 participants (total N = 224) is shown in Table 1. The two groups are comparable in terms of the proportion of men and women, their living situations, and whether they had attended a diabetes patient education program (a series of classes), although the coaches had attended such a program on average 6.1 years ago compared with 4.2 years for the participants. They are also comparable in terms of their average ages but the age distributions did vary, with the coaches having a more even distribution than the program participants in that there were higher percentages of coaches in both the youngest and oldest age groups and most of the program participants (73.4%) in the two middle age groups between the ages of 51 and 70 years old. The two groups also differed in terms of their language – with English being the mother tongue for a higher proportion (81.7%) of program participants compared with 65.1% of the coaches – and education levels, with the majority of coaches (55.5%) having at least a post-secondary degree (16 or more years of education) while the majority of the program participants (66.1%) had 15 years or less.

Table 1. Demographic Description of the Two Groups of Study Participants

		Coaches (n = 109)		Program Participants (n = 115)		TOTAL (N=224)	
		N	%	N	%	N	%
Sex	Female	74	67.9	73	63.5	147	65.6
	Male	35	32.1	42	36.5	77	34.4
Age (in years)	Mean Standard Deviation	61.6 12.8		60.8 9.3			
Age Group	20 to 50 years old	22	20.8	17	15.0	39	17.8
	51 to 60 years old	20	18.9	38	33.6	58	26.5
	61 to 70 years old	33	31.1	45	39.8	78	35.6
	71 to 90 years old	31	29.3	13	11.5	44	20.1
Mother Tongue	English	71	65.1	94	81.7	165	73.7
	Punjabi	11	10.1	5	4.4	16	7.1
	Other	27	24.8	16	13.9	43	19.2
Education level	High School or Less (0-12 years)	14	12.8	36	31.3	50	22.3
	Some post-secondary (13-15 years)	34	31.2	40	34.8	74	33.0
	Post-secondary degree (16 years)	31	28.4	20	17.4	51	22.8
	Post-Graduate (17 or more years)	30	27.5	19	16.5	49	21.9
Living Situation	Lives Alone	24	22.9	28	24.4	52	23.6
	Lives with Others	81	77.1	87	75.7	168	76.4
Attended a Diabetes Patient Education Program?	Yes	52	81.3	92	80.7	144	80.9
	No	12	18.8	22	19.3	34	19.1
	If yes, how many years ago?	n=52 Mean = 6.1 (SD = 8.4)		n=85 Mean = 4.2 (SD = 4.6)			

In terms of overall health and diabetes, Table 2 shows that of the 109 coaches just over a half (55.1%) had diabetes themselves, and these coaches had been diagnosed with it on average 12.76 years prior to the study, compared with 8.9 years on average for the 115 program participants. The program participants self-reported considerably more chronic conditions, and were also on average about 10 kg heavier than the coaches.

Table 2. General Health and Physical Description of the Two Groups

		Coaches (n = 109)		Program Participants (n = 115)	
		Number	%	Number	%
Who has Type 2 Diabetes?	**Self**	60	55.1	115	100
	Family/friend	17	15.6	0	0
	Other	32	29.4	0	0
Years since T2D diagnosis	**N**	58		113	
	Mean	12.76		8.91	
	Standard Deviation	12.51		8.38	
Number of Chronic Conditions including T2D*	**None**	23	21.1	0	0
	One	39	35.8	29	25.2
	Two	24	22.0	23	25.0
	Three	15	13.8	40	34.8
	4 or more	7	6.4	23	20.0
Height (in metres)	**N**	65		115	
	Mean	1.68		1.68	
	Standard Deviation	0.104		0.101	
Weight At Baseline (in kg)	**N**	65		115	
	Mean	82.1		92.2	
	Standard Deviation	25.9		22.0	
Note: (1) One coach was missing this information, therefore the percentages do not add to 100%					

With regard to the specific chronic conditions reported: heart-related conditions were self-reported by 6 (5.5%) coaches and 19 (16.5%) participants; asthma was self-reported by 4 (3.7%) coaches and 10 (8.7%) participants; arthritis was reported by 18 (16.5%) coaches and 13 (11.3%) participants; lung-related conditions were reported by 3 (2.8%) coaches and 5 (4.4%) participants; cancer was reported by 1 (0.9%) coach and no participants. One "other" chronic condition (only one) was also reported by 32 (29.4%) coaches and 34 (29.6%) participants, and two of more "other" chronic conditions (plural) were reported by 20 (18.4%) coaches and 46 (40.0%) participants.

Findings from the one-way repeated measures ANOVAs that assessed the impact of the coaching program on the various outcome measures over time are summarized in Table 3. Using statistical significance level of .007 to control for Type I error probability for each outcome measure, statistically significant changes over time are indicated in bold. The table also shows the p-value for outcomes that did not reach the preset level, but did have p-values of <.10.

Table 3. Means on the Outcome Measures at Baseline, 6-Months and 12-Months

Outcome Measure (1)	Coaches				Program Participants			
	At Baseline	At 6-Mo.	At 12-Mo	p-value	At Baseline	At 6-Mo	At 12-Mo	p-value
# of Respondents (2)	54 to 107	38 to 74	40 to 72		109 to 115	73 to 100	87 to 95	
A1C level (3)	6.80	6.62	6.84	ns	**8.35**	**7.58**	**7.60**	**.0002**
General Health (1 to 5 rating)↓	2.33	2.24	2.34	ns	3.34	3.11	3.09	ns (.0548)
Fatigue (0 to 10 rating) ↓	3.61	3.48	3.92	ns	5.64	4.90	4.82	ns (.0224)
Pain (0 to 10 rating) ↓	2.78	3.01	3.12	ns	4.20	4.09	4.14	ns
Patient Activation (PAM) score (0 to 100) ↑	**71.6**	**77.8**	**78.8**	**.0037**	**56.1**	**66.3**	**64.4**	**<.0001**
Diabetes Empowerment Scale (DES) score (1 to 5) ↑	4.09	4.21	4.30	ns (.0801)	**3.54**	**3.93**	**3.91**	**<.0001**
Self-Efficacy Scale (1 to 10) ↑	8.03	8.15	8.35	ns	**5.81**	**7.33**	**7.12**	**<.0001**
Depression (PHQ-9) (0 to 24) ↓	3.45	3.04	3.39	ns	**8.33**	**5.23**	**6.33**	**.0002**
Communication with Physician (0 to 5) ↑	3.33	3.77	3.68	ns (.0427)	**2.44**	**2.96**	**2.97**	**.0019**
Morisky's Medication Adherence Scale (0 to 8) ↑	6.26	6.25	6.52	ns	5.56	5.76	6.00	ns
Health Literacy – read (1 to 5 rating) ↑	4.63	4.74	4.71	ns	4.48	4.51	4.53	ns
Health Literacy – learning (1 to 5 rating) ↑	4.70	4.78	4.78	ns	4.39	4.55	4.55	ns
Health Literacy – fill out forms (1 to 5 rating) ↓	1.39	1.53	1.33	ns	1.59	1.63	1.70	ns
Number of ER visits in last 6 months	0.14	0.14	0.19	ns	0.49	0.39	0.29	ns
Number of MD visits in last 6 months (4)	3.07	3.11	2.57	ns	4.57	3.90	3.36	ns (.0356)
Number of Nights Spent in Hospital in last 6 months (5)	0.06	0	0.04	ns	0.80	0.40	0.18	ns (.0516)

Notes:

(1) ↓ indicates that lower scores on this measure are better; ↑ indicate that higher scores are better

Outcome Measure (1)	Coaches				Program Participants			
	At Baseline	At 6-Mo.	At 12-Mo	p-value	At Baseline	At 6-Mo	At 12-Mo	p-value

(2) The number of respondents are given as ranges, because some respondents did not provide a response, and for those coaches who did not themselves have diabetes or other chronic conditions, some of the questions and questionnaires were not applicable.

(3) A1C levels that were 3.0 or more standard deviations above the group means were considered extreme scores and were deleted from analyses. This criterion led to the deletion of three A1C scores for the coaches – two at baseline (13.9 and 13.0) and one at 6-months (11.0) – and six scores from four program participants – two at baseline (19.5, 18.0), two at 6-months (14.3, 12.7) and two at 12-months (16.4, 15.1).

(4) Two extreme scores (greater than 3.0 standard deviations from the group means) were removed from analyses of MD visits (scores of 48 (at baseline) and 30 (at 12 month) both obtained for the program participant group).

(5) Six extreme scores (greater than 3.0 SDs from the group means) were removed from analyses of nights spent in hospital, two scores from coaches and four from participants.

Six outcome measures changed significantly over time for the program participants. The A1C levels dropped from an average of 8.35 at baseline to 7.58 at 6-months and remained at 7.60 at 12 months, $F(2, 290)=8.57$, $p=.0002$.

Patient Activation Measure (PAM) scores showed the transformed activation levels had increased from an average of 56.1 at baseline to 66.3 at 6 months and remained elevated at 64.4 at 12 months, $F(2,306)=17.15$, $p<.0001$. For the coaches, statistically significant changes over time were observed only on the PAM scores. As with the program participants, the coaches' activation levels increased in the first 6 months, from an average activation level of 71.6 at baseline to 77.8 at 6 months and 78.8 at 12 months, $F(2,249)=5.72$, $p=.0032$.

Chi-square test of independence was conducted to test whether the percentage of study participants and coaches separately, at each PAM activation level changed over time. For the program participants (Figure 1), the increase in the proportions of people at the higher PAM Activation levels at 6- and 12 months was statistically significant, $\chi 2(df=6, N=281)=22.976$, $p=.001$. The top chart in Figure 1 shows that at baseline, the proportions of people were about equal across the four activation levels. At 6 months, the proportions at levels 3 and 4 rose while proportions at levels 1 and 2 dropped substantially, and remained elevated at 12 months, although some slippage back to level 2 was observed. In contrast, for the coaches (Figure 2), the test indicated that the proportions did not change statistically significantly ($\chi 2(df=6, N=229)= 8.628$, $p=.196$), although as shown in the bottom of the figure, there was a trend toward higher proportions at 6- and 12-months of coaches at level 4. Note also that almost two-thirds of the coaches (62.5%) were at the highest activation level at baseline already, and it appears that several coaches, particularly those at level 3, increased their activation level across time.

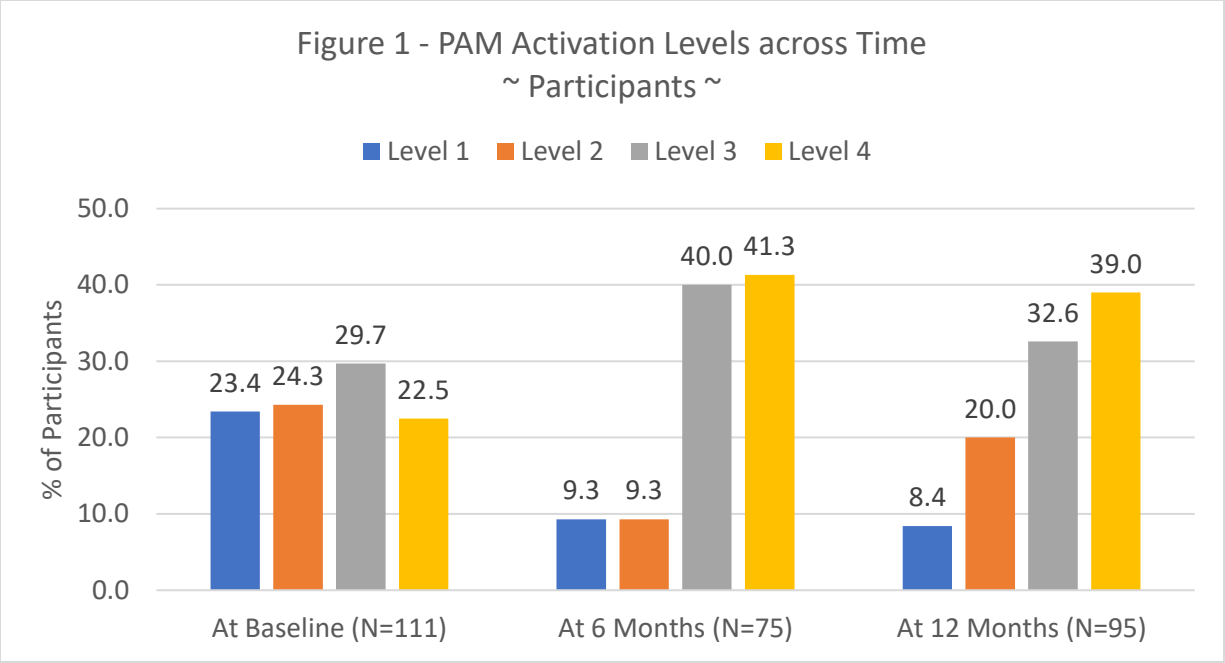
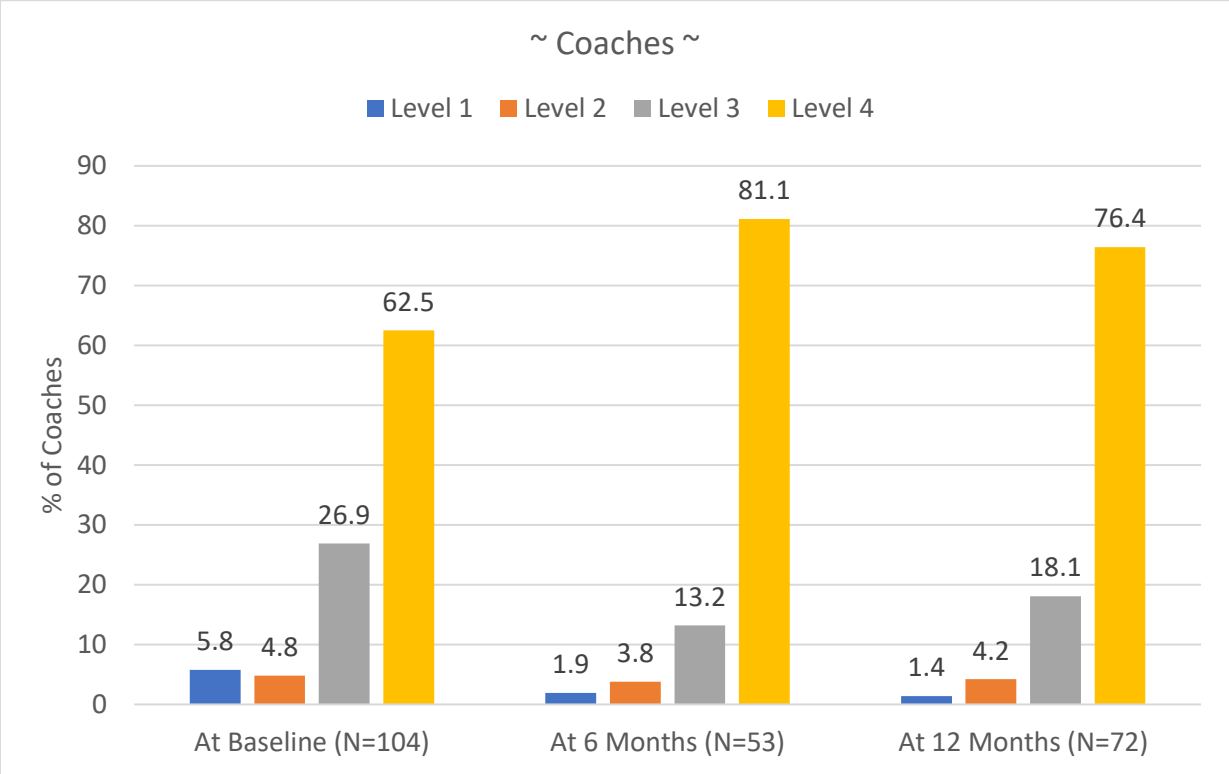


Figure 1 - PAM Activation Levels across Time
~ Participants ~
Level 1
Level 2
Level 3
Level 4
% of Participants
50.0
40.0
30.0
20.0
10.0
0.0
23.4
24.3
29.7
22.5
9.3
9.3
40.0
41.3
8.4
20.0
32.6
39.0
At Baseline (N=111)
At 6 Months (N=75)
At 12 Months (N=95)


~ Coaches ~
Level 1
Level 2
Level 3
Level 4
% of Coaches
90
80
70
60
50
40
30
20
10
0
5.8
4.8
26.9
62.5
1.9
3.8
13.2
81.1
1.4
4.2
18.1
76.4
At Baseline (N=104)
At 6 Months (N=53)
At 12 Months (N=72)

Diabetes Empowerment Scale (DES) scores, which increased from the baseline average of 3.54 to 3.93 and 3.91 at 6- and 12- months, $F(2,294)=22.66$, $p<.0001$; self-efficacy scores which also rose from the baseline average of 5.81 to 7.33 and 7.12 at 6- and 12-months, $F(2,306)=25.14$, $p<.0001$; depression (PHQ-9) scores which decreased from 8.33 at baseline to 5.23 at 6 months and 6.33 at 12 months, $F(2,275)= 9.01$, $p=.0002$; and communication with physician which improved from an average of 2.44 at baseline to 2.96 and 2.97 at 6 and 12 months, $F(2, 279)=6.39$, $p=.0019$.

The remaining outcome measures did not seem to be affected by the coaching. These were: self-ratings of health, fatigue and pain, scores on the Morisky Medication Adherence scale, and the three items assessing health literacy (all p-values > .0224). It should, however, be noted that although these outcome measures did not reach statistical significance, the changes in the mean scores were all in the predicted (better over time) direction when compared with baseline.

Additional variables related to general health – number of visits to the ER, number of visits to the doctor and number of nights spent in hospital – are summarized in the bottom of Table 3. For both groups, none of these measures changed statistically significantly over time.

The influence of covariates on program effectiveness

The effectiveness of the coaching program on different groups of participants, defined by sex, age, education level and total number of chronic conditions is explored next. In these analyses, a statistically significant two-way interaction effect between time and a grouping variable (sex, age, education or chronic conditions) is of particular interest as this would indicate that the coaching program had differential effectiveness on different types of program participants. We note that in the following two-way ANOVAs, some outcome variables that were not statistically significant in the one-way ANOVAs reported above showed statistically significant improvements. This is because the residual error variance in these factorial analyses is always smaller and some variability is partialled out of the error term by the other effects included in the linear model (viz., the sex main effect and the time by sex interaction), and this leads to greater statistical power to find a statistically significant result.

To test the second set of hypotheses, that the coaching program may be differentially effective for different groups of program participants – with groups based on sex, age group, education level and number of chronic conditions – differences in outcome measures across time and groups were tested using the linear mixed model, with time as a repeated measure and group as a between-subject fixed factor. In these analyses, statistically significant group by time interaction effects was further explored using post-hoc tests on the group means using Bonferroni adjustment for maintaining familywise Type I error probability at .10.

Influence of sex

Table 4 shows the group means and p-values from these factorial ANOVAs for the time by sex interaction. Based on these findings, there is no effect of sex (main effect or interaction effect) on any of these outcome variables. The marginally significant interaction for the health literacy "filling out forms" question (p=.0113) is due to the elevated mean for women at 6 months and likely a Type I error. The only statistically significant findings were the main effects of time.

Two outcome measures that were marginally significant in the previous (one-way) analyses showed statistically significant improvements over time in these two-way ANOVAs. These were the participants' self-ratings of their general health and fatigue, which both improved from baseline to 6 months, for both sexes, and remained better at 12 months when compared to baseline.

Table 4. Mean Changes in Outcome Measures over Time, by Sex

Outcome Measure (1)	At Baseline		At 6-Mo		At 12-Mo		ANOVA Result (p-value)		
	Women	Men	Women	Men	Women	Men	Sex	Time	Sex*Time
# of Respondents (2)	68 to 73	40 to 42	47 to 64	28 to 36	55 to 61	32 to 34			
A1C level (3)	8.12	8.77	7.51	7.87	7.52	7.75	ns	**<.0001**	ns
General Health (1 to 5 rating)↓	3.45	3.13	3.24	2.89	3.16	2.94	ns (.0797)	**.0003**	ns
Fatigue (0 to 10 rating) ↓	6.12	4.81	5.18	4.40	5.08	4.33	ns (.0149)	**.0023**	ns
Pain (0 to 10 rating) ↓	4.64	3.43	4.26	3.80	4.40	3.67	ns	Ns	ns
Patient Activation (PAM) score (0 to 100) ↑	56.0	56.3	66.4	66.2	64.4	64.3	ns	**<.0001**	ns
Diabetes Empowerment Scale (DES) score (1 to 5 score) ↑	3.49	3.62	3.97	3.87	3.89	3.94	ns	**<.0001**	ns
Self-Efficacy Scale score (1 to 10 score) ↑	5.60	6.19	7.22	7.52	7.01	7.32	ns	**<.0001**	ns
Depression (PHQ-9) (0 to 24 score) ↓	9.40	6.40	5.91	4.07	6.66	5.76	ns (.0695)	**<.0001**	ns
Communication with Physician (0 to 5 score) ↑	2.61	2.13	3.18	2.62	3.17	2.62	ns (.0751)	**<.0001**	ns
Morisky's Medication Adherence Scale (0 to 8 score) ↑	5.26	6.04	5.66	5.93	5.88	6.20	ns (.0921)	Ns	ns
Health Literacy – read (1 to 5 rating) ↑	4.63	4.21	4.66	4.23	4.65	4.32	ns (.0875)	Ns	ns
Health Literacy – learning (1 to 5 rating) ↑	4.44	4.31	4.61	4.44	4.62	4.44	ns	Ns (.0416)	ns
Health Literacy – fill out forms (1 to 5 rating) ↓	1.53	1.71	1.33	2.17	1.7	1.71	ns (.0985)	Ns	ns (.0113)
Number of ER visits in last 6 months	0.41	0.62	0.38	0.43	0.29	0.29	ns	ns (.0945)	ns
Number of MD visits in last 6 months (4)	5.01	3.81	4.14	3.47	3.50	3.12	ns	ns (.0749)	ns
Number of Nights Spent in Hospital in last 6 months (5)	0.62	0.81	0.61	0.03	0.12	0.26	ns	ns (.0938)	ns
Notes: For (1), (2), (3), (4) and (5) please see the Notes to Table 3.									

Influence of age

Table 5 shows the results of the two-way factorial mixed ANOVAs that examined the time by age group effects on the outcome measures. Only two outcome measures showed an interaction effect that approached statistical significance, and those were the PAM (both raw scores, p=.0457, and for the transformed activation scores, p=.0407) and communication with physician (p=.0662). (As was noted above, we suspect the health literacy "forms" was a spurious finding). For both the PAM and the communication outcomes, younger participants showed a larger improvement in their scores over time, which they also maintained at 12 months, while older participants showed a smaller improvement over time or initially improved but then again decreased over time.

Table 5. Mean Changes in Outcome Measures over Time, by Age Group

Outcome Measure (1)	At Baseline				At 6-Months				At 12-Months				ANOVA Result (p-value)		
	20-50	51-60	61-70	71-90	20-50	51-60	61-70	71-90	20-50	51-60	61-70	71-90	Age	Time	Age * Time
# of Respondents (2)	14 to 17	36 to 38	44 to 45	13	13 to 16	24 to 32	29 to 39	10 to 11	13 to 16	27 to 29	32 to 37	10 to 11			
A1C level (3)	8.76	8.47	8.16	8.09	7.47	7.72	7.64	7.65	7.53	7.61	7.64	7.64	ns	**<.0001**	ns
General Health (1 to 5 rating)↓	3.06	3.59	3.36	2.77	2.88	3.39	3.11	2.64	2.93	3.31	3.14	2.45	ns (.0211)	**.0017**	ns
Fatigue (0 to 10 rating) ↓	4.53	5.87	5.98	5.08	4.88	4.63	5.25	4.82	3.57	4.55	5.49	5.00	ns	ns (.0143)	ns
Pain (0 to 10 rating) ↓	2.94	4.29	4.49	4.92	3.63	4.25	3.86	5.18	2.86	4.24	4.27	5.09	ns	ns	ns
Patient Activation (PAM) score (0 to 100) ↑	54.1	54.7	56.1	63.4	65.7	61.9	68.7	71.1	69.7	60.3	65.6	63.4	ns	**<.0001**	ns (.0407)
Diabetes Empowerment Scale (DES) score (1 to 5 score) ↑	3.41	3.46	3.60	3.70	3.91	3.85	4.00	3.92	4.03	3.78	3.97	3.86	ns	**<.0001**	ns
Self-Efficacy Scale score (1 to 10 score) ↑	5.74	5.41	5.99	6.42	7.27	6.71	7.76	7.67	7.39	6.56	7.43	7.18	ns (.0725)	**<.0001**	ns
Depression (PHQ-9) (0 to 24 score) ↓	7.56	9.00	8.67	6.15	5.54	5.92	4.93	4.00	5.13	6.26	6.72	6.80	ns	**<.0001**	ns
Communication with Physician (0 to 5 score) ↑	2.25	2.34	2.56	2.54	2.44	2.81	3.38	2.83	3.00	3.02	2.95	2.70	ns	**.0003**	ns (.0662)
Morisky's Medication Adherence Scale (0 to 8 score) ↑	4.91	5.30	5.72	6.21	4.94	5.73	5.79	6.425	5.21	5.73	6.50	5.77	ns	ns	ns

Outcome Measure (1)	At Baseline				At 6-Months				At 12-Months				ANOVA Result (p-value)		
	20-50	51-60	61-70	71-90	20-50	51-60	61-70	71-90	20-50	51-60	61-70	71-90	Age	Time	Age * Time
Health Literacy – read (1 to 5 rating) ↑	4.71	4.55	4.31	4.46	4.81	4.59	4.29	4.45	4.81	4.72	4.32	4.20	ns	ns	ns
Health Literacy – learning (1 to 5 rating) ↑	4.59	4.55	4.27	4.00	4.75	4.53	4.46	4.55	4.69	4.72	4.41	4.30	ns	ns (.0231)	ns
Health Literacy – fill out forms (1 to 5 rating) ↓	1.29	1.51	1.76	1.77	1.25	1.41	1.74	2.18	2.13	1.41	1.81	1.60	ns	ns	ns (.0291)
Number of ER visits in last 6 months	0.82	0.55	0.38	0.23	0.31	0.31	0.55	0.27	0.25	0.29	0.32	0.20	ns	ns	ns
Number of MD visits in last 6 months (4)	4.88	4.74	4.45	4.31	3.31	4.41	3.79	3.81	2.75	3.56	3.54	3.30	ns	ns (.0603)	ns
Number of Nights Spent in Hospital in last 6 months (5)	0.85	0.47	1.02	0.07	0	0.50	0.34	1.0	0.06	0.11	0.31	0.10	ns	ns	ns
Notes: For (1), (2), (3), (4) and (5) please see the Notes to Table 3.															

Influence of education level

Table 6 shows the relationship that education level has with these outcome measures, and again the findings indicate that education level does not differentially affect the program participants' outcomes over time, except on one item. Perhaps not surprisingly, education level was related to one of the three measures of health literacy. Participants with lower levels of education improved their ratings of "how often [they] have problems learning about their medication condition because of difficulty understanding written information," whereas participants with high levels of education did not improve these scores (likely because of a ceiling effect on these items).

Table 6. Mean Changes in Outcome Measures over Time, by Education Level

Outcome Measure (1)	At Baseline				At 6-Months				At 12-Months				ANOVA Result (p-value)		
	HS or less	Some Post-2nd	Post-2nd Deg.	Grad/ Prof	HS or less	Some Post-2nd	Post-2nd Deg.	Grad/ Prof	HS or less	Some Post-2nd	Post-2nd Deg.	Grad/ Prof	Educ	Time	Educ * Time
# of Respondents (2)	34 to 36	39 to 40	17 to 20	15 to 19	24 to 31	28 to 36	13 to 16	10 to 17	25 to 29	33 to 35	11 to 14	15 to 17			
A1C level (3)	8.72	8.45	7.95	7.83	8.29	7.45	7.40	7.04	7.71	7.82	7.24	7.24	ns	**<.0001**	ns
General Health (1 to 5 rating)↓	3.37	3.26	3.20	3.58	2.97	3.26	3.06	3.12	2.89	3.20	2.93	3.29	ns	**.0001**	ns
Fatigue (0 to 10 rating) ↓	5.58	5.18	5.90	6.47	4.90	4.66	4.81	5.47	4.43	5.06	4.21	5.47	ns	**.0001**	ns
Pain (0 to 10 rating) ↓	4.33	3.83	5.30	3.58	4.55	3.80	5.13	2.94	4.11	3.82	5.21	3.94	ns	ns	ns
Patient Activation (PAM) score (0 to 100) ↑	57.4	56.7	53.0	55.8	67.8	65.1	63.3	69.0	64.7	63.7	63.6	65.8	ns	**<.0001**	ns
Diabetes Empowerment Scale (DES) score (1 to 5 score) ↑	3.61	3.57	3.43	3.47	3.98	3.86	3.94	4.03	3.91	3.86	3.98	3.93	ns	**<.0001**	ns
Self-Efficacy Scale score (1 to 10) ↑	5.50	5.97	5.57	6.34	7.35	7.32	7.07	7.57	7.09	7.10	7.04	7.26	ns	**<.0001**	ns
Depression (PHQ-9) (0 to 24) ↓	8.08	7.88	9.75	8.25	4.83	5.07	6.62	4.80	6.30	6.34	6.83	6.00	ns	**<.0001**	ns
Communication with Physician (0 to 5 score) ↑	2.49	2.45	2.22	2.57	3.25	2.80	2.62	3.17	2.88	2.88	3.19	3.14	ns	**<.0001**	ns
Morisky's Medication	5.76	5.46	5.24	5.75	6.11	5.56	5.34	5.91	6.31	5.80	5.81	6.00	ns	ns (.0603)	ns

Outcome Measure (1)	At Baseline				At 6-Months				At 12-Months				ANOVA Result (p-value)		
	HS or less	Some Post-2nd	Post-2nd Deg.	Grad/ Prof	HS or less	Some Post-2nd	Post-2nd Deg.	Grad/ Prof	HS or less	Some Post-2nd	Post-2nd Deg.	Grad/ Prof	Educ	Time	Educ * Time
Adherence Scale (0 to 8 score) ↑															
Health Literacy – read (1 to 5 rating) ↑	4.11	4.58	4.70	4.74	4.03	4.69	4.56	4.88	4.14	4.71	4.57	4.76	ns (.0237)	ns	ns
Health Literacy – learning (1 to 5 rating) ↑	3.89	4.63	4.45	4.79	4.26	4.69	4.50	4.82	4.14	4.66	4.71	4.88	**.0080**	ns (.0716)	ns
Health Literacy – fill out forms (1 to 5 rating) ↓	1.97	1.46	1.40	1.37	2.03	1.39	1.63	1.41	1.75	1.60	1.64	1.88	ns	ns	ns
Number of ER visits in last 6 months	.056	0.48	0.60	0.26	0.40	0.61	0.31	0	0.39	0.29	0.23	0.18	ns	ns (.0885)	ns
Number of MD visits in last 6 months (4)	4.17	4.62	4.30	5.53	3.58	4.22	4.50	3.24	3.04	3.79	3.15	3.18	ns	**.0075**	ns
Number of Nights Spent in Hospital in last 6 months (5)	0.83	0.86	0.25	0.53	0.37	0.36	1.00	0	0.11	0.35	0.08	0	ns	ns	ns
Notes: For (1), (2), (3), (4) and (5) please see the Notes to Table 3.															

Influence of number of chronic health conditions

Table 7 shows the results from the two-way ANOVAs looking at the changes in scores over time as a function of the number of chronic conditions self-reported by the participants. No statistically significant interaction effects were found for this grouping variable. As was found and reported above, many outcome measures showed a statistically significant effect of time, showing an improvement from baseline. In this set of analyses, however, as expected participants' self-rated health, pain and to some degree fatigue also differed across levels of chronic conditions. Participants with more chronic conditions rated their general health more poorly and their pain levels as higher (the main effects of general health and pain were $p<.007$); however, while these self-ratings generally improved over time, the improvement was similar for all groups of participants regardless of the number of chronic conditions, thus we cannot conclude that the program had differential effects on participants with more chronic conditions.

Table 7. Changes over Time, by Total Number of Chronic Conditions

Outcome Measure (1)	At Baseline				At 6-Mo				At 12-Mo				ANOVA Result (p-value)		
	One	Two	Three	Four or More	One	Two	Three	Four or More	One	Two	Three	Four or More	Chronic	Time	Chronic * Time
# of Respondents (2)	26 to 29	21 to 23	37 to 40	21 to 23	15 to 22	15 to 21	30 to 37	14 to 20	17 to 19	18 to 21	30 to 35	18 to 20			
A1C level (3)	8.10	8.69	8.67	7.80	7.29	7.82	7.75	7.61	7.19	7.54	7.90	7.54	ns	**<.0001**	ns
General Health (1 to 5 rating)↓	2.75	3.43	3.46	3.74	2.45	3.19	3.11	3.70	2.74	3.00	3.06	3.58	**.0006**	**.0002**	ns
Fatigue (0 to 10 rating) ↓	5.07	5.43	5.53	6.78	3.52	5.48	4.83	5.85	3.74	4.38	5.24	5.63	ns (.0140)	**0.0002**	ns
Pain (0 to 10 rating) ↓	2.24	4.52	4.75	5.39	2.10	3.90	5.00	4.50	2.21	3.95	5.00	4.74	**.0003**	ns	ns
Patient Activation (PAM) score (0 to 100) ↑	61.3	53.2	54.2	55.7	71.0	66.1	62.8	68.0	66.2	68.7	60.8	64.5	ns	**<.0001**	ns
Diabetes Empowerment Scale (DES) score (1 to 5 score) ↑	3.65	3.59	3.50	3.43	3.93	4.04	3.85	3.97	3.92	4.13	3.78	3.84	ns	**<.0001**	ns
Self-Efficacy Scale score (1 to 10 score) ↑	6.59	5.65	5.55	5.46	8.12	7.39	6.91	7.18	8.12	7.57	6.51	6.73	ns (.0554)	**<.0001**	ns
Depression (PHQ-9) (0 to 24 score) ↓	6.45	8.04	8.97	10.0	3.13	4.88	6.40	5.36	3.35	5.14	7.97	7.40	ns (.0320)	**<.0001**	ns
Communication with Physician (0 to 5 score) ↑	2.26	2.43	2.38	2.79	3.00	2.69	2.94	3.31	3.00	3.00	2.74	3.32	ns	**<.0001**	ns
Morisky's Medication	5.91	5.40	5.47	5.45	6.16	5.23	5.64	6.08	6.21	6.01	5.66	6.34	ns	ns (.0182)	ns

Outcome Measure (1)	At Baseline				At 6-Mo				At 12-Mo				ANOVA Result (p-value)		
	One	Two	Three	Four or More	One	Two	Three	Four or More	One	Two	Three	Four or More	Chronic	Time	Chronic * Time
Adherence Scale (0 to 8 score) ↑															
Health Literacy – read (1 to 5 rating) ↑	4.52	4.48	4.43	4.52	4.33	4.33	4.57	4.75	4.47	4.43	4.50	4.75	ns	ns	ns
Health Literacy – learning (1 to 5 rating) ↑	4.59	4.39	4.25	4.39	4.50	4.62	4.51	4.60	4.68	4.29	4.56	4.7	ns	ns (.0712)	ns
Health Literacy – fill out forms (1 to 5 rating) ↓	1.54	1.74	1.53	1.65	1.77	1.95	1.57	1.25	1.95	2.14	1.32	1.65	ns	ns	ns
Number of ER visits in last 6 months	0.17	0.87	0.43	0.61	0.23	0.33	0.53	0.40	0.22	0.33	0.29	0.30	ns	ns (.0879)	ns
Number of MD visits in last 6 months (4)	3.48	5.14	4.15	6.13	2.86	3.57	3.89	5.40	2.61	3.48	3.26	4.11	ns	ns (.0181)	ns
Number of Nights Spent in Hospital in last 6 months (5)	0.52	0.52	0.55	1.30	0	0.33	0.53	0.70	0	0.33	0.03	0.42	ns	ns (.0873)	ns
Notes: For (1), (2), (3), (4) and (5) please see the Notes to Table 3.															

The process of peer coaching

Grounded theory qualitative research was used to acquire a comprehensive understanding of how the peer coach intervention worked. This approach was used to explore how diabetes health coaches helped participants improve their diabetes management. The grounded theory method was chosen because it assists in describing a process over time and determining the social structures and patterns associated with that process [32, 33]. In this case, we were interested in the process of peer diabetes health coaching. Constant Comparative Analysis was utilized to explore and compare coaching dyads with each other [34] and to develop themes.

The researcher conducted 13 coach "check-ins" with 40 coaches over the 6 month intervention period resulting in 520 fifteen-minute conversations (130 hours). As well, at the conclusion of the coaching period, semi-structured interviews with 29 participants were conducted. Constant Comparative Analysis was used to relate data to ideas and then ideas to other ideas.

The data collection and analysis occurred in five phases. The data collection, note taking, coding, memoing and sorting/writing was an iterative process throughout the progression of the study. [35] Data was collected by research staff from 36 coaches (40 dyads as 4 coaches had two participants) during the 6 month coaching period via 13 bi-weekly semi-structured telephone check-ins. During the check-ins, coaches were asked what they discussed with their participant, how they supported them, what problems they helped them with, what self-management strategies they used and if they had any questions about coaching or coaching difficulties to report. The length of time for each check-in ranged between 7 and 30 minutes. They were audio recorded for reference and detailed notes taken during the conversations. The check-ins allowed the researchers to ensure fidelity of the pilot program and support the coaches with any questions or problems.

As well, semi-structured telephone interviews with 29 participants were conducted after their 6-month coaching period was completed. The participant interviews explored how and if having a peer diabetes health coach changed the way they managed their diabetes. A semi-structured interview guide was used and the length of time for interviews ranged between 10 and 60 minutes. Participant interviews were audio recorded and transcribed verbatim.

Results

Peer coaches reported discussing several topics during the telephone coaching sessions, including: blood glucose, medication, foot care, sleeping, weight concerns, self-care, their relationship with healthcare professionals, life and other health issues. A description of the role of the diabetes health coach emerged in five main themes: 1) teaching self-management skills; 2) providing accountability; 3) giving encouragement; 4) pointing to resources; and 5) clarifying boundaries. Figure 1 represents the Diabetes Health Coaching Framework (or schema) developed from the qualitative analysis. It is a visual representation of how the program functioned.

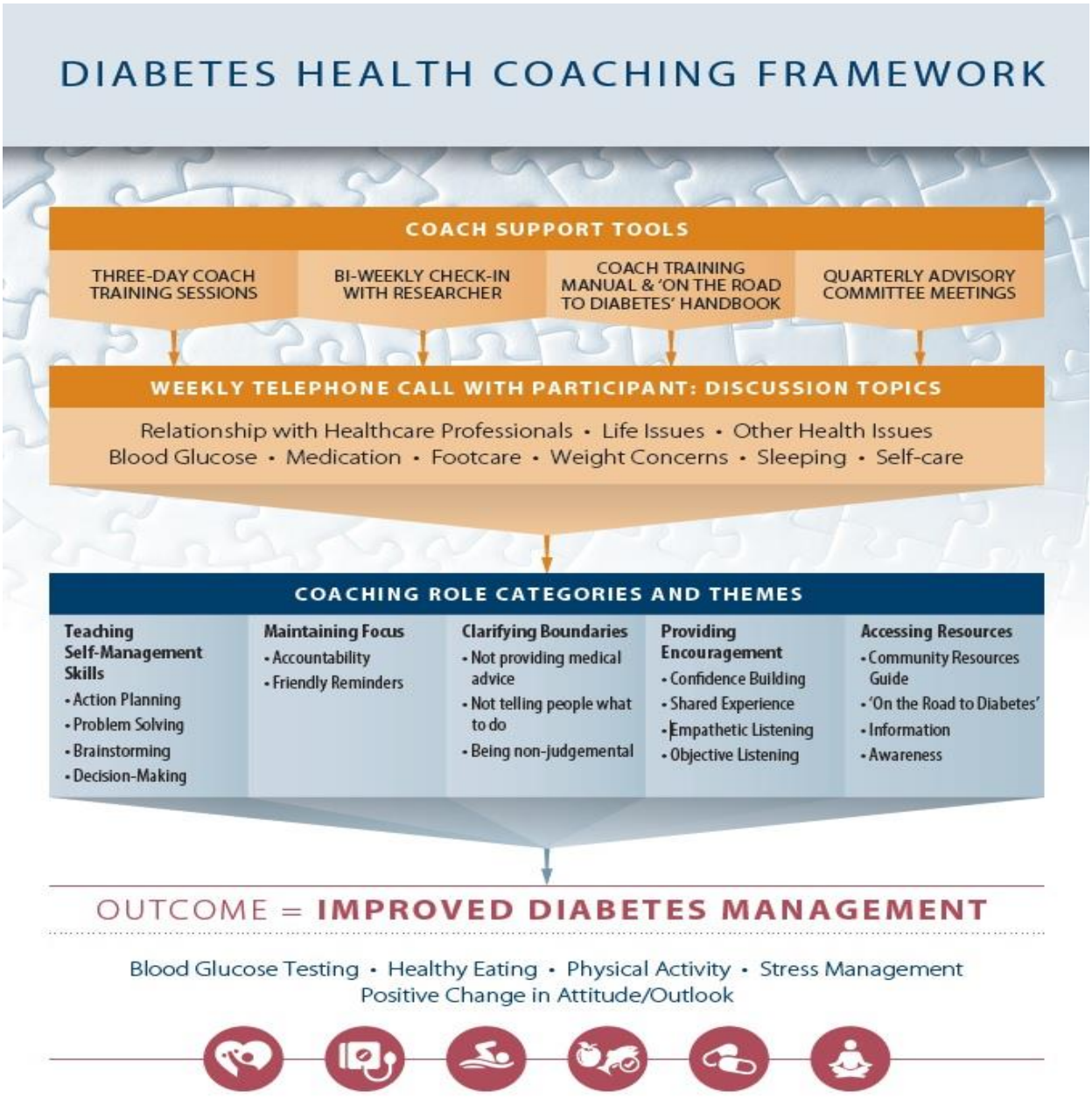


Figure 1 Diabetes Health Coaching Framework

Teaching Self-Management Skills

Diabetes coaches were trained to teach participants how to use self-management strategies (i.e., action planning, problem solving, brainstorming and decision-making) to assist them in managing diabetes. Brainstorming was used to identify gaps between where the participant was and where the participant wanted to be. The coach then helped the participant develop strategies and action plans to close the gap. The action planning process helped the coach to have the participant engage in more intentional thought on what behaviour changes they wanted to work on and how they wanted to accomplish this. The use of problem solving and decision-making

techniques were used to encourage the participant's own thought processes to identify solutions and actions.

Maintaining Focus

A key role of the coach was help their participant maintain their focus on diabetes management. This was especially relevant if they were currently in a caregiver role and were not accustomed or able to prioritize their own health. The participants appreciated having an accountability partner to report their progress or setbacks as it helped keep them on track. Coaches reminded participants of the things they wanted to accomplish and that they had the ability to successfully self-manage. Knowing their coach would be checking in on their progress was motivation to accomplish their weekly action plans.

Clarifying Boundaries

Clarifying boundaries early in the coaching relationship was essential in solidifying appropriate expectations between the coach and participant. Prior to joining the study, the project coordinator informed the participants that the coaches were not medical professionals. The coaches reiterated this fact to the participants and would not provide medical advice if asked. They avoided discussing specific medical issues and encouraged them to seek professional advice when appropriate. Instead, they promoted the use of self-management skills by not directing the participants but instead allowing them to take the lead, make their own decisions and find their own answers to questions. This inspired the participants to actively engage in and learn from the self-management process. Most of the participants indicated they felt safe speaking to the coach because there was no judgement involved. The coaches at all times tried to be supportive and non-judgmental of the client, their views, lifestyle and goals. This established a positive rapport and openness between the coaches and participant.

Providing Encouragement

Giving positive reinforcement by celebrating successes was a common technique used for encouraging the participant's progress and building confidence. The coach created a safe environment in which participants were able to analyze themselves and their situation; the coach did this by listening, asking focused questions, reflecting back, challenging, and acknowledging the participant. Continuing to encourage the participants to work through setbacks until success was achieved increased the participant's confidence in their own ability to self-manage. Learning and applying practical skills, such as problem solving, during coaching sessions ensured participants were able to not only identify the issues that were hindering progress but produce their own solutions to overcome them. Participants reported benefiting from having a shared experience. The participants reported no longer feeling alone in their diagnosis due to the value of having an ally who understood the daily challenges. Linking the participant's experience with the coach's experience opened up a new dimension for many of the participants who had not received this type of support in the past. In fact, many reported negative instances with healthcare providers who could not relate. The coaches filled a support gap between medical appointments and everyday life. Coaches acted as both empathetic and objective listeners. They empathized with the participants struggles yet at the same instance were objective. This objectivity was appreciated by many of the participants who often felt their family members and

friends were too emotionally invested in their diabetes management leading to sensitive interactions that left them feeling drained. Their family and friends could not relate to their experience; therefore, participants found it difficult to engage them in meaningful conversations about diabetes.

Accessing Resources

Providing information on available resources was a crucial part of coaching. The coaches were given a community resources guide for people with diabetes focused on the Fraser Health region. The guide outlined current programs available in the community which was a reference point to assist the participant in finding resources. The resources supported the participant in accomplishing their health goals such as where to find credible medical information, a list of available exercise classes in their area or mental health support lines. Coaches and participants were also given a handbook entitled *"On the Road to Diabetes Health"* which outlined general medical facts about type 2 diabetes. If medical questions were raised by the participant during the coaching sessions the coach referred them to specific sections of the handbook and encouraged the use of this resource. Coaches also passed on general information on diabetes and created awareness about different techniques or issues around diabetes management. For example, prompting participants to ask their doctor for a foot exam during their check-ups, teaching them how to read food labels (using *"On the Road to Diabetes Health"*) or discussing the importance of eating meals at regular intervals. The participants indicated the information given by the coaches was easier to understand and digest.

OUTCOME - Improved Diabetes Management

The interactions between the coach and participant (the coaching role) shaped the process of coaching and resulted in participants reporting improved diabetes management behaviour changes which included: more consistent blood glucose testing, healthier eating and food choices, increased physical activity, improved stress management, better sleep practices and positive change in attitude or outlook.

Discussion and Limitations

This longitudinal pilot study used different research methods to examine the implementation and effectiveness of a peer-led telephone intervention for persons with type 2 diabetes who were experiencing challenges and stress in daily management. A review of the processes used to recruit and train the coaches and determine participants' interest demonstrates that the concept is both feasible and viable. Regarding the effectiveness of the coaching intervention, six outcome measures improved from baseline to six months and were maintained at 12 months, namely: A1C (-9%); patient activation (+15%); diabetes empowerment (+10); self-efficacy (+23%); depression (-24%) and communication with physician (+22%). In addition, these outcome measures were not influenced by covariates of sex, age, education level, and the number of chronic health conditions participants were experiencing.

In the study, A1C level was the primary health outcome and was measured at baseline and at 6 and 12 months. At six months, there was a mean reduction in A1C level of almost 9% and at 12 months the mean A1C levels still maintained the 9% decrease from baseline without any type of reinforcement. This study did not have a control group, however the findings are consistent with findings of other studies which measured the impact of peer support in improving glucose control in patients with type 2 diabetes.[14, 16-20, 22, 36]

Importantly, the peer coaching was able to bring about improvement in other important areas, namely depression and activation levels. Depression was measured by the PHQ-9 [29] and a score of 10 or higher indicates major depression. At baseline the mean depression score was 8.33, but at six months the score had decreased to 5.23 and to 6.33 at 12 months. Since individuals with diabetes perform the vast majority of routine daily care, self-care represents a critical element in diabetes management. However, studies consistently show that co-morbid depression in diabetes is associated with poorer self-care and non-adherence to diabetes management, [37] leading to increased episodes of hyperglycaemia, microvascular and macrovascular complications, and an associated increase in morbidity and mortality. [38, 39]

Another important change was in activation level. The Patient Activation Measure [24] has been shown to be an important surrogate measure for several outcomes. Activation refers to people's ability and willingness to take on the role of managing their health and health care. The Patient Activation Measure (PAM) was designed to assess an individual's knowledge, skill and confidence in managing their health.

Systematic reviews of evidence on the performance of the PAM conducted by the National Health Service in 2012 and 2014 [40, 41] found that: activation scores have been robustly demonstrated to predict a number of health behaviours and individuals with higher PAM scores were significantly more likely to exhibit healthy behaviours; the relationship between patient activation and health outcomes has been demonstrated across a range of different populations and health conditions; PAM scores are closely linked to clinical outcomes, the costs of health care and patients' ratings of their experience and to report higher levels of satisfaction with services; and PAM scores were strongly associated with improved adherence to treatment, with doctor-patient communication; and with increased patient participation. The PAM has been used extensively in health care research with results published in numerous journals

(http://www.insigniahealth.com/research/archive/). A 2016 systematic review of the association between patient activation and medical adherence, hospitalization, and emergency room utilization in patients with chronic illness found that patient activation is associated with reduced hospitalization and emergency room utilization. [42]

Behaviour change, and specifically changing diet and physical activity behaviour is one of the cornerstones of diabetes treatment, but changing behaviour is challenging. In a recent systematic review and meta-analysis by Cradock and colleagues [43] the researchers found that combined diet and physical activity interventions achieved clinically meaningful reductions in A1C at 3 and 6 months, but these were not sustained at 12 and 24 months, thus showing the difficulty in maintaining initial reductions in A1C over time.

In this pragmatic study, improvements in A1C and other health outcomes were sustained without reinforcement at 12 months (6 months post intervention), a noteworthy achievement rarely seen in other studies.

Acknowledgements

The project team would like to thank the Lawson Foundation for the funding and ongoing support to implement this study. Sincere appreciation needs to be expressed to the diabetes educators in the 11 Fraser Health Diabetes Education Centres who contributed to the success of the project by recruiting patients and to the members of the Community Advisory Committee for their ongoing support. As well, a special thank you to the Executive Director of Primary Health Care in Fraser Health, Petra Pardy, for the initial encouragement and support to successfully implement this project.

References

1. Parchman ML, Zeber JE, Palmer RF. Participatory decision making, patient activation, medication adherence, and intermediate clinical outcomes in type 2 diabetes: a STARNet study. *Annals of family medicine.* 2010;8(5):410-417.
2. Chrvala CA, Sherr D, Lipman RD. Diabetes self-management education for adults with type 2 diabetes mellitus: A systematic review of the effect on glycemic control. *Patient education and counseling.* 2016;99(6):926-943.
3. Ebrahimi H, Sadeghi M, Amanpour F, Vahedi H. Evaluation of empowerment model on indicators of metabolic control in patients with type 2 diabetes, a randomized clinical trial study. *Primary care diabetes.* 2016;10(2):129-135.
4. Higgs C, Skinner M, Hale L. Outcomes of a community-based lifestyle programme for adults with diabetes or pre-diabetes. *Journal of primary health care.* 2016;8(2):130-139.
5. Cheng L, Sit JW, Choi KC, Chair SY, Li X, He XL. Effectiveness of Interactive Self-Management Interventions in Individuals With Poorly Controlled Type 2 Diabetes: A Meta-Analysis of Randomized Controlled Trials. *Worldviews on evidence-based nursing.* 2017;14(1):65-73.
6. Brady TJ, Murphy L, O'Colmain BJ, et al. A meta-analysis of health status, health behaviors, and healthcare utilization outcomes of the Chronic Disease Self-Management Program. *Preventing chronic disease.* 2013;10:120112.
7. Yuan C, Lai CW, Chan LW, Chow M, Law HK, Ying M. The effect of diabetes self-management education on body weight, glycemic control, and other metabolic markers in patients with type 2 diabetes mellitus. *Journal of diabetes research.* 2014;2014:789761.
8. Kosmala-Anderson JP, Wallace LM, Turner A, Bourne C. Self-reported effects of attending the Health Foundation's Co-Creating Health self-management programme for patients with type 2 diabetes mellitus in London, England. *Archives of medical science : AMS.* 2014;10(4):773-781.
9. Chen MF, Wang RH, Lin KC, Hsu HY, Chen SW. Efficacy of an empowerment program for Taiwanese patients with type 2 diabetes: A randomized controlled trial. *Applied nursing research : ANR.* 2015;28(4):366-373.
10. Davis S, Keep S, Edie A, Couzens S, Pereira K. A Peer-led Diabetes Education Program in a Homeless Community to Improve Diabetes Knowledge and Empowerment. *Journal of community health nursing.* 2016;33(2):71-80.
11. Flode M, Iversen MM, Aarflot M, Haltbakk J. Lasting impact of an implemented self-management programme for people with type 2 diabetes referred from primary care: a one-group, before-after design. *Scandinavian journal of caring sciences.* 2017;31(4):789-795.
12. Paz-Pacheco E, Sandoval MA, Ardena GJ, et al. Effectiveness of a community-based diabetes self-management education (DSME) program in a rural agricultural setting. *Primary health care research & development.* 2017;18(1):35-49.
13. Wolever RQ, Dreusicke M, Fikkan J, et al. Integrative health coaching for patients with type 2 diabetes: a randomized clinical trial. *The Diabetes educator.* 2010;36(4):629-639.
14. 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.

15. Varney JE, Weiland TJ, Inder WJ, Jelinek GA. Effect of hospital-based telephone coaching on glycaemic control and adherence to management guidelines in type 2 diabetes, a randomised controlled trial. *Internal medicine journal.* 2014;44(9):890-897.
16. Young RJ, Taylor J, Friede T, et al. Pro-active call center treatment support (PACCTS) to improve glucose control in type 2 diabetes: a randomized controlled trial. *Diabetes care.* 2005;28(2):278-282.
17. Long JA, Jahnle EC, Richardson DM, Loewenstein G, Volpp KG. Peer mentoring and financial incentives to improve glucose control in African American veterans: a randomized trial. *Annals of internal medicine.* 2012;156(6):416-424.
18. Gagliardino JJ, Arrechea V, Assad D, et al. Type 2 diabetes patients educated by other patients perform at least as well as patients trained by professionals. *Diabetes/metabolism research and reviews.* 2013;29(2):152-160.
19. Thom DH, Ghorob A, Hessler D, De Vore D, Chen E, Bodenheimer TA. Impact of peer health coaching on glycemic control in low-income patients with diabetes: a randomized controlled trial. *Annals of family medicine.* 2013;11(2):137-144.
20. Baumann LC, Frederick N, Betty N, Jospehine E, Agatha N. A demonstration of peer support for Ugandan adults with type 2 diabetes. *International journal of behavioral medicine.* 2015;22(3):374-383.
21. Safford MM, Andreae S, Cherrington AL, et al. Peer Coaches to Improve Diabetes Outcomes in Rural Alabama: A Cluster Randomized Trial. *Annals of family medicine.* 2015;13 Suppl 1:S18-26.
22. Peimani M, Monjazebi F, Ghodssi-Ghassemabadi R, Nasli-Esfahani E. A peer support intervention in improving glycemic control in patients with type 2 diabetes. *Patient education and counseling.* 2017.
23. Liddy C, Johnston S, Nash K, Ward N, Irving H. Health coaching in primary care: a feasibility model for diabetes care. *BMC family practice.* 2014;15:60.
24. Hibbard JH, Stockard J, Mahoney ER, Tusler M. Development of the Patient Activation Measure (PAM): conceptualizing and measuring activation in patients and consumers. *Health services research.* 2004;39(4 Pt 1):1005-1026.
25. Anderson RM, Funnell MM, Fitzgerald JT, Marrero DG. The Diabetes Empowerment Scale: a measure of psychosocial self-efficacy. *Diabetes care.* 2000;23(6):739-743.
26. Lorig K, Ritter PL, Villa FJ, Armas J. Community-based peer-led diabetes self-management: a randomized trial. *The Diabetes educator.* 2009;35(4):641-651.
27. Stewart AL, Ware JE. *Measuring functioning and well-being: the medical outcomes study approach.* Durham: Duke University Press; 1992.
28. Lorig K, Stewart A, Ritter P, Gonzalez V, Laurent D, Lynch J. *Outcome measures for health education and other health care interventions.* Thousand Oaks: Sage Publications; 1996.
29. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *Journal of general internal medicine.* 2001;16(9):606-613.
30. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. *Medical care.* 1986;24(1):67-74.
31. Chew LD, Griffin JM, Partin MR, et al. Validation of screening questions for limited health literacy in a large VA outpatient population. *Journal of general internal medicine.* 2008;23(5):561-566.

32. Corbin JM, Strauss A. Grounded theory research: Procedures, canons, and evaluative criteria. *Qualitative Sociology.* 1990;13(1):3-21.
33. Strauss AL, Corbin JM. *Basics of qualitative research: grounded theory procedures and techniques.* Newbury Park, Calif: Sage Publications; 1990.
34. Glaser BG, Strauss AL. *The discovery of grounded theory: strategies for qualitative research.* Chicago: Aldine Pub. Co; 1967.
35. Charmaz K. *Constructing grounded theory: a practical guide through qualitative analysis.* Thousand Oaks;London;: Sage; 2006.
36. Heisler M, Vijan S, Makki F, Piette JD. Diabetes control with reciprocal peer support versus nurse care management: a randomized trial. *Annals of internal medicine.* 2010;153(8):507-515.
37. Gonzalez JS, Peyrot M, McCarl LA, et al. Depression and diabetes treatment nonadherence: a meta-analysis. *Diabetes care.* 2008;31(12):2398-2403.
38. Egede LE, Ellis C. The effects of depression on diabetes knowledge, diabetes self-management, and perceived control in indigent patients with type 2 diabetes. *Diabetes technology & therapeutics.* 2008;10(3):213-219.
39. Petrak F, Herpertz S. Treatment of depression in diabetes: an update. *Current opinion in psychiatry.* 2009;22(2):211-217.
40. Mukoro F. Summary of the evidence on performance of the patient activation measure (PAM). In: National Health Service; 2012.
41. Hibbard J, Gilburt H. Supporting people to manage their health: An introduction to patient activation. In: The King's Fund; 2014.
42. Kinney RL, Lemon SC, Person SD, Pagoto SL, Saczynski JS. The association between patient activation and medication adherence, hospitalization, and emergency room utilization in patients with chronic illnesses: a systematic review. *Patient education and counseling.* 2015;98(5):545-552.
43. Cradock KA, G OL, Finucane FM, Gainforth HL, Quinlan LR, Ginis KA. Behaviour change techniques targeting both diet and physical activity in type 2 diabetes: A systematic review and meta-analysis. *The international journal of behavioral nutrition and physical activity.* 2017;14(1):18.