DIABETES SELF-EFFICACY QUESTIONNAIRE (DSEQ)

OUTCOME MEASUREMENT FOR DIABETES EDUCATION

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Effective outcome measurement of diabetes education programs requires valid and reliable measures that are sensitive to clinical change in program participants and demonstrate stability in the absence of intervention. In times of fiscal constraint it is particularly important to validate the efficacy of programs and to demonstrate and enhance our understanding of the value of cost-effective interventions such as group education programs. The questionnaire that has been developed focuses on self-efficacy, a critical construct related to diabetes education. Several studies were undertaken and will be discussed in this manual. One study, titled Questionnaire Development: An Essential Component of Outcome Measurement for Diabetes Education focused upon psychometric testing of the DSEQ (2002-2004). The other study, Effectiveness of the Rideau Valley Diabetes Project, currently Rideau Valley Diabetes Services (1999-2000) utilized a wait-list control design and a number of measures, including the DSEQ.

The purpose of these studies included:

1. Program Evaluation of the Rideau Valley Diabetes Services.

2. Pilot testing of the DSEQ on a small sample of persons (n=80) participating in a group diabetes program.

3. Having developed a questionnaire about diabetes self-efficacy, to complete psychometric testing of the questionnaire including reliability and stability on a suitable sample of persons (n=478).

4. To develop scales to provide a means to succinctly describe relevant concepts related to diabetes education and to assist program providers with feedback on specific aspects of diabetes education.

5. To measure and compare two general aspects of self-efficacy across numbers of items, belief about the importance of aspects of care and confidence in the ability to take action on those aspects of care.

THEORETICAL PERSPECTIVE
DIABETES EDUCATION AND SELF-EFFICACY

Diabetes education is concerned with prompting independence and confidence so that people carry out their self-care activities. Patients report that carrying out their self-management program is even more difficult than dealing with the diagnosis of diabetes. The challenge becomes one of helping individuals develop their own strategies for the long term management of their diabetes (Hurley & Shea, 1992).
Self-efficacy is described as a belief in one's capabilities to organize and execute courses of action required to meet given situational demands. Self-efficacy refers to personal beliefs of how well one can plan and carry out patterns of behaviour that may contain novel, unpredictable and stressful elements. Self-efficacy is believed to be specific to areas of life and setting and not related to a generalized feeling of success or control. The individual's confidence in their ability to perform a task determines those behaviours that they will engage in, how long they persist and the amount of effort they will expend to achieve their goals (Hurley & Shea, 1992). The concept of self-efficacy as described by Bandura (1989) in his social cognitive theory is useful in conceptualizing strategies to enhance diabetes self-care.

The issue of self-efficacy is germane to diabetes education as clients are encouraged to achieve optimal metabolic control through their own efforts (Grossman, Brink & Hauser, 1987). The relationship between self-efficacy, factual knowledge about diabetes and coping style are crucial in understanding the educational needs of persons with diabetes. The level of disruption created by illness as perceived by clients may interfere with learning. Lee, Graydon & Ross (1991) found significant relationships between measures of physical status, psychological well-being and impact of illness. Graydon (1988) stated that controlling symptoms and enhancing physical well-being should be a central focus of clinical practice in order to reduce the impact of illness.

Lazarus and Folkman (1984) note that appraisal of life events and coping processes enhanced adaptation. Positive quality of life outcomes may include improved functioning in work and social living, increased morale or life satisfaction and improved somatic health. Perception of quality of life and how events are construed are clearly related. The provision of knowledge without assisting the client to integrate it into their lifestyle may not be sufficient to effect change and improve quality of life (DeWeerdt et al. 1990). Having factual knowledge may not necessarily lead to either confidence in carrying out a task or to compliance with performing a task. Utilizing the DSEQ that allows comparison of both belief and action related to self-efficacy as well as a standardized factual knowledge test may offer insight into these issues.

Garrard et al. (1987) note the importance of focusing on the relationship between knowledge and successful management of the disease. They found difficulty generalizing results due to differing programs, instructional objectives and content of tests. Patient knowledge has been recognized as a necessary ingredient in the patient's ability to lead a normal and productive life. One of the responsibilities of educators is to test how well the teacher taught what the student learned (Garrard et al. 1987 p.500).

Our research group perceives that it is important to differentiate factual knowledge from self-efficacy.

Coping is described by Lazarus as the efforts, both cognitive and behavioral that an individual makes to manage environmental and internal demands. Individuals appraise the impact of a situation for personal well-being and then appraise possible coping resources and options. Coping is influenced by the level of distress, social support, health and energy and accurate conception of events (Graydon, 1988). Persons vary in their coping style or approach when confronted with an illness and the daily demands or challenges of self-care. In order to understand variation in individuals' responses to comparable conditions, one must take into consideration the cognitive processes that intervene between the encounter and the reaction. The idea of how one construes or appraises the event shapes emotional and behavioral responses to it. Questions asked by persons include; "Are the risks serious if I don't change?" and "Is it realistic to hope to find a better solution?" (Lazarus & Folkman, 1984 p.27).

Cognitive style is related to how one copes with seemingly adverse situations and to the appraisal of illness as a challenge that one attempts to transcend. Lazarus and Folkman (1984) define coping as "constantly changing cognitive and behavioral efforts to manage specific internal and external demands that are appraised as taxing or exceeding the resources of the person" (p.141). The coping process when people are dealing with a physical illness can involve helplessness, panic and disorganization and stages of encounter, retreat, and reality testing that may be precursors to psychological growth, renewed sense of personal worth and reduction of anxiety.

However, not all persons are successful in completing this coping process and it is also known that persons with an illness have less energy to expend on coping than their healthy counterparts. Positive appraisals of control in dealing with an illness or efficacy expectations also determine coping effort and persistence. Bandura describes outcome expectancy as the person’s evaluation that a given behaviour will lead to certain outcomes (Bandura, 1989; Lazarus & Folkman, 1984).

In a study involving 525 respondents, Hofsteller, Sallis, & Howell (1990) noted that general self-efficacy and domain-specific self-efficacy, such as self-efficacy related to managing one's diabetes are distinct. Effective self-care requires knowledge however a positive sense of self-efficacy involves mastery experiences, role modeling and the recipient's confidence in the person giving the information. The issue of self-efficacy is germane to the current medical treatment of diabetes, which encourages clients to achieve optimal metabolic control through their own efforts (Grossman, Brink & Hauser, 1987). These investigators found significant positive correlations between self-efficacy scores and metabolic control in girls. The individual's confidence in their ability to perform a task (self-efficacy) determines those behaviours that they will engage in, how long they persist and the amount of effort they will expend to achieve their goals (Hurley & Shea, 1992).

Prediction of motivation and behaviour change following health promotion involves health beliefs, social support and self-efficacy (Kelly, Zyzanski, & Alemago, 1991). Kelly et al (1991) found that the strongest predictors were perceived benefits and self-efficacy strength. Motivation is described as a very strong intervening variable in resultant behavioral change. Wysocki, Hough, Ward, & Green (1992) found that positive self-efficacy was a predictor of compliance as measured by the Diabetes Compliance Questionnaire. Self-efficacy models enable prediction of modification of behaviour and maintenance of that behaviour (Fitzgerald, 1991). Holden (1991) stated that subjective ratings of self-efficacy consistently predicted subsequent health-related outcomes.

Hence the aim of diabetes education programs in fostering a sense of self-efficacy should be to promote, model and provide practice with skills related to self-care and flexibility. Day to day living requires flexibility and adaptability versus rigid compliance. Flexibility is associated with resilience while rigidity is associated in the extreme with pathology (Lazarus & Folkman 1984).

Garrett (1993) noted that diabetes is a chronic illness with high economic and social costs. Just over 400 new cases of diabetes are diagnosed yearly in the Kingston, Frontenac, Lennox and Addington catchment area. The total number of persons with diabetes in the region was projected to climb to 30,000 cases by 2001 (KFLA-DHC, 1992). Health and Welfare Canada state that the annual health cost due to diabetes is estimated at $1.4 billion. Social costs are incalculable (Health and Welfare Canada [HWC], 1991).

The traditional structures for providing education for a chronic disease were seen as inadequate (Metropolitan Toronto District Health Council [MTDHC], 1988). There were missed clients, poor knowledge retention and growth, and indicators of level of control over the disease were not significantly different three to six months after traditional education (Pichert, 1990). The completion of the ten year Diabetes Control and Complication Trial proved tight blood sugar control could reduce the risk of development and progression of diabetes complications by 60 percent (DCCT Research Group, 1993). Intensive therapy reduced clinically significant retinopathy by 34% to 76%, nephropathy (decreased development of microalbinuria by 35%), and clinical neuropathy was decreased by 60%. This represented improved quality of life for clients and a potential savings in health care costs (Garrett, 1993).

Geluth, speaking at DCCT in June of 1993 noted that there was a moral obligation on the part of physicians, nurses and dietitians to convince patients to keep their blood sugar as close to normal as possible and an obligation on the part of administrators to pay for it. The impact of glucose control on microvascular complications is clear. The challenge will be to safely implement intensive therapy in the clinical setting and within the context of individuals' lifestyles.

However, programs may be designed without consideration of the individual differences among people participating in the program. Diabetes-specific self-efficacy and coping resources may be powerful predictors of the utility of diabetes programs for those who

participate. For example, we would expect those with high self-efficacy and a preference for cognitive coping style to be better users of written information and self-care procedures. Those with lower self-efficacy and less social support will be more likely to need personal intervention by clinicians. If this is true, assessment of self-efficacy would be a valuable means of matching specific services to those who need and benefit from that particular approach. The examination of self-efficacy and the relationship to program planning and educational outcomes is in keeping with the Rideau Valley Diabetes Project and the study designs that are described below.

EFFECTIVENESS OF RIDEAU VALLEY DIABETES SERVICES

The Rideau Valley Diabetes Project (currently Rideau Valley Diabetes Services) came about through a request for proposals from the Province of Ontario Ministry of Health and Long-Term Care. Communities in the Rideau Valley responded by bringing those with an interest in improving care for people with diabetes together to write a proposal. Their goal was to identify needs and implement strategies to delay or prevent complications related to diabetes.

Rideau Valley Diabetes Services (RVDS) provides assessment, education and support to residents of Lanark, Leeds, and Grenville counties whose lives are affected by diabetes. Lanark County covers an area of 2939 km2 and has a population of 57,877 and Leeds & Grenville County covers an area of 3356 km2 and has a population of 104,000. This community-based project is dedicated to assisting the 6845 persons diagnosed with diabetes and the 30% more that are estimated to be undiagnosed in the area (**Hux & Tang, 2000).** The Merrickville District Community Health Centre sponsors RVDS.

Rideau Valley Diabetes Services provides accessible programming to residents of Lanark, Leeds and Grenville counties whose lives are affected by diabetes. RVDS is community-based and dedicated to assisting people in developing their strengths to live healthy, active lives and to building support for coordinated diabetes prevention and management. Those designing the intervention program focused upon taking the education programs to where people live and used a cost effective small group format. The goal was to have an impact on both participants' knowledge and their behaviour. A supportive environment and opportunity for social contacts was seen as critical to promoting self-efficacy and in helping persons to take action in their daily lives in managing their diabetes.

One of the primary needs identified for Adults with Type 2 diabetes was timely accessible care and education. Rideau Valley Diabetes Services contracted educators from Communities across Lanark, Leeds and Grenville counties to provide the One Step Closer Program to the people in their community. The project has provided the opportunity for educators across Lanark, Leeds, and Grenville to teach together in teams, to learn and share together at bi-annual meetings and provide a high quality and consistent program across the tri-county. Outcome measurement was sought by the

diabetes educators and steering committee members to assist educators in program evaluation and revision.

Appropriate outcome measurement expertise and practical tools were sought. A questionnaire that had been developed for evaluation of an in-hospital program by Roblin, Little & Garrett was revised for use with a community-based diabetes education program. The tool closely matched the educational goals of the multidisciplinary team that provides care for persons with diabetes in the Rideau Valley. A research project was designed to provide feedback about the community education program related to knowledge, coping style and self-efficacy and to begin the initial psychometric evaluation of the instrument that was called the Diabetes Self-Efficacy Questionnaire (DSEQ). Ethics review was obtained and funding was sought and received from a number of sources for the research.

The purpose of the outcome measurement study for the Rideau Valley Diabetes Project was to:

1. Evaluate the effectiveness of a community-based group format diabetes education program.
2. Complete initial psychometric testing of the Diabetes Self-Efficacy Questionnaire (DSEQ).
3. Explore the relationship amongst self-efficacy, coping style and knowledge of diabetes.

Methodolgy

A sample of 80 persons was obtained for the study. All clients referred to Rideau Valley Diabetes Services were sent the information letter and consent form. Those who agreed to participate in the study and registered with adequate time to complete the questionnaires ahead of the program were asked to sign the consent and complete the questionnaires. Participants completed questionnaires 1 month prior to the program and immediately before the program to test if there was stability of results in the absence of intervention (wait-list control). They were tested three months post-program to test for change in scores after the intervention. Completed questionnaires were mailed to the researcher who does not have any direct involvement with these clients.

Persons excluded from the study were able to participate in the program. Participants in the study were between 18 and 90 years of age excluding pregnant clients and those with severe renal, visual, neurological, and cardiovascular involvement.

Instrumentation

Knowledge Test

A standardized knowledge instrument is essential if outcome results are to be compared across education programs. The International Diabetes Centre Test of Patient Knowledge is a well researched instrument that is suitable for studying pre and post intervention level of client knowledge. The International Diabetes Centre (IDC) Test of Patient Knowledge, a 50 item knowledge test has been developed over the past 23 years. The test has seven independent content categories determined by an extensive content validity analysis using clients and professionals. The seven categories tested are nutrition, insulin, general knowledge, methods of control, pattern control, exercise and complications. Readability level is at the 8th grade level and therefore appropriate for the general population. Test results are not dependent on educational level. The test is described as having good discriminative capability and sensitivity to diabetes-specific instruction. The total score for the knowledge test was utilized for this study.

Diabetes Self-Efficacy Questionnaire (DSEQ)

A number of other self-efficacy scales specific to diabetes have been developed. Grossman, Brink, & Hauser 1987 developed a scale for adolescents. Crabtree in consultation with Bandura developed a scale for non-insulin dependent diabetes. This scale was adapted by Hurley (1990) for use with clients who use insulin. Due to the relatively small number of subjects tested with these instruments and as aspects of care considered important for the Rideau Valley program were not included (such as foot care) a self-efficacy instrument, the Diabetes Self-Efficacy Questionnaire (DSEQ) was designed/revised by the investigators. The educators involved with the program from a number of disciplines provided critique.

The DSEQ asks respondents about their belief in the importance of an activity and about how confident they are that they can carry out that activity. The investigators predicted that while participants would have high belief scores that they might be less confident in acting on knowledge about diabetes. Psychometric testing and factor analyses were completed on the Rideau Valley participants (n=80) and on a large mail-out sample (n=478). These will both be described in this manual.

Coping Resources Inventory (CRI)

Coping resources are those resources inherent in individuals that enable them to handle stress more effectively or to recover faster from exposure to stress. The Coping Resources Inventory is a standardized instrument developed by Hammer and Marting. The test-retest correlations for the CRI scales (cognitive, social, emotional, physical, spiritual/philosophical and total) range from .62 to .78. Internal consistency measures are from .71 to .91 on a sample of n=749. The CRI was used to predict coping related to a measure of life events. The CRI was tested for convergent validity which ranged from .61 for the spiritual/philosophical scale to .80 for the physical coping scale. The Coping

Resources Instrument is useful in determining coping styles of persons and enabling the study of the relationship of this style to self-efficacy and metabolic outcome.

Definition of Scales - CRI

Cognitive
The extent to which individuals maintain a positive sense of self-worth, a positive outlook toward others and optimism about life in general.

Social
The degree to which individuals are imbedded in social networks that are able to provide support in times of stress.

Emotional
The degree to which individuals are able to accept and express a range of affect, based on the premise that a range of emotional response aids in ameliorating long-term negative consequences of stress.

Spiritual/Philosophical
The degree to which actions of individuals are guided by stable and consistent values derived from religious, familial, or cultural tradition or from personal philosophy.

Physical
The degree to which actions of individuals enact health promoting behaviors believed to contribute to increasing well-being.

Analysis

Item reliability, an initial principal component factor analysis (SYSTAT) to develop scales, ANOVA to test for stability of the questionnaire in the absence of intervention (wait list control) were completed on the DSEQ. Repeated Measures ANOVA was utilized to measure change on the DSEQ, knowledge test and Coping Resources Inventory in the intervention group. The subscales of the tests relating to coping strategies and the total knowledge score were utilized.

Results for the Rideau Valley Diabetes Project (n=80)

An evaluation of the Rideau Valley Diabetes Services education project was completed in 2000. Knowledge (International Diabetes Center-Diabetes Information Test), coping style (Coping Resources Inventory) and self-efficacy (Diabetes Self-Efficacy Questionnaire) were assessed using a wait-list control design. Findings (n=80) demonstrate statistically significant improvement post-program using Repeated Measures ANOVA for a number of measures.

Factual Knowledge remained stable in the wait-list control group for the total score (F 0.163, Prob 0.696). Repeated Measure Anova results demonstrated statistically significant improvement in the total knowledge score (F 9.943, Prob 0.002).

Coping Resources Inventory

Standardized norms are provided from the manual of the Coping Resources Inventory (n=436) for coping resources and scores for participants in the Rideau Valley program are provided (n=80). The data shown in Table 1 indicate that there was some improvement in the use of physical coping strategies in the intervention group versus the wait-list control group (F=4.246, Prob=0.042).

Table 1
Coping Resources Inventory

Mean Scores	Cognitive	Social	Emotional	Spiritual/ Philosophical	Physical
Normative Group (n=436)	28.1	39.6	46.6	32.0	29.0
Test A RV Participants (n=80)	26.2	37.6	44.0	30.9	26.0
ANOVA Test A and B (Stability) F Ratio Probability	0.117 0.739	0.499 0.494	0.545 0.474	0.101 0.474	0.826 0.381
RM ANOVA (Post intervention) F Ratio Probability	0.699 0.533	0.789 0.376	1.025 0.313	0.974 0.326	4.246 0.042*

Diabetes Self-Efficacy Questionnaire

The results from the community diabetes education program were analyzed (Wait-List Control Data and Repeated Measures ANOVA). The results demonstrate that the DSEQ was stable in the absence of intervention (wait-list control) and sensitive to change in the intervention group once they had received the intervention (RM ANOVA). The initial factor analysis resulted in 3 scales. These were revised following the large survey of persons with diabetes in 2003 and will be described in the instrument development portion of the manual. Although the scales were revised, the items that comprise the DSEQ were not changed. Results for the Rideau Valley Project are presented for the initial factor analysis. The total scores for belief and action were analyzed as well as the initial scales that are as follows:

1. Managing social, emotional and food-related aspects of diabetes.

2. Managing diabetes related to exercise, blood glucose and prevention.

3. Integrating knowledge and day to day care.

Table 2
Repeated Measures Results for Wait-List Control Data and Post Intervention Data (n=80)

DSEQ Scale	ANOVA - Stability		RM ANOVA Tests A,B,C.	
	F Ratio	Prob	F Ratio	Prob
Social/Emot/Health-Belief	0.608	0.456	2.013	0.156
Social/Emot/Health- Action	0.188	0.674	4.614	0.034*
Exercise/Bl Glucose- Belief	0.967	0.351	1.431	0.234
Exercise/Bl Glucose- Action	0.029	0.869	7.353	0.008*
Knowledge/Care - Belief	1.028	0.337	1.972	0.326
Knowledge/Care - Action	0.220	0.650	10.586	0.001*

The Diabetes Self-Efficacy Questionnaire (DSEQ) was developed as a measure to gain insight into persons' sense of self-efficacy in implementing self-care for diabetes as a suitable tool was not available. There was a statistically significant increase in self-efficacy scores related to being able to take action on diabetes management, while belief about the importance of diabetes care remained strong although stable as expected. Belief about the importance of skills related to diabetes management and feeling confident in taking action upon implementing them were statistically dissimilar ($t=9.741$, $p<0.000$) upon initial testing. Improved scores on self-efficacy action scales derived by Principal Component Factor Analysis are shown in Table 2, social/emotional health ($F=4.614$, $p=0.034$), exercise and blood glucose monitoring ($F=7.352$, $p=0.008$) and self-efficacy related to factual knowledge ($F=10.586$, $p<0.001$).

In reviewing total scores for DSEQ for Belief and Action, it is interesting to note that mean scores for Belief on Test A were 229.3 for Belief and 177.0 for Action, a statistically significant difference ($t=9.741$, Prob 0.000). Total Belief Scores remained stable in the wait-list control group and post-intervention. However Action scores demonstrated statistically significant change (F 9.300, Prob 0.003) using Repeated Measures ANOVA post-intervention.

QUESTIONNAIRE DEVELOPMENT: AN ESSENTIAL COMPONENT OF OUTCOME MEASUREMENT FOR DIABETES

Rationale-Instrument Development for Evaluative Purposes

In order to present information for program evaluation in a mathematically credible way, instrument development work is needed. Specific reasons why instrument development is important are described.

1. Instrument scales provide a way to describe concepts succinctly and efficiently.

2. Instruments enable comparisons between groups to be made statistically. For example, instruments should be able to differentiate by age and gender of clients.

3. Statistical procedures assist our understanding of the magnitude of change following an intervention. This reflects change that goes beyond that of chance and shows the level of statistical significance. This type of information is considered essential by many funding groups.

4. Evaluation of programs can be completed by measuring the change in respondent's answers pre and post intervention. A successful intervention would show no change before an intervention followed by post-intervention change in scores on instrument scales.

The Steps in Instrument Development

1. **Determine Outcome Domains**
   Diabetes educators identified the important domains of care.

2. **Determine the Focus of Measurement**
   The statements that are used in the questionnaire operationalize important aspects of care specific to patients with diabetes. Much of the **conceptual work** had been completed in creating an instrument for evaluative purposes that also was thought likely to enable comparisons between groups of patients. However, the following steps were necessary to complete psychometric testing of the instrument.

4. Refine the Items (Questions or Statements) and Randomizing items.
   Rideau Valley managers and educators were asked to review and critique the DSEQ items for completeness and readability. Items were randomized.

5. **Establish Credibility of the Measurement Tool**
   In order to be credible as a measurement tool, the instrument also needs to meet certain criteria. These include reliability, validity, responsiveness, precision in the range where effects are expected to exist and ease of implementation.

A) Reliability refers to the dependability of the test. It is important to determine:

i) Test-retest reliability.
This shows that respondents score the instrument in a similar manner in the absence of an intervention program. A questionnaire needs to demonstrate stability in scores if no change in treatment has occurred.

ii)Internal consistency reliability.
This is completed statistically on the long version of an instrument by comparing one half of the questionnaire to the other half and/or comparing alternate items. Over time, as item reliability statistics are completed, instruments can be shortened and therefore the burden to respondents is reduced.

B) Validity refers to the meaning of test results and what specifically is being measured. Validity concerns what interpretations can be placed on an instrument and other issues such as bias. Because of the careful conceptual work done previously we anticipate that the instrument will be valid.

C) Responsiveness of the instrument is related to sensitivity to change. This requires post-testing and relates to the ability of the instrument to measure change. (Guyatt, Deyo, Charlson, Levine, Mitchell, 1989). A tool that is specific to an education program's goals/curriculum would be expected to show change post intervention.

D) Precision relates to the measurement range where effects are expected to exist for a particular group of respondents.

E) Ease of Implementation refers in part to the acceptability of completing the instrument to respondents (i.e. reading level, length of questionnaire).

6. **Development of Scales**

Scales were determined using a statistical procedure called Principal Component Factor Analysis. Factor Analysis allows the determination of which items cluster together statistically. By looking at the items that load together and meet certain statistical criteria (e.g. Eigenvalues $\geq$ 1.00) scales can be determined, named and described conceptually.

It is important to determine scales using statistics and not simply by grouping together questions that appear to describe a principle of care - in fact one may inadvertently be grouping "oranges and apples". Certain questions may not be included in the final instrument if they do not cluster on any of the scales at an acceptable factor loading level.

The purpose of this study included:

1. Having developed a questionnaire about self-efficacy related to diabetes care to complete psychometric testing of the questionnaire including reliability and stability on a large sample of persons.
2. To develop scales to provide a means to succinctly describe relevant concepts related to diabetes education and to assist program providers with feedback on specific aspects of diabetes education.
3. To measure two general aspects of self-efficacy across numbers of items, belief about the importance of aspects of care and confidence in the ability to take action on those aspects of care.

Methodology and Sample

The Kingston Division of the Canadian Diabetes Association agreed to mail questionnaires to approximately 1200 subjects on their mailing list. Subjects were asked to complete the Diabetes Self-Efficacy Questionnaire on two occasions over a three month interval. No names were recorded unless participants agreed to participate in the second survey. Postage-paid envelopes were provided. Subjects participating in the study were between 18 and 90 years of age excluding pregnant clients and those with severe renal, visual, neurological, and cardiovascular involvement according to standardized criteria. The number of participants was 478, approximately a 40 % return rate given incorrect addresses and persons who were deceased.

Psychometric Testing and Factor Analysis of the Diabetes Self-Efficacy Questionnaire (DSEQ)

The questionnaire (DSEQ) was revised for evaluation of a community diabetes program. The items were developed based on the literature and the experience of a number of experienced diabetes educators. Direct care providers and managers of the Rideau Valley Project were involved in critiquing and revising the questionnaire. The purpose of this questionnaire is to understand what persons with diabetes believe about self-care and how persons with diabetes view their competence in managing their diabetes. The questionnaire was analyzed pre and post program with a convenience sample and tested for stability with a survey sample. Psychometric testing and factor analyses were completed for the initial convenience sample (n=80) and for the survey sample (n=478). Initial factor analyses results are given for the Rideau Valley sample in the previous section of the manual; however the psychometric data, factor analyses and revised scales will be utilized in future studies.

Mean Scores and Standard Deviation Scores for DSEQ Questions

The DSEQ consists of questions answered on a six point Likert scale ranging from ‘never’ to ‘always’. Items are scored using a 6 point scale with “0” as “Never” and “5” as “Always”.

The questionnaire asks questions about living with diabetes. For each question asked, there are two columns to answer. One column asks **how important you <u>think</u> that it is to do** the action listed. The other column asks **how sure you are that you <u>can do</u>** the action listed. Respondents **circled <u>one</u> answer in <u>both</u> columns <u>for each</u> question**.

Mean and standard deviation scores are given for each item (question) of the DSEQ for belief and action for the initial test (Test A) of the survey sample in Table 3. Detailed descriptive statistics are provided for each item of the DSEQ for the initial testing, Test A (n=478 with 186 using insulin) and for the repeat testing, Test B (n= 332 with 135 using insulin) of the survey sample in Appendix 1. Reviewing the items individually may be useful in understanding the concerns of respondents. Scores on individual items may clarify respondent's perceptions about belief in the importance of aspects of diabetes care and their ability in performing that skill or communicating about an aspect of diabetes. For example adjusting diabetes care when having the flu (# 3), giving the correct amount of insulin when having a cold or the flu (#56), exercising when one doesn't feel like it (# 17), and being able to solve problems resulting from diabetes (# 41), have close to a full point of difference in belief and action ratings. Statistically significant differences between belief and action scores are given by scale (p.21). It is also interesting to note that there is little difference in belief and action scores and narrower standard deviation scores for the insulin questions (#53 to 58) with the exception of #56 that relates to managing insulin when having the flu.

Table 3
Mean and Standard Deviation Scores for DSEQ Scale Items

Item Number	Test A Results DSEQ Statement	Mean Belief	Standard Deviation Belief	Mean Action	Standard Deviation Action
1.	Prevent low blood sugar reactions when exercising.	4.554	0.896	3.667	1.158
2.	Figure out what to do when blood sugar is high.	4.650	0.731	3.702	1.230
3.	Adjust diabetes self-care when having a cold or flu.	4.247	1.038	3.255	1.297
4.	Figure out what to do when blood sugar is low.	4.729	0.752	4.228	1.122
5.	Fit diabetes plan into usual lifestyle.	4.611	0.689	3.826	0.916
6.	Follow diabetes plan when daily routine changes.	4.427	0.801	3.480	0.998
7.	Resist overeating or missing meals when I am anxious or nervous.	4.406	0.892	3.410	1.242
8.	Ask for support from family / friends in keeping diabetes routine.	4.020	1.177	3.448	1.393
9.	Check feet every day.	4.122	1.123	3.849	1.250
10.	Do activities that I enjoy while taking care of my diabetes.	4.443	0.783	3.939	1.054
11.	Manage diabetes plan when feeling sad.	4.315	0.975	3.579	1.177
12.	Follow my way of eating when at a party.	4.354	0.826	3.377	1.057
13.	Exercise several times a week.	4.572	0.837	3.590	1.372
14.	Resist overeating or missing meals when depressed or down.	4.416	0.895	3.504	1.245
15.	Apply proper lotion to feet.	4.016	1.220	3.628	1.393
16.	Take care of my diabetes when I am frustrated.	4.438	0.882	3.645	1.052
17.	Exercise when I don't feel like it.	4.246	0.959	2.934	1.311
18.	Talk about the effect of diabetes on my life with family / friends.	3.787	1.247	3.400	1.386

Item Number	Test A Results DSEQ Statement	Mean Belief	Standard Deviation Belief	Mean Action	Standard Deviation Action
19.	Know about medications that I take for diabetes.	4.692	0.796	4.275	1.140
20.	Eat meals at the same time every day.	4.357	0.879	3.633	1.159
21.	Stay on my eating plan when staying with family / friends.	4.349	0.842	3.482	1.062
22.	Feel sure of my ability to manage diabetes.	4.622	0.677	3.847	1.084
23.	Cut toe nails the right way.	4.406	0.984	3.874	1.364
24.	Test blood when away from home.	4.603	0.843	4.306	1.047
25.	Recognize when blood sugar is high.	4.690	0.698	4.038	1.156
26.	Stay on my meal plan when people around me don't know that I have diabetes.	4.456	0.848	3.818	1.044
27.	Exchange one food for another in the same food group.	4.194	1.012	3.516	1.289
28.	Be active when there are a lot of demands at home or at work.	4.284	0.895	3.372	1.210
29.	Carry out daily diabetes care.	4.598	0.754	4.030	1.020
30.	Stop a low blood sugar reaction when having one.	4.741	0.771	4.157	1.219
31.	Know when to call a health professional about foot problems.	4.642	0.770	4.139	1.168
32.	Plan how to handle delayed meals.	4.412	0.841	3.808	1.031
33.	Avoid overeating or missing meals when angry or upset.	4.375	0.937	3.568	1.178
34.	Manage diabetes when disagreeing with family or a friend.	4.331	0.980	3.776	1.074
35.	Manage my diabetes when on holidays.	4.593	0.731	3.792	1.029
36.	Avoiding overeating or missing meals when having to say no to others.	4.298	1.040	3.793	1.071
37.	Know about “lab tests” for diabetes.	4.464	0.981	3.940	1.298
38.	Understand the effect that diabetes has on family or friends.	4.083	1.142	3.597	1.191
39.	Avoid overeating or missing meals when happy or relaxed.	4.408	0.907	3.976	0.963
40.	Be in control of diabetes so can spend time with family / friends.	4.558	0.788	4.108	0.958
41.	Be able to solve problems resulting from diabetes.	4.538	0.865	3.648	1.104
42.	Avoid overeating or missing meals when watching TV.	4.378	1.061	4.060	1.105
43.	Talk to family about their chances of getting diabetes.	4.258	1.147	3.966	1.193
44.	Take care of myself and my diabetes.	4.743	0.576	4.064	0.989
45.	Be active when feeling tired.	4.137	1.019	3.101	1.161
46.	Ask health professionals about managing diabetes care.	4.651	0.667	4.088	1.122
47.	Deal with my feelings about living with diabetes.	4.515	0.853	3.913	1.168
48.	Understand other people’s feelings about me having diabetes.	3.907	1.276	3.543	1.229
49.	Discuss concerns about diabetes complications with health professionals.	4.656	0.699	4.133	1.121
50.	Have a plan about what I need to do in case I become ill.	4.416	0.955	3.389	1.286
51.	Ask health professional to explain why a change in diabetes care is needed.	4.584	0.788	4.012	1.228
52.	Tell health professionals when I don’t agree with their suggestions.	4.281	1.108	3.675	1.397

Item Number	Test A Results DSEQ Statement	Mean Belief	Standard Deviation Belief	Mean Action	Standard Deviation Action
	Please answer the following questions only if you are taking insulin.				
53.	Give myself insulin using the proper method.	4.903	0.474	4.730	0.793
54.	Take insulin when away from home.	4.927	0.390	4.901	0.377
55.	Figure out how much insulin to take when there is a change in my usual day.	4.713	0.782	4.037	1.286
56.	Give the correct amount of insulin when having a cold or the flu.	4.747	0.674	3.784	1.314
57.	Change the amount of insulin based on blood sugar test result.	4.694	0.769	4.086	1.361
58.	Choose a different spot to inject the insulin into each time I give myself a needle.	4.732	0.606	4.516	0.874

Test Score Statistics

The Spearman Brown coefficients for Test A and Test B for Belief and Action scores (Questions 1 to 52) are given for odd/even items and split half data (Appendix 2). It became clear through the process of completing the statistical analyses that there were statistically significant differences in participant's scores for belief and action and that combining belief and action scores was not useful, therefore belief and action scores are given separately (Appendix 17). Results for both Test A and Test B are listed.

Test A Belief – Odd/even	0.973
Test A Belief – Split Half	0.934
Test A Action– Odd/even	0.961
Test A Action – Split Half	0.937
Test B Belief – Odd/even	0.971
Test B Belief – Split Half	0.940
Test B Action– Odd/even	0.969
Test B Action – Split Half	0.940

Test Score Statistics by Scale

The factor analyses section of the manual will explain the process by which scales were derived for the DSEQ. The test score statistics for Scales 1 to 5 are given by scale (Appendix 3).

Scale 1 is composed of items 38, 42, 39, 34, 33, 48, 8, 11, 36, 32, 43, 7, 16, 18, 47, 35, and 40. The Spearman Brown coefficients are .952 (odd/even) and 0.937 (split/half).

Scale 2 is composed of items 49, 51, 46, 31, 52, 37, 50, and 41. The Spearman Brown coefficients are .893 (odd/even) and .823 (split/half).

Scale 3 is composed of items 30, 4, 1 and 19. The Spearman Brown coefficients are 0.717 (odd/even) and 0.721 (split/half).

Scale 4 is composed of items 17, 6, 5, 2, 13, 22, 45, 10, 25, 44, 14, 28, and 3. The Spearman Brown coefficients are 0.891 (odd/even) and 0.893 (split/half).

Scale 5 is composed of items 15, 23, 9, 20, 21, 24, 29, 26, 27, and 12. The Spearman Brown coefficients are 0.849 (odd/even) and 0.817 (split/half).

Scale for Persons Using Insulin

Scale 6 is composed of the insulin questions (53, 54, 55, 56, 57, and 58) that were grouped together and not included in the factor analysis. The Spearman Brown coefficients for Test A and Test B for Belief and Action scores (Questions 53 to 58) are given for odd/even items and split half data for the insulin questions (Appendix 4). The results are given for Test A and Test B separately. As these questions are few in number and were not randomized, the odd/even item results are inconsistent as expected, while the split-half coefficients range from .854 to .899.

Test A Belief – Odd/even	0.834
Test A Belief – Split Half	0.899
Test A Action– Odd/even	0.420
Test A Action – Split Half	0.854
Test B Belief – Odd/even	0.627
Test B Belief – Split Half	0.922
Test B Action– Odd/even	0.881
Test B Action – Split Half	0.893

Item Reliability Statistics

Item reliability statistics were completed for belief and action total scores (questions 1 to 52) of the DSEQ. Detailed item reliability statistics are provided in Appendix 5. Ranges for the reliability for individual items are as follows:

Test A Belief	0.373 to 0.813
Test A Action	0.439 to 0.908
Test B Belief	0.381 to 0.737
Test B Action	0.405 to 0.791

Item reliability statistics were also completed for belief and action and combined belief and action scores for questions 53 to 58 (Appendix 4). The insulin items were grouped together and there were 182 respondents who used insulin who responded to Test A and 129 respondents for Test B. Ranges for the reliability for individual items about insulin are as follows:

Test A Belief	0.687 to 0.857
Test A Action	0.325 to 0.879
Test B Belief	0.783 to 0.899
Test B Action	0.711 to 0.822

Scale Reliabilities

The factor analyses section of the manual will explain the process by which scales were derived for the DSEQ. The range of test item reliabilities are given by scale below and in detail in Appendix 6.

Scale 1 – Belief	0.519 to 0.914
Scale 1 – Action	0.516 to 0.881
Scale 2 – Belief	0.437 to 0.800
Scale 2 – Action	0.595 to 0.968
Scale 3 – Belief	0.566 to 0.696
Scale 3 – Action	0.598 to 0.708
Scale 4 – Belief	0.345 to 0.725
Scale 4 – Action	0.471 to 0.759
Scale 5 – Belief	0.507 to 0.920
Scale 5 – Action	0.554 to 0.791

Factor Analyses of the DSEQ

The principal component factor analysis that was completed on the convenience sample from the Rideau Valley Project (n=80) was described on pages 16 to 25. The DSEQ was reanalyzed following the larger survey sample.

Factor analysis (n=478) for 2, 3, 4 and 5 factors is provided in Appendix 8 for Belief and Action scores and combined Belief and Action Scores for Tests A and B for questions 1 to 52 (insulin questions were excluded and form an independent scale).

Five scales were derived by Principal Component Factor Analysis (Varimax Rotation) based on results for 478 respondents using the Belief items for Test A. Eigenvalues were set at greater than 1 and factor loadings for the scales are shown in Table 4. The concepts measured by the scales are described below. Table 4 shows the items that comprise the scales and the factor loading for each item. The five scales account for 59% of the variance in the DSEQ. Items that comprise the scales are listed by scale and are provided in order from highest to lowest factor loading in Table 4. The scales are named based on the ideas/concepts of the items that comprise the scales.

DSEQ Scales

Managing Social, Emotional and Food-Related Aspects of Diabetes

Scale 1 is composed of items 38, 42, 39, 34, 33, 48, 8, 11, 36, 32, 43, 7, 16, 18, 47, 35, and 40. This scale explains 17.78 % of the variance in the DSEQ (Items 1 to 52).

Communicating With Health Professionals and Planning

Scale 2 is composed of items 49, 51, 46, 31, 52, 37, 50, and 41. This scale explains 10.61% of the variance in the DSEQ (Items 1 to 52).

Managing Low Blood Sugars
Scale 3 is composed of items 30, 4, 1 and 19. This scale explains 6.42% of the variance in the DSEQ (Items 1 to 52).

Managing Diabetes Related To Exercise, Blood Glucose And Prevention.
Scale 4 is composed of items 17, 6, 5, 2, 13, 22, 45, 10, 25, 44, 14, 28, and 3. This scale explains 13.69 % of the variance in the DSEQ (Items 1 to 52).

Integrating Knowledge And Day To Day Care.
Scale 5 is composed of items 15, 23, 9, 20, 21, 24, 29, 26, 27, and 12. This scale explains 10.45 % of the variance in the DSEQ (Items 1 to 52).

Managing insulin
Scale 6 is composed of the insulin questions (53, 54, 55, 56, 57, and 58) that were grouped together and not included in the factor analysis.

Table 4

Factor Analysis Results - Diabetes Self-Efficacy Questionnaire (DSEQ)

Item	Item Statement	Factor Loading
Scale 1	**Managing Social, Emotional And Food-Related Aspects Of Diabetes**	
38	Understand the effect that diabetes has on family or friends.	0.737
42	Avoid overeating or missing meals when watching TV.	0.734
39	Avoid overeating or missing meals when happy or relaxed.	0.698
34	Manage diabetes when disagreeing with family or a friend.	0.689
33	Avoid overeating or missing meals when angry or upset.	0.681
48	Understand other people's feelings about me having diabetes.	0.678
8	Ask for support from family / friends in keeping diabetes routine.	0.661
11	Manage diabetes plan when feeling sad.	0.636
36	Avoiding overeating or missing meals when having to say no to others.	0.634
32	Plan how to handle delayed meals.	0.596
43	Talk to family about their chances of getting diabetes	0.551
7	Resist overeating or missing meals when I am anxious or nervous.	0.546
16	Take care of my diabetes when I am frustrated.	0.523
18	Talk about the effect of diabetes on my life with family / friends.	0.506
47	Deal with my feelings about living with diabetes.	0.483
35	Manage my diabetes when on holidays.	0.482
40	Be in control of diabetes so can spend time with family / friends.	0.413
Scale 2	**Communicating With Health Professionals And Planning**	
49	Discuss concerns about diabetes complications with health professionals.	0.799
51	Ask health professional to explain why a change in diabetes care is needed.	0.783
46	Ask health professionals about managing diabetes care.	0.647
31	Know when to call a health professional about foot problems.	0.627
52	Tell health professionals when I don't agree with their suggestions.	0.572
37	Know about "lab tests" for diabetes.	0.505
50	Have a plan about what I need to do in case I become ill.	0.486
41	Be able to solve problems resulting from diabetes.	0.477

Scale 3	**Managing Low Blood Sugars**	
30	Stop a low blood sugar reaction when having one.	0.814
4	Figure out what to do when blood sugar is low.	0.757
1	Prevent low blood sugar reactions when exercising.	0.706
19	Know about medications that I take for diabetes.	0.551
Scale 4	**Managing Diabetes Related To Exercise, Blood Glucose And Prevention.**	
17	Exercise when I don't feel like it.	0.650
6	Follow diabetes plan when daily routine changes.	0.648
5	Fit diabetes plan into usual lifestyle.	0.644
2	Figure out what to do when blood sugar is high.	0.643
13	Exercise several times a week	0.612
22	Feel sure of my ability to manage diabetes.	0.580
45	Be active when feeling tired.	0.530
10	Do activities that I enjoy while taking care of my diabetes.	0.522
25	Recognize when blood sugar is high.	0.518
44	Take care of myself and my diabetes.	0.513
14	Resist overeating or missing meals when depressed or down.	0.502
28	Be active when there are a lot of demands at home or at work.	0.498
3	Adjust diabetes self-care when having a cold or flu.	0.447
Scale 5	**Integrating Knowledge And Day To Day Care.**	
15	Apply proper lotion to feet.	0.693
23	Cut toe nails the right way.	0.659
9	Check feet every day.	0.636
20	Eat meals at the same time every day.	0.619
21	Stay on my eating plan when staying with family / friends.	0.587
24	Test blood when away from home.	0.564
29	Carry out daily diabetes care.	0.560
26	Stay on my meal plan when people around me don't know that I have diabetes.	0.502
27	Exchange one food for another in the same food group.	0.451
12	Follow my way of eating when at a party	0.393
Scale 6	**Managing insulin**	
	***Questions about insulin were not included in the factor analysis**.	
53	Give myself insulin using the proper method.	
54	Take insulin when away from home.	
55	Figure out how much insulin to take when there is a change in my usual day.	
56	Give the correct amount of insulin when having a cold or the flu.	
57	Change the amount of insulin based on blood sugar test result.	
58	Choose a different spot to inject the insulin into each time I give myself a needle.	

Test/Retest Statistics

The total scores for items 1 to 52 and the 6 scales including the questions (Scale 6) that were completed by those using insulin were analyzed for stability and change between Test A and Test B using a matched sample. The survey was sent to respondents who provided their name and address and completed the consent form for a second survey (n=302) that was sent at 3 months. Of those who agreed to complete a second

questionnaire, 89 used insulin. The DSEQ was tested for stability (Repeated Measures ANOVA) using the matched sample of respondents who completed both questionnaires. The scales (Appendix 11) that remained stable (did not demonstrate statistically significant change) over the 3 month period included all of the Belief scales: Belief Scale 1 (F Ratio 1.595, Prob 0.208), Belief Scale 2 (F Ratio 1.503, Prob 0.221), Belief Scale 3 (F Ratio 0.302, Prob 0.583), Belief Scale 4 (F Ratio 0.395, Prob 0.530), Belief Scale 5 (F Ratio 0.330, Prob 0.566), and Belief Scale 6 (F Ratio 0.562, Prob 0.456). Action scores that remained stable were Action Scale 1 (F Ratio 0.151, Prob 0.698), Action Scale 2 (F Ratio 0.248, Prob 0.619), and Action Scale 6 (F Ratio 0.649, Prob 0.429). Action Scale 3 (F Ratio 4.985, Prob 0.026), Action Scale 4 (F Ratio 7.913, Prob 0.005) and Action Scale 5 (F Ratio 5.074, Prob 0.025) demonstrated change. While 196 of the respondents had no education between questionnaires, 106 persons had education about diabetes from one or more of a physician, a community diabetes program or a hospital program. When the data by group (those who participated in educational programs versus those not educated since the previous test) were analyzed, no pattern emerged. Length of time between tests, receipt of multiple interventions and variability of diabetes education may account for these findings.

Discriminative Ability of the DSEQ

Differences in Belief and Action Self-Efficacy Scores

Belief and Action scores were compared using t Tests with Bonferroni probability. Participants' perception of belief in the importance of the issue and their perception of their ability to take action on the issue or skill in their day to day management of diabetes care were compared. Results are presented by DSEQ scale in Appendix 10. There are statistically significant differences in Belief and Action scores on Test A for Scale 1 ($t = 11.766$, Prob $= 0.000$), Scale 2 ($t = 13.426$, Prob $= 0.000$), Scale 3 ($t = 14.887$, Prob $= 0.000$), Scale 4 ($t = 22.741$, Prob $= 0.000$), Scale 5 ($t = 15.673$, Prob $= 0.000$) and Scale 6 ($t = 3.264$, Prob $= 0.004$). Belief about the importance of an aspect of care is not statistically related to confidence in carrying out that aspect of care.

Differences by Attendance at Diabetes Education Programs

Participants who agreed to participate by completing the second survey were asked if they had attended a diabetes education program in the community or in the hospital or if they had received education from their physician since they had completed the first survey. Of the respondents, 196 had not received any education and 106 had one or more educational contacts with one or more of the above services. The DSEQ was not able to discriminate between the educated and non-educated groups in the survey group. This is not a surprising finding given that there was no consistency in location, person providing the education, approach to education, nor time involved in these educational contacts. The DSEQ did discriminate between those who were educated in the wait-list control design in the Rideau Valley study (p. 5 to 10). While the scales were revised following the survey, the items that comprise the questionnaire were not changed. Although the

DSEQ needs further study (as it is utilized in future diabetes education programs) it appears to be a useful tool for outcome measurement of diabetes education programs.

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