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# The use of self blood glucose monitoring and its relationship to effective management for people with insulin dependent diabetes mellitus

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# The use of Self Blood Glucose Monitoring and its relationship to effective management for people with insulin dependent diabetes mellitus.

BY

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# USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

ABSTRACT

It is believed that people who effectively self manage their own diabetes will achieve higher levels of health and well being (Pender, 1987). Although diabetes education has increased rapidly in the last 10 years, the emphasis has been placed on increasing people's knowledge of diabetes as a medical condition, which does not necessarily ensure effective self management of diabetes. Previous research suggests that self blood glucose monitoring (SBGM) is an effective tool for promoting the use of blood glucose levels as a basis for initiating behaviour changes related to eating, exercise and insulin dosage. Yet, while most people with diabetes practise SBGM to some degree, it is unknown whether SBGM is used to promote effective self management of diabetes or simply to comply with the instructions of health professionals.

In this study, two specific aspects of Pender's (1987) Health Promotion Model (HPM) guided the investigation: perceived control of health and perceived self efficacy. A survey design was used to study whether people with Insulin dependent diabetes meliitus (IDDM) who have attended The Diabetes Association of W.A. for education, can correctly perform SBGM and whether they use the information from SBGM to self manage their diabetes. The study involved a convenience sample of 67 people with IDDM who completed a questionnaire eliciting their perception of their diabetes related to blood glucose monitoring and self management.

It was found that 63% of subjects relied on blood glucose monitoring to initiate behaviour change. Forty seven percent of subjects met the criteria prescribed for performing blood glucose monitoring correctly. Seventy percent of subjects performed blood glucose tests frequently and regularly enough to effectively monitor blood glucose. However, willingness to monitor blood glucose frequently, tended to decrease with duration of diabetes.

Monitoring blood glucose to comply with the instructions of health professionals was considered by subjects to be as important as SBGM for the purpose of self management. This indicated that the participants did not feel autonomous and independent regarding the use of blood glucose data.

It was found that individuals' ability to self manage their own diabetes was not affected by sex, duration of diabetes or level of education. However, increase in age was related to correctly performing blood glucose testing and use of data to initiate behaviour change.

Findings of this study suggest that the usefulness of SBGM in promoting effective management skills may be compromised by incorrect technique and a decrease in motivation to monitor blood glucose over time. In addition, the dependence of subjects on health professionals to use blood glucose data does not indicate autonomy and independence in the self management of diabetes.

**"I certify that this thesis does not incorporate, without acknowledgment, any material previously submitted for a degree or diploma in any institution of higher education and that, to the best of my knowledge and belief, it does not contain any material previously published or written by another person except where due reference is made in the text".**

**Signature**

**Date** 18.10.92

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# CHAPTER 1

## INTRODUCTION

### 1.1 Background and Significance

The question of whether people with insulin dependent diabetes mellitus (IDDM) are able to manage their diabetes effectively is of importance to nurses involved in their care. Self blood glucose monitoring (SBGM) has provided a means by which patients with diabetes can actively use blood glucose levels to achieve the degree of skill, confidence and autonomy required for effective self management (Delamater, Bubb, Davis, Smith, Schmidt, White & Santiago, 1990).

It is reported in a study undertaken by Cohen, Matthew & Zimmett (1989) that SBGM has been used since 1978 and that 65% of known diabetics in Australia monitor blood glucose levels. In a recent study 80% of subjects reported monitoring their blood glucose levels (Gibson & Marsh, 1991). Prior to SBGM people relied on symptoms of hyperglycaemia, hypoglycaemia and urine testing to control diabetes. However, as reported by Ostram-Jayne (1988), urine testing provided limited and inaccurate results. Hamera, Cassmeyer, O'Connell, Weldon,

Knapp and Kyner (1988, 1990) found that relying on symptoms was an unreliable way for patients to make appropriate life style changes.

These studies indicate that people with diabetes could not ascertain how well their diabetes was controlled until SBGM became available. However, it is unknown whether people with diabetes use the correct technique to monitor blood glucose, whether SBGM is used to increase the likelihood of achieving normal blood glucose levels, or whether it is performed more often to comply with requests from attending health professionals. Further, it is unclear whether the interpretation of blood glucose levels for initiating behaviourial changes regarding eating, exercise and insulin use is understood. In addition, there may be variables that decrease individuals' propensity to monitor blood glucose levels effectively. Unless people use SBGM data appropriately, it will not achieve its ultimate aim, which is to promote self care skills that will allow patients to use data to adjust behaviour (Rubin, Peyrot & Saudek, 1989).

## 1.2 Purpose of the Study

This research is designed to determine whether SBGM is useful in promoting effective management, and whether people with diabetes can correctly perform

blood glucose monitoring. The purpose of this study is to assess whether people with IDDM who have attended The Diabetes Association of W.A. for education, can correctly and effectively monitor blood glucose, and, if there are deficiencies, whether they are related to age, sex, duration of diabetes and level of education.

## 1.3 Objectives of the Study

The major objective of the study is to ascertain whether SBGM performed correctly is used in promoting effective self management skills in people with IDDM.

A further objective is to examine the reasons why individuals monitor their blood glucose levels.

A third objective is to determine whether an individual's propensity to self manage his/her diabetes is related to age, sex, duration of diabetes and level of education.

## 1.4 Research Questions

The research questions in this study are as follows:

1) What proportion of people with IDDM who have attended The Diabetes Association of WA for education use the correct technique to perform SBGM?

2) What proportion of people use the information from SBGM to initiate behaviour changes related to eating, exercise and adjustment of insulin in order to maintain normal blood glucose levels?

3) What are the reasons that people with diabetes monitor blood glucose levels?

4) What is the relationship between age, sex, duration of diabetes or level of education and the propensity to use the information from SBGM to initiate behaviour changes related to eating, exercise and adjustment of insulin dose?

5) To what extent is there a relationship between SBGM and to self management of diabetes?

6) To what extent is there a relationship between between SBGM and to self management of diabetes?

7) Is there a relationship between perceived control of diabetes and

perceived self efficacy of diabetes.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Blood Glucose Monitoring Technique

Since SBGM was initiated, technology has advanced rapidly. The improvement in blood glucose monitoring technology has helped to increase the potential for people to perform SBGM. The methods available to monitor blood glucose are visual testing with a reagent strip and measurement by blood reflectance meters, of which many types are available. Comparison studies of the meters show very little difference in accuracy (Cohen, et al, 1989; Muller, 1988). The ongoing problem with SBGM is operator error, that is incorrect technique or a dirty, un-calibrated meter. (Muller, 1988; Ward, Haas & Beard, 1985).

Other factors associated with operator error that lead to inaccurate SBGM are incorrect removal of blood from the strip, applying an inappropriate drop of blood, incorrect timing, improper instruction in the use of the meter, deterioration of technique over time, use of expired out of date strips or neglecting to wash hands prior to testing (Perogallo-Dietiko, 1991). Despite reports of incorrect technique causing inaccurate results, a recent study conducted by Gibson and

Marsh (1991), found that 62% of people who SBGM could accurately perform a test, and age did not affect the results. The way to ensure accurate results according to Cohen et al (1989) and Ostram-Jaynes (1988) is initial instruction, ongoing checking and assessment from trained personnel. These authors suggest that anything less is a disservice to the patient.

## 2.2 Effective Self Management of Diabetes

A survey of diabetes education programmes by Rubin et al (1989) found that diabetes education programmes have been knowledge orientated, rather than directed at ability to self care. None of the studies reviewed on diabetes education included SBGM, which is regarded as "the cornerstone" of current approaches to optimal self care. These authors did, however, find that educational intervention incorporating effective behaviour change strategies for improving self care skills was successful (Rubin et al, 1989). Rubin et al's (1989) study involved 165 subjects, who attempted a five day education programme. Six months following the programme it was found that emotional well-being, self esteem and self efficacy had increased. SBGM and exercise had increased, whereas anxiety, depression and glycosolated haemoglobin all had decreased. These findings were supported by a study undertaken by Delamater

et al (1990), where 36 newly diagnosed children were randomly assigned to a conventional education programme and a self management training programme (SMT). Those assigned to the SMT programme maintained better metabolic control and had less admissions to hospital over a 12 month follow up period.

SBGM may serve to motivate patients to achieve normoglycaemia, where effective SBGM has enabled blood glucose levels to be maintained within the normal range 90% of the time (Robertson, 1985; Jennings, 1988). However, patients need continual encouragement from their health care team to continue SBGM. Cohen & Zimmet (1989, p.54) reported that "patients suffer from 'burn out' from repeatedly pricking fingers, and that patients lack technique to remain motivated over the years". One of the problems identified that decreases patients' motivation for SBGM is health professional support. It was reported by Robertson (1985) that when patients become autonomous and independent they may be in conflict with some health professionals. Robertson found that as the patient learns to manage his or her condition the health care provider's role diminishes. Some nurses in Robertson's study felt threatened by this. This conclusion was supported by Germain & Hemchik (1988), who found that patients were not permitted to practise self care when hospitalised.

It has been questioned whether SBGM could be practised by elderly diabetic patients, on the basis that the technology was too difficult and disabilities such as arthritis and poor vision prevented the use of SBGM in the elderly (Gilden, Casia, Hendryx and Singh, 1990). However, Gibson (1991) reported that people at the age of 86 years could monitor blood glucose levels. Further, Gilden et al (1990) investigated the effects of SBGM on quality of life in the elderly, and found an improvement in general well being, eating patterns, taking medication and achieving normal blood glucose levels in subjects of this study.

In order for patients to be able to interpret the results of their own SBGM, they need to know what variables will affect blood glucose and the maintenance of normal blood glucose range (Wilson, Rosenkoetter & Endres, 1985). According to Ostram-Jaynes (1988) patients often do not know the normal blood glucose range and, when asked, state that they have never been told. A consensus statement from the American Diabetes Association on SBGM (1986, p.945) states that the proper uses of SBGM are to "develop a data base, ... aid day to day decision making ... recognise and respond to emergency situations ... and increase understanding of diabetes." The ultimate aim of SBGM is that it be used as a tool for promoting self care skills that will allow patients to use data

to adjust behaviour (Rubin, Peyrot & Saudek, 1989).

It is stated by Beebe (1987, p.64) that "SBGM provides patients with the tool to assess their blood glucose status ... and ... if patients understand the relation between food uptake, insulin and activity they can learn to make their own adjustments appropriately." People with IDDM need constant data in order to be able to administer appropriate insulin replacement. If they can be taught self care skills with the aid of SBGM it seems that people with IDDM will move closer to maintaining normoglycaemia and hence prevent complications. However, it is unknown whether people with diabetes use SBGM to assist in effective self management of their diabetes or whether it is performed to comply with an instruction from health professionals.

## 2.3 Literature Related to Methodology

A search of the literature in order to identify an instrument to answer the questions raised in this study located very few studies researching the role of SBGM in effecting self management of diabetes. A meta-analysis of 47 studies on diabetes education by Brown (1988, 1990) has shown that most of the research had been compromised by lack of instrument reliability and validity,

lack of research questions, large sample attrition rates and questionable sampling methods. Brown (1988) suggests that the reason for such a scarcity of useful studies is the rapid increase in diabetes education in the last 10 years, and the lack of time to develop instruments to measure current programmes. A further difficulty in locating a suitable instrument for the study was that most studies emphasised knowledge of diabetes rather than self management. Two studies (Beebe, 1987; Delamater et al, 1990) were found which questioned the use of SBGM as an adjunct to promoting self care. Instruments used in these studies did not relate to the questions addressed in the present study. The first studied the use of SBGM in quantifying blood glucose rise after various foods (Beebe, 1987). The second studied self management by problem solving with data from SBGM in a programme for newly diagnosed children with diabetes (Delamater et al 1990).

The literature also revealed few instruments related to the attitude and perceptions of people with diabetes to SBGM. For the present study, attempts were made to adopt the Diabetes Attitude Scale (DAS) (Anderson, Donnelly and Dedrick, 1990) and the Attitude 39 Question Scale (ATT39) (Dunn, Smart, Beeney and Turtle, 1986). Both scales measure attitudes to diabetes in general

rather than specific attitudes to SBGM. For this reason, it was important to develop an instrument for the present study, which would measure technique, the effectiveness of technique, the purpose of SBGM, and the variables which impact on an individual's propensity to self manage his/her diabetes needed to be developed.

## 2.4 Summary

SBGM has been considered an important adjunct in the management of diabetes mellitus for the last 10 years. Despite the advocacy of researchers for the usefulness of SBGM in the management of diabetes, such management can be compromised by incorrectly performing SBGM. Further, if the data is not interpreted and appropriate behaviour changes instigated, SBGM will not increase the likelihood of persons with diabetes achieving normal blood glucose levels. In addition, the literature focuses on health professional's point of view, which may not be congruent with that of the person with diabetes.

The literature suggests that SBGM can be used to achieve effective management of diabetes. However, the inability to locate studies confirming this suggestion

revealed a lack of research in this area. For this reason, an explanatory descriptive study was designed to gain more information on the topic.

# CHAPTER 3

## 3.1 Theoretical Framework

Pender's (1987) Health Promotion Model (HPM) has been chosen as the theoretical framework for this study because of its emphasis on health-promoting behaviour and the role of individual perceptions and beliefs about health and illness in determining health behaviour. The nurse's function in this model is as an agent of change.

According to Pender, health-promoting behaviours are actions directed towards achieving higher levels of health and well-being. The potential of individuals can thus be enhanced or actualised by the promotion of goal directed behaviour, self care, and self adjustment. Impediments that may prevent optimum health can also be prevented through the promotion of health protection behaviours (Pender, 1987). In this model the nurse acts as an agent of change and as a leader in health promotion. Pender's determinants for health-promoting behaviour are divided into individual perceptions, modifying factors and variables affecting the likelihood of action (see Figure 1 - Pender's health promotion model.)

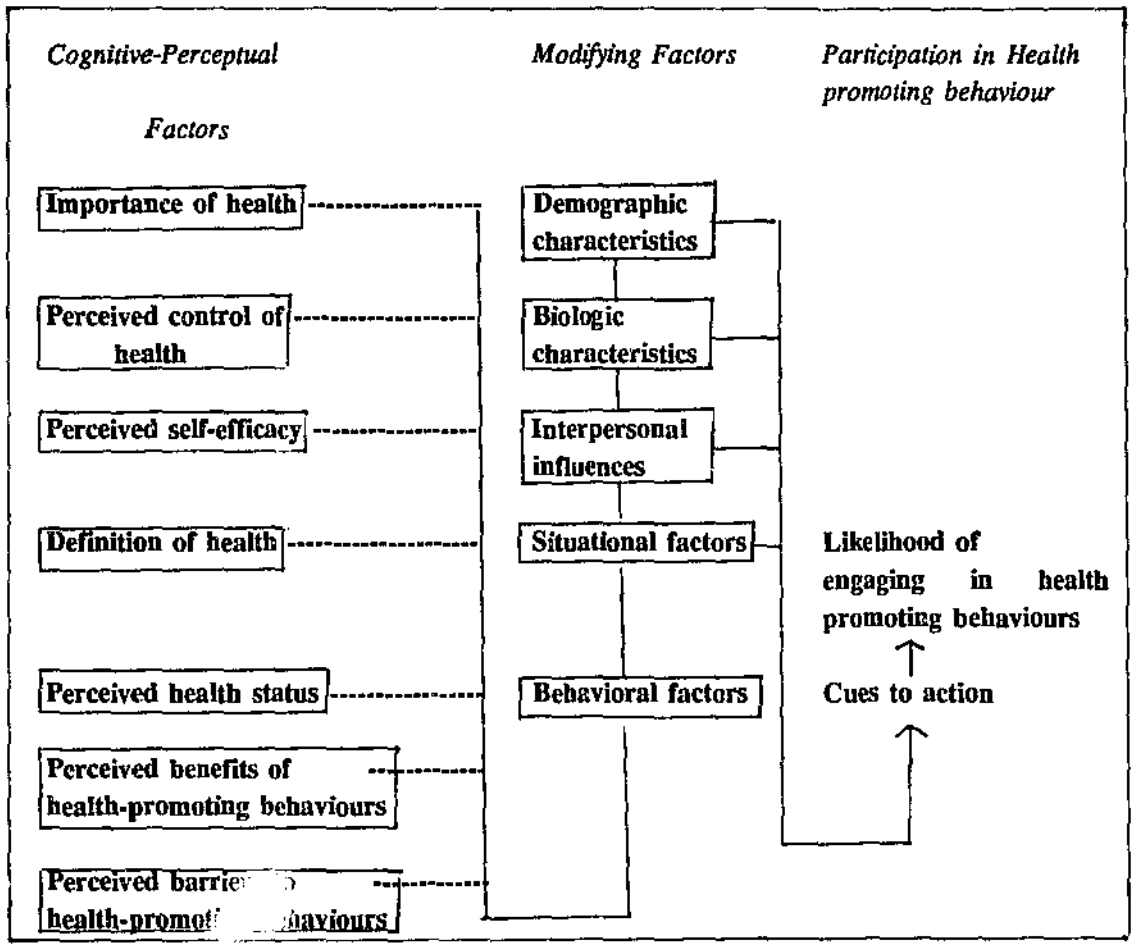


**Fig 1 Pender's, Health Promotion Model (Pender, 1987)**

The current research study is designed to explore two of the components of individual perception: perceived control of health and perceived self-efficacy. When both perceived health control and perceived self efficacy are high, the likelihood of performing the action is high. In IDDM, perceived health control and self efficacy would therefore be expected to lead to self management. SBGM allows the patient to become actively involved in the management of his or her disease (Brecher and Birrer, 1984; Wilson, Rosenkoetter, & Endres 1985;

Cohen, et al, 1989) and likely to facilitate continued practice of self-management, which is the desired behaviour. According to Leventhal, Safer and Panagis (1983, p.24) "active participation in the testing process is critical for change." Unless people with diabetes are actively participating in controlling their blood glucose levels their perceived control will be low. Those who perceive information gained from SBGM as helpful in self managing their diabetes are more likely to increase in self efficacy.

## 3.2 Definition of Terms

Self Blood Glucose Monitoring (SBGM):

The ability to perform a self blood glucose test correctly and interpret the results.

Correct Self Blood Glucose Monitoring:

Ability to perform correct SBGM. Correct performance being measured by:

* how often the meter is calibrated. This frequency will be determined by the recommendations of the manufacturer of each individual meter.

* how often the meter is cleaned. The prescribed frequency will be at least once a month or when a new bottle of reagent strips is opened.
* whether a control solution is used and how often. The frequency will be determined by the recommendations of each individual manufacturer.
* whether an expert has provided initial instruction and whether technique has been reviewed by an expert.

Effective Self Blood Glucose Monitoring:

Ability to perform effective SBGM. Effective performance is measured by:

* the frequency and time of testing. The prescribed frequency being 3 - 4 times a day every 3 - 7 days.
* the method of recording. The prescribed method of recording will be either a record book or a computer.
* the ability to identify acceptable blood glucose range. This is according to World Health Organisation criteria, which is between 4 - 10 mmol/L.

Self Management:

* Actively using data from SBGM for initiating behaviour changes regarding eating, exercise and insulin use.

Insulin Dependent Diabetes Mellitus (IDDM):

* Absolute deficiency of endogenous insulin production.

Perceived Control of Health:

* The subjective understanding that health status can be self regulated.

Perceived Self Efficacy:

* The subjective power to feel able to produce desired results, i.e. in the present study, to control blood glucose levels.

Duration of Diabetes:

The number of years since the subjects have been diagnosed with insulin dependent diabetes mellitus.

Level of Education:

The number of years spent in education. Either primary, secondary, tertiary, apprenticeships, TAFE or professional courses.

## 3.3 Assumptions

By choosing subjects in the work force, it is assumed that the population for study are independent adults that have the ability to perform SBGM. The study did not identify or exclude subjects that may have long term complications of diabetes. It was assumed that this should not exclude them from using data from SBGM to make appropriate lifestyle changes and to adjust insulin regimen.

Due to the restraints of the study and the geographical isolation of many of the subjects, it was not feasible to observe subjects' technique of blood glucose monitoring. Instead, the study relied on self report. The literature review revealed that the most common factors contributing to inaccurate results included inadequate instruction, and dirty uncalibrated machines. It was assumed that this information could be gained through a questionnaire, to which subjects would respond honestly and to the best of their ability.

It was assumed that the subjects attending The Diabetes Association had received a comprehensive education programme that would give them the information required to be able to self manage their diabetes. This assumption seemed

reasonable as a structured programme had been formalised for attending clients. The subjects chosen had attended for education within a 4 year period, as it was assumed that information gained prior to that period may not reflect current principles of diabetes care.

# CHAPTER 4

# METHODOLOGY

## 4.1 Design

A survey design was used in this study. The questionnaire used in the survey was designed to gain as much insight as possible into the perceived attitudes of people with IDDM towards self managing their diabetes. In addition, the questions attempted to determine whether SBGM is useful in providing the necessary information for self management, and whether age, sex, duration of diabetes and level of education are related to individuals' propensity to effective self management of his/her diabetes.

## 4.2 Population and Sampling

The population for this study consists of people with IDDM, who have attended The Diabetes Association of Western Australia (Inc.) for education. The sampling criteria established for inclusion in the study were that they must have IDDM, be in the work-force, which is considered to be between 18 and 65 years

of age and must have attended The Diabetes Association of W.A. for education within the last 4 years.

People with IDDM were chosen as the target population because they are a homogenous group and all require the same skills to self manage their diabetes. Having the research centred in one education centre ensured that the subjects had been provided with a consistent programme of education. The content of the education programme includes aetiology and pathophysiology of IDDM, hyperglycaemia, hypoglycaemia, principles of good control, general principles of insulin therapy, self blood glucose monitoring, dietary principles, exercise, stress and illness, ketoacidosis, long term complications and life style issues. The approximate time to complete an education programme is 16 hours. See Appendix 2 for details of this programme.

There were 68 subjects who met the criteria for the study. The subjects were all contacted by phone initially to give an explanation of the study and to gain verbal consent to participate. Of the 68 subjects, 67 agreed to participate. Questionnaires were sent to these 67 subjects. All subjects expressed interest in the outcome of the study and requested a report to be sent to them on its

completion.

### 4.3 Instrumentation

A self-administered questionnaire of four sections was employed to examine the research questions (see Appendix I). Section A identifies demographic variables that may have an influence on individual attitude to effective self management of diabetes. These variables include age, sex, duration of diabetes and level of education. Each was analysed to determine its relationship to effective or non-effective SBGM.

Section B deals with ability to perform correct and effective SBGM. Effective performance was measured by frequency, timing, method and recording of tests, ability to identify acceptable blood glucose range and to use SBGM data to initiate self management of diabetes. Correct performance of SBGM was measured by ascertaining the frequency of the calibration and cleaning of the meter, whether a control solution was used to measure precision in obtaining an accurate result, and whether or not instruction had been given on the use of the meter by an expert. Questions three, six, seven, eight and nine relate to obtaining a correct results. Whereas questions one, two four and ten relate to the

frequency of testing, and question three identified the method used to perform the test. In order to gain insight into whether pain could be a deterrent to effective SBGM, an extra question was added to this section.

Section C of the questionnaire was intended to assess the reasons that people with IDDM perform self blood glucose monitoring. Scores for this variable were obtained by using six items, each of which consisted of a 5 point likert-type scale. The participants were asked to rate the degree of importance each statement has for performing SBGM. A final section was allocated for respondents to identify reasons that had not been suggested by the researcher.

Section D of the questionnaire was intended to measure the extent to which respondents perceive the information from SBGM to be useful in initiating behaviour changes regarding eating, exercise and insulin dose. Scores for this variable were obtained by using a 10-item measure, which consisted of a 5 point likert-type scale. The participants rated how often they rely on SBGM for each of the ten items. A score of 0-30 would indicate that they do not rely on SBGM to increase their ability to effectively self manage their diabetes, whereas a score of 31-50 would indicate that they do.

## 4.4 Validity and Reliability

The questionnaire has been specifically developed for this study and thus has not documented evidence of validity and reliability. A literature search on published instruments that could be adapted for this study showed a lack of diabetes-related measurement instruments.

The instrument was submitted to two diabetes educators at The Diabetes Association of Western Australia, three diabetes educators working in specialist diabetes centres, one Endocrinologist, two Dietitians and two volunteers with IDDM. All concluded that the questionnaire had face and content validity. However, one expert felt that "accuracy" should be redefined as "correctness" of technique. As it would be impossible to ascertain accuracy of SBGM technique via a questionnaire, it was pertinent to act on this advice and change "accuracy of technique" to "correct technique". In addition, the Endocrinologist questioned whether Section C included enough questions. However, further questions in this section may have influenced the subjects to perform SBGM for reasons identified by the researcher. The number of questions in this section was limited, and several open questions were included to allow the respondent to express his or her own reasons.

Test-retest reliability was tested by administering the questionnaire twice to 40 participants of the study. Thirty of these were returned. The questionnaire administrations were two weeks apart to try to prevent the subjects from remembering previous answers.

No test-retest coefficient was calculated for Section A as demographic data would not alter. The test-retest correlation coefficients for the other sections are shown in Table 4.1.

TABLE 4.1 Test-retest Reliability Coefficients

| SECTION OF THE INSTRUMENT | CORRELATION COEFFICIENT |
|---|---|
| B. CORRECTNESS OF TECHNIQUE | r = 0.864 |
| B. EFFECTIVE S.B.G.M. | r = 0.750 |
| C. REASONS FOR S.B. | r = 0.50 |
| D. INITIATING BEHAVIOUR CHANGE | r = 0.772 |

(n = 30)

The correlation coefficient of Section C indicated a low reliability. One possible reason for the change in responses is that the first questionnaire led subjects to start considering reasons for SBGM. Later conversations with four subjects indicated that those subjects had initially indicated that they performed SBGM for their doctor and for health professionals. However, the first questionnaire had prompted them to perform more tests for themselves in relationship to food, exercise and insulin dosage. Therefore, by the time the second questionnaire arrived, these subjects had changed their answers to Section C. They were now performing SBGM more for themselves in relation to food, exercise, and insulin dosage than for their doctors.

Internal consistency as measured by Cronbach's coefficient alpha was very low ($r = 0.064$) in Section C, and high in Section D ($r=0.89$). However nearly half of the subjects had not answered the questions relating to stress, illness and strenuous exercise ($n=35$), therefore, this data had to be deleted. A significant reason for this result is that Section C of the questionnaire had been specifically designed to ascertain whether the subjects performed SBGM for themselves or because it had been requested by health professionals. It was assumed that those subjects who reported performing SBGM for themselves would not consider it

important to do so for their doctors and that those subjects who reported performing SBGM for their doctors would not consider it important to do so for themselves. Therefore, the two items regarding doctors and health professionals were reverse scored. However, this assumption proved to be false. All subjects performed SBGM for themselves. However, 78% also thought it very important to self blood glucose monitor for their doctor and 73% felt it important to follow health professionals instructions relating to SBGM.

Internal consistency was not performed in the other sections. It was not appropriate in Sections A & B.

## 4.5 Data Collection Procedure

The questionnaires were mailed to subjects, and mailed back to the researcher when completed. A list of questionnaire recipients was kept by the researcher and the forms were coded to identify the test-retest questionnaires of each of the participants. The first 40 subjects who returned the first questionnaire were sent the same questionnaire two weeks later. Of the 67 subjects sent the first questionnaire, 66 were returned which indicates a 98% response rate. Seventy

five percent (n = 30) of the retest questionnaires were returned.

The data were coded and entered onto a sheet. Once all the data had been returned, they were statistically analysed using Mini-tab.

## 4.6 Ethical Considerations

The study commenced following approval from the Research and Ethics Committee of Edith Cowan University, School of Nursing. Permission to access names, addresses and telephone numbers of subjects who met the criteria was obtained from the Committee of The Diabetes Association of Western Australia (Inc.). The sample included those subjects who consented to participate. Consent was implicit in their voluntary completion of the questionnaire, and verbal consent by telephone prior to the administration of the questionnaire.

Participation in this study was voluntary and subjects were free to withdraw at any time. This was clearly explained to them by telephone prior to the administration of the questionnaire and was also in writing on the cover sheet of the questionnaire. (See Appendix I). Confidentiality of information was

maintained in that no names were attached to the questionnaires and only the researcher had access to the data. Anonymity in the report was ensured by not including individual names and/or personal characteristics. Further, data analysis expressed group rather than individual information. A summary of the research findings was made available and mailed to subjects.

# CHAPTER 5

## RESULTS

On the basis of Section B of the questionnaire, an evaluation of how many people perform SBGM correctly and effectively, was undertaken. Both frequencies and percentages were calculated (see Table 5.3 and Table 5.5). In addition, to determine the ways in which the subjects failed to perform SBGM correctly and effectively, question by question analysis of Section B was undertaken.

The proportion of people who rely on SBGM to initiate behaviour changes regarding eating, exercise, stress and insulin adjustment was ascertained from the items in Section D of the questionnaire. A question by question analysis of Section D was undertaken, giving frequencies of people responding to each question (see Table 5.8).

A correlation coefficient was constructed to examine the relationship between age, duration of diabetes and level of schooling in relation to scores in Section

D (see Table 5.9). In addition, a t-test was performed to investigate the relationship between sex and scores in Section D. An evaluation of the statements given in Section C of the questionnaire was undertaken, producing frequencies and percentages of people identifying particular reasons for SBGM. Any other reasons that the subjects gave were also reported.

## 5.1 Demographic Characteristics

Table 5.1 shows the general demography of the subjects.

TABLE 5.1 Demographic Characteristics

| | Males | Females |
|---|---|---|
| SEX | 32 | 33 |
| | **Range(Yrs)** | **Mean(Yrs)** |
| AGE | 18 - 64 | 34 |
| DURATION OF DIABETES | 0 - 31 | 11 |
| LEVEL OF EDUCATION | 7-18 | 13 |

**(N = 65)**

## 5.2 Form of SBGM

Table 5.2 represents the information on types of meters used by the participants of the study. All subjects reported that they tested their own blood sugar levels.

Four subjects used both an Exactech and a Glucometer II.

TABLE 5.2 Types of Meters Used for SBGM

| TYPE | NUMBER |
|---|---|
| Glucometer II | 35 |
| Exactech | 16 |
| Hypocount | 4 |
| Glucometer GX | 4 |
| Reflolux | 5 |
| BM Glycaemie 20/800 Strips | 1 |
| | (n = 65) |
| Glucometer II & Exactech | 4 (using two meters) |

This information was required to identify whether or not the participants were following the recommendations of the manufacturers for the calibration of the meters, and the use of control solutions.

## 5.3 Correctness of Technique

The description of correct technique indicated that the 47% of subjects met the criteria outlined for correct technique of SBGM. The scoring defined for correct technique included a score of 2 for correct response, a score of 1 for partly correct and a score of 0 for incorrect response. The questions designed to assess

correctness of technique could achieve a maximum of 8 and a minimum of 0. Subjects achieving a measurement greater than 4 demonstrated correct technique. Of the 63 subjects, the mean score for correctness of technique was 4.0, with a range of 0-8. An analysis of each question gave some indication of the areas in which subjects achieved correct technique (See Table 5.3). The criteria will be discussed separately for each question relating to correctness of technique.

TABLE 5.3 Analysis of Questions Indicating Correct/Incorrect Technique

| | **Correct** | **Partly Correct** | **Incorrect** |
|---|---|---|---|
| QUESTION | SCORE-2 | SCORE-1 | SCORE-0 |
| Calibrates Meter | 48 (74%) | 8 (11%) | 9 (14%) |
| Uses a control solution | 20 (31%) | 13 (20%) | 32 (49%) |
| Cleans meter | 19 (29%) | 5 (8%) | 41 (63%) |
| Review of Technique | 23 (35%) | 2 (3.0%) | 40 (62%) |

(n = 65)

The first question asked how often the meter was calibrated. This frequency was determined by the recommendations of the manufacturer of each individual meter. Almost three quarters of the subjects calibrated their meters at the prescribed time (score=2). The only meter that will not perform a test without performing the calibration procedure is the Hypocount. With the other meters, 8 (11%) of the subjects felt it was not necessary to calibrate the meter (score=1) and 9 (14%) did not know how to (score=0). The one subject who blood glucose monitored without a meter, was excluded from this analysis.

The second question asked whether a control solution was used and how often. The frequency was determined by the recommendations of each individual manufacturer. Approximately one third of subjects used a control solution to check the accuracy of their technique (score=2). The subject performing blood glucose monitoring without a meter would not know this procedure. It is not provided to the 4 subjects using the Hypocount, and it is not available in the initial kit of the 16 subjects using an Exactech. The extra cost incurred in using a control solution is a possible deterrent for some individuals using an Exactech. These subjects using Hypocount and Exactech meters may account for the high

percentage of subjects who did not think it was necessary (20%)(score=1) and who did not know how to use a control solution (49%)(score=0). An additional explanation was offered by one subject who commented "my control solution is as old as my glucometer, I doubt its accuracy, so I usually coerce a member of my family", who provides a drop of blood, that would be within the normal range, as a control solution.

The third question asked how often the meter was cleaned. The prescribed frequency was at least once a month or whenever a new bottle of reagent strips was opened. Just over one third of subjects cleaned their meters either once a week (score=2) or each time they opened a bottle of reagent strips (score=1). Almost two thirds of the subjects never cleaned their meter (score=0). The one subject in this category who reported testing blood glucose levels without a meter, was excluded from this procedure.

The fourth question asked whether an expert had provided initial instruction and whether technique has been reviewed by an expert. Just over one third of the subjects had their technique reviewed by an expert after initial instruction

(score=2) or were not sure whether they had theirs checked or not (score=1). Almost two thirds of subjects had never had their technique reviewed (score=0).

An analysis of questions relating to correct performance of blood glucose monitoring, indicates that the 53% of 65 subjects in the study do not perform blood glucose monitoring correctly, mainly because they do not clean their meter, use a control solution and have not had their technique reviewed since initial instruction.

## 5.4 Relationship between demographic variables and correct technique

Data were analysed to investigate whether demographic variables were associated with performance of monitoring blood glucose correctly. Table 5.4 shows the correlations between correct technique and age, duration of diabetes and level of education.

TABLE 5.4 Relationship between demographic variables and correct technique

| VARIABLE | CORRECT TECHNIQUE |
|---|---|
| AGE | 0.260* |
| DURATION OF DIABETES | 0.106 |
| LEVEL OF EDUCATION | 0.000 |

*($p < 0.05$)

These correlations indicate that age was significantly related to correct technique at $p < 0.05$. However, duration of diabetes and level of education were not significantly related to correct technique at $p < 0.05$.

Using a t-test to analyse data, the relationship between sex and correct technique was examined. This was not significant at $p < 0.05$ ($t(60) = 0.02$; $p > .05$) indicating that there is no significant difference in the correctness of technique between men and women.

## 5.5 Effective SBGM

Analysis of the data indicates that the 70% of subjects achieved effective SBGM.

The scoring of effective or ineffective SBGM included a score of 3 for exceeding criteria, a score of 2 for meeting criteria, a score of 1 for partly achieving criteria and a score of 0 not achieving criteria. The questions designed to measure effectiveness of SBGM could achieve a maximum score of 10 and a minimum score of 0. Subjects achieving a measurement greater than 5 demonstrated effective SBGM. Of the 65 responding subjects, the mean score for effective SBGM was 8, with a range of 0 - 10. A description of both percentages and scores for effective technique are described in Table 5.5.

TABLE 5.5 Analysis of Questions Indicating Effective/Non Effective Technique

| | SCORE | | | |
|---|---|---|---|---|
| QUESTION | 3 | 2 | 1 | 0 |
| How often do you check your blood sugar level? | 22 (34%) | 23 (35%) | 7 (11%) | 13 (20%) |
| At what times of day do you test? | 19 (29%) | 34 (52%) | 8 (12%) | 4 (6%) |
| How do you record your blood sugar levels? | | 52 (80%) | 11 (17%) | 2 (3%) |
| Identify acceptable blood glucose level. | | 40 (62%) | 13 (20%) | 12(19%) |

n = 65

An analysis of individual questions gives an indication of aspects of testing which subjects were performing effectively or ineffectively. Question 1 asked how often blood glucose monitoring was performed. The prescribed frequency

being three - four times a day every three to seven days. More than one third of subjects performed blood glucose testing more than once or twice a week (score=3) and more than one third of subjects performed blood glucose tests once or twice a week (score=2). Of the remaining subjects, 7 performed blood glucose tests once a fortnight or once a month (score =1) and 13 performed blood glucose tests only when told by a diabetes educator or when diabetes is was out of control (score=0).

Question 2 asked subjects how often in a day tests were performed. Nearly one third of the subjects performed tests more than four times a day (score=3) and over half performed tests at least four times per day, (score=2). There were 8 subjects who performed two tests per day (score=1) and 4 subjects who performed 1 test per day (score=0).

Question 3 asked subjects how blood glucose tests were recorded. The prescribed method of recording was either a record book or a computer. The majority of subjects either recorded in a record book or on a computer (score=2). The number of subjects who recorded in the memory of their meter was 11,

(score=1) and 2 subjects did not keep a record (score=0).

Question 4 asked subjects to identify acceptable blood glucose levels. The expected answer was between 4-10 mmol/L. More than 50% of subjects depicted 4-10 mmol/L as acceptable (score=2) and 13 subjects depicted 3-8 mmol/L as acceptable (score=1). The remaining subjects (19%) had not picked either of these ranges (score=0).

Additional comments identified changes in their daily monitoring procedure, mostly related to Hypoglycaemia or Hyperglycaemia. There were some comments from subjects specific to Hypoglycaemia who stated that they would test more often "if they have hypo's" and "before and after a hypo." Other comments referred to times when diabetes was out of control. One subject stated that he would test "three times plus if he was having a high or a low." This comment was supported by two other subjects who tested more frequently "if they felt a hypo or hyper and 2 hourly when ill" and 2 hourly if I am high." Other subjects commented that they tested more frequently to avoid hypoglycaemia. One subject stated that she tested "before sport and social

occasions", and another stated that she tested "before sport and if I'm going out as I sometimes get a little nervous or excited and it affects my control. No one wants to have a hypo in public." Another subject stated that he performed more tests "if I have been exercising or eating differently." Another subject said that she performed extra tests "when I am told by my doctor."

One other question was included in Section B to attempt to ascertain whether the pain experienced in doing SBGM may be a deterrent. However, this did not seem to be a major deterrent as 21 (32%) had never experienced any pain from blood glucose monitoring, 39 (60%) sometimes experienced pain and 4 (8%) found SBGM always painful.

Analysis of questions relating to effective monitoring of blood glucose indicates that the majority of subjects attending The Diabetes Association monitor their blood glucose effectively, mainly because they test their blood glucose levels frequently throughout the day, and at least once or twice a week. In addition, they keep a record of their results and know the acceptable blood glucose range.

## 5.6 Relationship between demographic variables and effective SBGM

Data were analysed to investigate whether demographic variables were associated with effective monitoring of blood glucose. Table 5.6 shows the correlations between effectiveness of SBGM and age, duration of diabetes and level of education.

TABLE 5.6 Relationship of demographic variables to effective SBGM

| VARIABLE | EFFECTIVE SBGM |
|---|---|
| AGE | 0.157 |
| DURATION OF DIABETES | 0.263* |
| LEVEL OF EDUCATION | 0.035 |

(*p < 0.05)

These correlations indicate that neither age nor level of education were significantly related to effectiveness of SBGM at $p < 0.05$. However duration of diabetes was significantly related to effectiveness of SBGM at $p < 0.05$. A t-test was performed to determine whether there is any difference in the effectiveness of SBGM between females and males. There was no significant difference at $p < 0.05$ ($t(68) = .42$, $p > .05$).

## 5.7 Reasons for SBGM

The questions designed to determine the reasons why the subjects felt SBGM important were scored between 0 and 4. The subjects were also asked to indicate any other reasons that SBGM was important. Importance was categorised on a five point scale of very important, important, not sure, not very important or not important. A description of these reasons indicated that 67% or 62 subjects identified it important to SBGM to assist in self management of diabetes. Of the 62 subjects responding the mean score was 16.0, with a range of 11-24. Table 5.7 provides some possible explanation as to why the subjects in this study did not score highly on Questions 1 and 3.

TABLE 5.7 Reasons that were Important/not Important to monitor blood glucose levels

| QUESTION | Not Sure/ Important/ Very Important | Not Important/ Not Very Important |
|---|---|---|
| So my doctor can prescribe the right dose of insulin. | 79% | 21% * |
| So I have enough information to be able to adjust my own insulin. | 96% | 4% |
| Because I have been asked by my doctor/diabetes educator. | 72% | 28% * |
| Because it helps me understand what foods affect my blood glucose level. | 98% | 2% |
| Because I cannot rely on how I feel to tell if my blood glucose is high or low. | 83% | 17% |
| Because it helps me to keep my blood glucose normal when I'm exercising. | 93% | 7% |

*** Reverse Scored**

The majority of subjects rated all the reasons identified by the researcher as important to monitor blood glucose levels by answering important or very important. One subject indicated that it was not important for the doctor to

have data to adjust his insulin dosage, but the data should be "available as required". Another had indicated that it was very important to know if his blood glucose was high or low "since commencing human insulin."

It is evident that despite Questions 1 and 3 highlighting that the subjects felt it was important to monitor blood glucose for their doctor and diabetes educator or others assisting them to effectively manage their diabetes, they also felt SBGM was important for themselves.

Further insight into the reasons that the subjects performed SBGM is gained from additional comments. Many of the reasons could be categorised according to the reasons suggested in the questionnaire, which were insulin adjustment, affect of food on blood glucose level and identifying blood glucose out of the normal range, but added a personal perspective. Some comments were related to the importance of SBGM to enable insulin adjustment. A comment by one subject was that she performed more tests "so I can adjust insulin as required." A specific comment relating to a social occasion made by another subject was that she tested "to adjust insulin dose for a night out." A comment by one

subject that related to symptoms was that he would test "if I am feeling low in the morning so I can adjust my insulin for what I am doing during the day." A more general comment from another subject was that she would test "to adjust insulin related to blood sugar levels, activity and food for the next 4 - 12 hours."

Other comments related to subjects' understanding of how foods affect blood glucose levels. Two comments related to decisions on whether snacks were required in between meals: "To determine if morning and afternoon tea and supper is still necessary" and "I can check blood sugar levels are sufficiently high enough to last until next meal." One subject who found SBGM useful in times of prolonged abstinence of food, said it "helps me to plan activities e.g. if I am having a long period without food."

Some respondents explained that they monitored to identify the difference between high and low levels. A general comment by one subject was that "it is essential for control of health." The importance of SBGM for overall control of diabetes was reflected in comments by other subjects. One subject stated that

he performed SBGM "for general physical health", another stated that he performed SBGM "to maintain a balance." A further comment by one subject was that it was important to test frequently and perform enough tests "to locate an overall pattern" of what his blood sugar levels were throughout the day. A more specific comment related to the difficulty of working odd hours. He found that "being a shift worker my blood sugars jump up and down like a yo yo and I need to keep a regular check on it." One subject found performing SBGM useful "because I get aggressive feelings and I use a meter to check if I am over the top."

Many other reasons for blood glucose monitoring were identified by the subjects. These included understanding stress and illness, preventing long term complications, during pregnancy and being in charge of their own diabetes. One comment that identified the profound effect of stress on blood glucose levels was: "I recently had a hypo. I was taking extra insulin because of extreme work related stress, Uni studies and a very pregnant wife were pushing up my glucose levels. Suddenly all the stress left and I was caught out because I didn't reduce

my insulin levels fast enough." A further comment relating to stress by another subject included: "Social occasions and public speaking affect my control."

There were comments relating specifically to sickness. One subject felt it essential to perform SBGM if "I have had food poisoning and monitoring is essential when it's difficult to eat." Another subject performed blood glucose monitoring "when I have an infection to maintain good control." A more general comment by another subject was that she performed SBGM "when I'm ill with other complaints it helps me keep my diabetes stable."

The importance of maintaining normal blood glucose levels to reduce the likelihood of long term complications was reported by one subject who stated that he performed SBGM "for less problems later on in life." This was supported by another subject who stated that she performed SBGM "because keeping my blood sugar levels within the normal range lessens the chance of getting long term complications."

One subject felt that it is very important to perform SBGM "because its my

diabetes and I want to have control". This comment indicated a desire for autonomy and independence over managing his diabetes.

## 5.8 Extent to which SBGM is relied on to initiate Behaviour Change

The responses to Section D of the questionnaire indicated that 64% of subjects relied on SBGM to initiate behaviour change. The subjects received a score of 0 when SBGM was never used to initiate behaviour change, a score of 1 when subjects rarely used SBGM to initiate behaviour change, a score of 2 when subjects sometimes used SBGM to initiate behaviour change, a score of 3 when subjects frequently used SBGM to initiate behaviour change, and a score of 4 when subjects very frequently used SBGM to initiate behaviour change. Of the 57 subjects who responded to this section the mean score was 22, and the range was between 4 and 35. An analysis of each individual's responses indicated that the subjects frequently relied on SBGM to make decisions about food, exercise, insulin adjustment, understanding the effects of stress and illness and ensuring that normal blood glucose levels were maintained. A description of both scores

and percentages of the questions relating to behaviour change are displayed in Table 5.8.

TABLE 5.8 Frequency of SBGM to initiate behaviour change

| QUESTION | NEVER/RARELY | SOMETIMES/ FREQUENTLY/VERY FREQUENTLY |
|---|---|---|
| 1. Rely on SBGM to maintain normal blood glucose levels. | 10%(6) | 90%(51) |
| 2. Rely on SBGM to understand effects of individual foods on blood glucose levels. | 18%(10) | 82%(47) |
| 3. Rely on SBGM to help work out why blood glucose is high or low. | 18%(10) | 82%(47) |
| 4. Rely on SBGM to increase understanding of how exercise affects blood glucose. | 18%(10) | 82%(47) |
| 5. Rely on SBGM to increase confidence in insulin adjustment. | 15%(8) | 85%(49) |
| 6. Rely on SBGM to increase understanding of how illness affects insulin requirements. | 27%(13) | 73%(42) |
| 7. Rely on SBGM to increase awareness of why sweet foods should be avoided. | 43%(25) | 57%(32) |
| 8. Rely on SBGM to avoid hypoglycaemia during strenuous exercise. | 30%(17) | 70%(40) |
| 9. Rely on SBGM to understand affects of stress in blood glucose levels. | 48%(27) | 52%(30) |
| 10. Rely on SBGM in choosing an insulin regime that meets your needs. | 24%(14) | 76%(43) |

Additional comments provided a clearer rationale for the frequency with which subjects relied on SBGM to self manage their own diabetes effectively. One subject reported that "once done I always remember what effect food has on my control." This comment suggested that once information relating to a specific food was known and understood, it was not necessary to continue to gather more information on that food. It was evident that some subjects felt it was not necessary to test after sweet foods as one subject, who did not rely on SBGM to understand the effects of sweet foods stated "this is an undisputable fact for me", and another answered that he "already understands problems associated with eating sweet food". Another subject felt that in general, the public did not understand why people with diabetes mostly avoid sweet foods. His statement was:

> I feel this misconception (the idea that diabetics shouldn't eat sweet foods) inconvenient at the best of times. When I go low the last thing I need is a barrage of questions which stems from the idea that diabetics should not eat sugar. Diabetics function pretty much the same way normal people function, like normal people they have highs and lows, except it may be more extreme. I think this point should be re-examined in terms of redefining education to understand how normal people function, then with this understanding, and the use of a novo-pen try to mimic normal function.

This suggests that education programmes should include the role of insulin in normal metabolism. This should help reduce the misconception that people with

diabetes must avoid sugar.

Other comments identified a possible reason for the 27% of 60 subjects not relying on SBGM during illness. This occurred because many subjects were rarely or never ill. One subject, who had never been ill since diagnosis stated: "This problem has never risen," whereas another stated: "I am rarely ill so I feel I cannot answer this question accurately."

The comments relating to stress help to identify a possible reason for the high percentage (48%, 27 subjects) who did not rely on SBGM to increase their understanding of stress. One subject stated: "I am not aware of the degree of stress that can alter glucose levels." Because the effects of stress are virtually immeasurable, this subject's comments suggest that there is a feeling of helplessness and lack of control over the effects of stress. This comment was supported by another subject who stated: "for me, having an understanding of the effects of stress does not alter my control over the same situation. I cannot effect any changes from that knowledge, just a knowledge is not enough to cause a change for me."

In relation to relying on SBGM in choosing an insulin regime, one subject stated that he "would only do this with medical approval." Another subject who rarely relied on SBGM to initiate any behaviour changes commented that "as my blood glucose levels are usually 5.5 mmol/L and I eat basically the same foods (avoiding sweet foods) I find it quite easy to control my blood glucose levels." However, the fact that this subject knew that her blood glucose was maintained around 5.5 mmol/L indicates that SBGM was used to ensure that blood glucose levels were within the normal range. This was confirmed by her response to Question 1 of Section D, which was that she frequently relied on SBGM to maintain normal blood glucose levels.

## 5.9 The relationship between behaviour and age, sex, duration of diabetes and level of education

Table 5.9 shows the correlation coefficients between behaviour and age, education and duration of diabetes.

TABLE 5.9 Relationship between Behaviour and Age, Education, duration of Diabetes

| VARIABLES | BEHAVIOUR |
|---|---|
| AGE | .29* |
| DURATION OF DIABETES | .22 |
| LEVEL OF EDUCATION | .06 |

*($p < .05$)

The low correlation between duration of diabetes and level of education with behaviour was not significant at $p < 0.05$. The correlation between age and behaviour was significant at $p < 0.05$. The data were analysed by using a t-test to determine whether there is any difference between the behaviours of males and females. This was not significant at $p < 0.05$ ($T(53)= .11$, $p > .05$).

## 5.10 The relationship between self management, correct SBGM and effective SBGM

Table 5.10 shows the correlation coefficients between correct SBGM, effective SBGM and self management of diabetes.

TABLE 5.10 The relationship between correct technique and effective SBGM with self management of diabetes

| | SELF MANAGEMENT |
|---|---|
| CORRECT SBGM | r = 0.583* |
| EFFECTIVE SBGM | r = 0.406* |

*p < .01

These correlation coefficients indicate that correct technique is moderately related to self management of diabetes. Further, effective SBGM, which relates to the frequency and number of tests being performed is moderately related to self management of diabetes.

## 5.11 The relationship between the reasons why SBGM is performed and the use of blood glucose data to increase the likelihood of achieving normal blood glucose.

Questions two, four, five and six in Section C of the questionnaire were not reverse scored. These four questions were correlated with Section D of the questionnaire. If there was a relationship between the reasons why the subjects performed SBGM and used blood glucose for themselves, it would suggest that

high levels of self efficacy was related to high levels of self control. According to Pender's H.P.M.(1987), when an individual's perceived health control and perceived self efficacy is high the likelihood of performing an action is high. In IDDM, perceived health control and self efficacy would therefore lead to self management.

The correlation coefficient between SBGM for themselves and use of blood glucose data was significant at $p < .01$ ($r=0.45$). This indicates that there was a relationship between perceived importance of performing SBGM for oneself and use of blood glucose data to increase the likelihood of achieving normal blood glucose.

# CHAPTER 6

# DISCUSSION

The results of this study will be discussed in relation to the research questions.

## 6.1 Correct technique

The first research question states: What proportion of people with IDDM who have attended the Diabetes Association of W.A. for education use correct technique to perform SBGM?

Although accuracy of SBGM was not measured, 47% of the 63 subjects met the criteria for correct technique. The majority of subjects had not had their technique reviewed since initial instruction (61%). This was also identified by Perragallo-Dittko (1991), Cohen et al (1989) and Ostram-Jayes (1988) as a reason for erroneous results. A possible explanation for this deficit is that many of the subjects could have been monitoring their blood glucose prior to attending education. This may be linked to the fact that many study participants had been diagnosed with diabetes for a considerable length of time. (The mean duration

was 11 years.) However, the subjects had been chosen from people who had received education within the last 4 years. If the subjects had already been performing SBGM, the educator may not have recognised the need to review blood glucose monitoring technique.

Since the majority of the subjects in the study were not newly diagnosed with IDDM when they attended their education programme, clearly many people with diabetes are willing to continue to seek more knowledge about diabetes after their initial education following diagnosis of diabetes. A principle of adult learning stated by Mast (1986, p35) is that "readiness to learn is motivated by what is immediately applicable to life's tasks". Initial diagnosis of diabetes may not be the time when people are most ready to learn. Despite this, most education programmes are implemented at diagnosis. Diabetes education programmes should be designed to meet individual ongoing learning needs.

It was significant that 63% of the 65 subjects did not clean their meter as prescribed and that 41% of the 65 subjects did not use a control solution to check their technique. This result is congruent with the areas of concern identified in the literature (Muller,1988;Ward et al,1985; & Peregallo-

Dittko,1991). The deficits observed in blood glucose monitoring technique, confirm that more attention should be focused on teaching and reviewing correct technique for SBGM.

However, the extent of SBGM reported by 65 of the subjects of the study suggested that sufficient data was obtained to monitor blood glucose effectively. In fact, 55% of the 65 subjects exceeded the prescribed criteria by monitoring more than four times a day, twice a week. These results are congruent with the American Diabetes Association consensus statement (1986) for proper uses of blood glucose monitoring data. Therefore, this data should not be compromised by erroneous results caused by incorrect technique.

## 6.2 Use of data to Initiate Behaviour Changes

The second research question states: What proportion of people use the information from SBGM to initiate behaviour change related to eating, exercise and adjustment of insulin in order to maintain normal blood glucose levels.

The extent to which SBGM is relied upon by the subjects indicates that, in

general, the subjects frequently relied on SBGM to understand variables that affect blood glucose levels (see Table 5.8). However, a significant percentage of the subjects did not rely frequently on data from SBGM to adjust insulin doses to compensate for stress, illness and effects of sweet foods. Twenty seven percent of 60 subjects did not rely on SBGM to monitor effect of illness on blood glucose levels. A possible reason for this finding is that these subjects are rarely ill. Comments of the subjects need to be considered carefully by health professionals providing diabetes education programmes for people with diabetes. Potentially serious situations occur when people with IDDM are ill and rapidly progress to high blood sugar levels, dehydration, ketoacidosis and coma. Specific instructions on fluid requirements, when and how often to test for ketones and blood glucose levels, and how to adjust insulin requirements, are included in all education programmes. Because illness occurs infrequently, it is important that written information for managing diabetes during illness, be provided. This will assist in recalling initial instructions and provide a rationale for management of diabetes during an illness, and hence reduce the risk of developing serious life threatening complications.

A further consideration highlighted by comments from some subjects relates to

the effect of stress on diabetes control. A high percentage (48% of 63 subjects), do not rely on SBGM to understand the effects of stress on diabetes control. Additional comments suggest that knowledge did not help them gain control over stress. One subject described a severe hypoglycaemic reaction because he did not reduce his insulin dosage when the stress resolved. This highlights the fact that strategies need to be included that will enable individuals to identify and act on stress factors in their lives in diabetes education programmes . There is a possibility that at present, education programmes are inadequate in preparing people to identify potential stress periods in their lives. More intensive SBGM is needed during these periods t ensure that insulin dosage is increased and decreased accordingly.

An interesting observation concerns the attitude of many of the subjects regarding food. A high percentage (82% of 57 subjects) reported that they rely on SBGM to understand individual foods. However, 57% of 57 subjects reported that they did not rely on SBGM to understand the effects of sweet foods. It appears that the effect of sweet food on blood glucose levels is an indisputable fact with most of the subjects, and consequently they are prepared to avoid these foods without question. One subject addressed the need for the

educator to teach normal digestion, absorption and metabolism, rather than give prescribed information on what foods should be avoided and what foods can be eaten. This information would then enable the diabetic to mimic normal function as closely as possible. This response to insulin replacement would be possible to achieve if health professionals allowed people with diabetes to adjust their own insulin dosage. At present, education programmes do not necessarily teach people with diabetes how to adjust insulin according to individual needs.

This same subject also highlighted a problem relating to the general public's misconception of why people with diabetes avoid sweet food. He expressed a feeling of annoyance that the public think that people with diabetes are forbidden to eat sweet foods. It is clear that the general public need to be educated in the concepts of diabetes.

A high percentage (82% of the 60 subjects) of respondents relied on SBGM to understand the effect of exercise on blood glucose levels. However, a smaller percentage (70% of the 37 subjects) relied on SBGM to avoid hypoglycaemia in strenuous exercise, and, in fact, 27 subjects failed to respond to the question

relating to hypoglycaemia in strenuous exercise at all. Although there were no comments relating to exercise, there is a possibility that these subjects do not undertake strenuous exercise. A further possibility could be the inconvenience of performing SBGM during strenuous exercise. Another factor may be the lack of emphasis placed on exercise physiology in education programmes.

The majority of subjects (53% of the 62 subjects) relied frequently on SBGM to choose insulin regimes. This was an unexpected finding in that it has traditionally been the responsibility of the medical practitioner to choose insulin regimes for people with diabetes. However, one subject noted that it would not be done without consultation with a doctor. It would be difficult for people with diabetes to change insulin regimes without consultation with a doctor for the appropriate prescription. However, the majority of subjects (76% of 62 subjects), monitor blood glucose frequently to ascertain whether or not their current insulin regime suits their lifestyle and they are aware of the choice in different insulin regimes and available types.

## 6.3 Reasons for SBGM

The third research question states: What are the reasons that people with diabetes monitor blood glucose levels?

Equal importance was placed by subjects on performing blood glucose monitoring for health professionals as for themselves. This emphasis placed on performing SBGM for health professionals and following instructions on what doctors and educators perceive as important does not indicate promotion of client autonomy and independence in managing diabetes. This is consistent with Rubin et al's (1989) suggestion that diabetes education programmes are currently knowledge based rather than directed at ability to self care. The literature indicates that facilitating a problem solving approach will assist people with diabetes to have the skills to make decisions for themselves (Beebe, 1987; Wilson et al 1985).

The decision of the researcher not to include all of the recognised reasons for blood glucose monitoring proved to be advantageous. The omission of some of the variables allowed the subjects to identify what they considered important

reasons for blood glucose monitoring rather than being prompted by the questionnaire. Additional comments confirmed the importance respondents placed on blood glucose monitoring to assist in adjustments in relation to food, exercise and insulin.

The response and extent of comments relating to the importance of blood glucose monitoring to ensure that blood glucose is maintained within the normal range, emphasised the importance placed on maintaining normal blood glucose. This positive response to avoiding short and long term complications was confirmed with additional comments relating to hypoglycaemia and prevention of complications in later life. Comments relating to avoiding hypoglycaemia suggested that this was a very important reason to monitor blood glucose.

The comments relating to effects of stress, illness and hypoglycaemia outlined the importance of personal experience rather than information through an education programme. One subject reported performing blood glucose monitoring "because it's my diabetes and I want to have control." This emphasised that the health professional's role was to assist people with diabetes to maintain normal blood glucose. Health professionals should adopt a problem

solving approach that will assist individuals to identify variables that affect their blood glucose levels.

A finding that was supported in the literature was the need for continued motivation to perform blood glucose monitoring. Some subjects performing test-retest reliability reported that the questionnaire acted as a prompt to perform more tests relating to food, exercise and insulin dosage. Cohen et al (1989) reported that "patients suffer from 'burn out' from repeatedly pricking fingers, and that patients lack technique to remain motivated over the years." This change in behaviour was due to these subjects participating in research. The Hawthorne Effect, first described in 1920, suggests that subjects can change behaviour simply as a result of being involved in research (Burns and Grove, 1987). In this study, the questionnaire was instrumental in providing the participants with the motivation to monitor their blood glucose levels more frequently.

## 6.4 The relationship between demographic variables and behaviour

The fourth research question states: What is the relationship between age, sex,

duration of diabetes or level of education and the propensity to use the information for SBGM to initiate behaviour changes related to eating, exercise and insulin adjustment?

There was a weak correlation between demographic variables and the use of blood glucose monitoring to initiate behaviour change. The literature identified that age and duration of diabetes were related to performing blood glucose monitoring (Gilden et al 1990; Cohen et al, 1989; Germain et al, 1988). Although age was significant at $p < .05$, duration of diabetes was not and all correlation coefficients were small. (See Table 5.9). A possible reason for this difference is that the literature discussed performance of blood glucose monitoring. In this study, the correlation was between age and use of blood glucose monitoring to initiate behaviour change.

All of the subjects included in this study had elected to attend further education. They had the motivation and problem solving skills necessary to initiate behaviour change as a result of information from blood glucose data. However, the relationship between duration of diabetes and effective blood glucose monitoring was significant at $p < .05$. Although the correlation coefficient was

small, it indicates that the longer a person has diabetes the less willing they are to test blood glucose levels frequently. This is congruent with Cohen et al (1989 p.54)) who reported "the need for continued encouragement from their health care team to continue to blood glucose monitor". There is the possibility that over time, people may feel that they have enough experience with diabetes to interpret their body intuitively and not need clinical indicators. Hamera et al (1988, 1990) found symptoms of hypoglycaemia and hyperglycaemia an unreliable prediction of blood glucose levels. In order to prevent a false sense of security occurring, and the potential risk of hyperglycaemia, the health care team should incorporate motivation strategies into their programmes, that will increase the likelihood of people with diabetes effectively maintaining blood glucose levels.

## 6.5 The Relationship between correct SBGM and self management of diabetes

The fifth research questions states: Is correct SBGM related to self management of diabetes?

There was a moderate relationship between subjects' ability to perform correct blood glucose monitoring and initiate behaviour changes (See Table 5.10). This suggests that those subjects who perform SBGM correctly also use blood glucose data to increase the likelihood of normal blood glucose. This confirms the importance of diabetes education programmes ensuring that blood glucose monitoring technique is taught correctly and is reassessed frequently by an expert.

## 6.6 The Relationship between effective SBGM and the self management of diabetes

The sixth research question states: Is effective SBGM related to self management of diabetes?

There was a moderate relationship between subjects SBGM and the use of blood glucose data to increase the likelihood of maintaining normal blood glucose. This suggests that subjects who perform SBGM, who keep a record of blood glucose data and who know the normal blood glucose range, also use blood glucose data to increase the likelihood of maintaining normal blood glucose and

therefore effectively self manage their diabetes. Strategies that promote encouragement and motivation of people with diabetes to monitor frequently and to base behaviour change on adequate information should be included in all diabetes education programmes.

## 6.7 The Relationship between perceived self efficacy and perceived control of health

The seventh research question states: Is there a relationship between perceived control of diabetes and perceived self efficacy of diabetes.

Pender's (1987) Health Promotion Model predicted that if perceived health control and perceived self efficacy are high, the likelihood of performing any health action is high, and in this case, the chance of effectively self managing their diabetes is high. Since SBGM provides information that will increase the person's ability to self manage, this should lead to an increase in self efficacy. The correlation coefficient between the reasons why people perform SBGM and the use of blood data was moderate. This indicates that when blood glucose data is used to initiate behaviour change, the likelihood of people performing

SBGM for themselves increases. Therefore, for people with diabetes to be able to control blood glucose, they must also understand that their blood glucose levels can be self regulated. Education programmes should be designed to empower people with diabetes with the skills and knowledge to use blood glucose data to increase self efficacy and self management of their diabetes.

# CHAPTER 7 CONCLUSIONS & RECOMMENDATIONS

## 7.1 CONCLUSIONS

This study was undertaken to ascertain whether SBGM, performed correctly, is useful in promoting effective self management in people with IDDM. It also examined the reasons why individuals monitor their blood glucose levels. In addition, it attempted to determine whether an individual's propensity to self manage his/her diabetes is affected by age, sex, duration of diabetes and level of education.

It was found that the majority of the subjects relied on blood glucose monitoring data to initiate behaviour changes considered necessary to increase the likelihood of achieving normal blood glucose levels. However, more than half of the subjects did not meet the criteria prescribed for performing blood glucose monitoring correctly. The majority of subjects performed blood glucose tests both frequently and regularly enough to self monitor blood glucose effectively. In addition, both correct SBGM and effective SBGM were related to effective self management. This indicated that the usefulness of SBGM in the promotion

of effective self management skills is directly related to both correct and effective SBGM.

Equal importance was placed in performing blood glucose monitoring to comply with the instructions of health professionals and for the purpose of self management. It is unknown whether the use of SBGM data by the health care team is initiated at the request of the health professional or the person with diabetes. It is also unclear, whether education programmes are encouraging people with diabetes to be autonomous and independent regarding the use of blood glucose monitoring data.

The moderate relationship between the reasons for SBGM and involvement in the self management of their diabetes indicates that diabetes education programmes should promote goal directed behaviour, self care and self adjustment. This finding reflects Pender's H.P.M. (1987), where high levels of health control and high levels of self efficacy are expected to lead to effective self management.

Individuals' propensity to initiate behaviour change was not related to sex,

duration of diabetes or level of education. However, age was slightly related to correct blood glucose monitoring and use of data to initiate behaviour change. In addition, duration of diabetes was slightly related to frequency of blood glucose monitoring in that the frequency of SBGM declined over time.

## 7.2 Recommendations

According to the literature surveyed, this is the first study assessing the usefulness of blood glucose monitoring, from the perspective of the person with diabetes. Many of the findings support other researchers' conclusions related to inaccurate blood glucose monitoring and decreased motivation to monitor with time. This supports the need for diabetes education programs to include adequate instruction, by an expert, on correct technique to perform blood glucose monitoring. In addition, these programmes should have formal criteria that will ensure that people with diabetes have regular assessment of blood glucose monitoring technique and a forum for health professionals to provide motivation and support.

The temptation for the health care team to make decisions, based on blood

glucose monitoring data, needs to be considered. A problem solving approach that will empower the person with diabetes to make his or her own decisions, is compatible with Pender's Health Promotion Model (1987), and should be encouraged.

The potentially serious problems that can arise as a result of emotional and physical stress need to be considered. It should be mandatory that health professionals involved in diabetes care and education provide written information regarding management of diabetes during illness and rationale for these instructions. Further, education programmes should empower persons with diabetes with skills that will enable them to understand and act on the effects of stress on blood glucose levels.

There is a possibility that people with diabetes may rely on symptoms to determine blood glucose levels rather than monitor blood glucose levels. However, research has proven symptoms to be unreliable predictors of blood glucose levels. Further study needs to be undertaken to ascertain the reason why duration of diabetes is related to a decrease in monitoring blood glucose levels.

## 7.3 Recommendations for further research

The questionnaire was developed specifically for this study and has had some reliability and validity testing. It is recommended that more extensive testing be undertaken to reduce the risk of errors in measurement. This is especially important in Section C when both test-retest reliability and internal consistency were low.

This study has implied that the usefulness of monitoring blood glucose can be compromised by incorrect technique that may cause inaccurate results. Studies should be undertaken to assess correct and accurate blood glucose monitoring technique. This would be best assessed by demonstration as opposed to the self reported responses of a questionnaire.

It remains unclear why the participants felt it important to gather blood glucose data for health professionals' use. Further research should be undertaken to ascertain whether this is in response to the attitudes of the health professional or the person with diabetes and to ascertain whether diabetes education programmes are designed to empower the person with diabetes with skills to

manage their own diabetes.

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# APPENDIX I

## QUESTIONNAIRE INTRODUCTION

This questionnaire is part of a research project being conducted for a Bachelor of Applied Science (Nursing) - Honours Degree at Edith Cowan University. The study is investigating the use of self blood glucose monitoring in increasing self management skills in people with insulin dependent diabetes.

In order to gather the necessary information I seek your co-operation in completing the attached questionnaire which will take approximately 5-10 minutes to complete. Your participation is completely voluntary and I totally respect your right to withdraw at any time.

The information from the questionnaire will be used for research study only and confidentiality and anonymity is guaranteed for all participants as collected data will be used for statistical purposes only.

Please place your completed questionnaire inside the attached envelope and return to me.

Please do not place your name on the questionnaire.

Thank you for your co-operation and participation.

If you require further information please do not hesitate to contact:

Maureen Unsworth

Telephone: [redacted]

## QUESTIONNAIRE

### SECTION A

This set of questions are about the individual differences that may have some influence on how you manage your diabetes.

*Please read the following questions and clearly circle the answer which is applicable to you.*

1) Date of Birth: _____

2) Sex: Male Female

3) I have had Diabetes Mellitus _____ years

4) I have attained _____ years of education

Example: Primary School = 0-7 years
High School = 8-12 years
Post School = 13+ years
(Apprenticeships, University, TAFE, Professional Courses)

5) Do you test your own blood sugar levels?

a) YES
(If you answered yes, proceed to Section B, and complete questionnaire.)

NO
(If you answered no, please explain why below). There is no need for you to answer any more questions. Thank you for participating. Please return the questionnaire to me in the attached envelope.

WHY

_____

_____

**SECTION B**

This set of questions is about how and why you monitor your blood glucose levels.

*Please read the following questions and clearly circle the answer which is applicable to you.*

1) How often do you test your blood sugar levels?

a) Once or twice a week
b) Once a fortnight
c) Once a month
d) Only prior to an appointment with my diabetes educator or doctor
e) Only when I think my diabetes is out of control
f) Other - Please specify

_____

2) At what <u>times</u> of the day do you normally test? Circle as many as necessary.

a) Before breakfast
b) Before lunch
c) Before tea
d) Before bed
e) Two hours after meals

f) Other - Please specify

1_____

2_____

3_____

4_____

3) Which of the following do you test your blood sugar levels with?

a) BM Glycaemie 20/800 strips (visually)
b) Glucostix (visually)
c) Reflolux
d) Glucometer II
e) Glucometer GX
f) Hypocount
g) ExacTech
h) Other - Please specify

_____

4) Do you think blood sugar testing is:

a) Always painful
b) Sometimes painful
c) Never painful

5) How do you keep a record of your blood sugar levels?

a) I don't keep a record/or a book
b) In a record book or diary
c) In the memory of my blood glucose meter
d) On a computer
e) Other - Please specify

_____

6) Do you calibrate your meter?

a) Yes - with each new bottle of strips
b) Yes - with each new strip
c) No - it's not necessary
d) No - I don't know how to

7) Do you usually check your technique with control solution?

a) Yes
b) No - it is not necessary
c) No - don't know how to

8) How often it is necessary to clean your meter

a) Each time I open a new bottle of strips
b) Once a month
c) Once a week
d) When I think it might be dirty
e) Other - Please specify

_____

9) Has a diabetes educator ever checked how you do a blood sugar test since your initial instruction?

a) Yes
b) No
c) I am not sure

10) Please identify what you think is the acceptable blood sugar range for people with diabetes.

a) 3.5 - 8.0 mmol/L
b) 4.0 - 10.0 mmol/L
c) 5.0 - 8.0 mmol/L
d) Other - Please specify

_____

## SECTION C

This set of questions is to gain an understanding of what you feel are the most important reasons for monitoring your own blood glucose levels.

*Please rate how important each of the following reasons are for monitoring your own blood glucose levels:*

| CODE: | VERY IMPORTANT VI | FAIRLY IMPORTANT FI | NOT SURE NS | NOT VERY IMPORTANT NVI | NOT IMPORTANT NI |
|---|---|---|---|---|---|

1) So my doctor can prescribe the right amount of insulin for me.
VI FI NS NVI NI

2) So that I have enough information to be able to adjust my own insulin
VI FI NS NVI NI

3) Because I have been asked to by my Doctor/Diabetes Educator.
VI FI NS NVI NI

4) Because it helps me to understand what foods affect my blood glucose levels.
VI FI NS NVI NI

5) Because I can not rely on how I feel to tell me if my blood glucose is too high or too low.
VI FI NS NVI NI

6) Because if helps me to keep my blood glucose normal when I undertake exercise

VI FI NS NVI NI

Other reasons not stated above.

7) _____

VI FI NS NVI NI

8) _____

VI FI NS NVI NI

**SECTION D**

This set of questions is to ascertain to what extent you rely on the information from blood glucose testing to help you control your diabetes.

*Please circle clearly your response to each of the following questions:*

| CODE: | NEVER | RARELY | SOMETIMES | FREQUENTLY | VERY FREQUENTLY |
|---|---|---|---|---|---|
| | N | R | S | F | VF |

1) To what extent do you rely on the information you get from your own blood glucose testing to keep your blood glucose levels within the normal range?

N R S F VF

2) To what extent do you rely on information from your own blood glucose testing in increasing your understanding of effects of individual foods on your blood glucose levels?

N R S F VF

3) To what extent do you rely on information from your own blood glucose testing in helping you work out why your blood glucose levels are too high or too low?

N R S F VF

4) To what extent do you rely on information from blood glucose testing in increasing your understanding of the effects of exercise on your blood glucose levels?

N R S F VF

5) To what extent do you rely on information from blood glucose testing on increasing your confidence in adjusting your own insulin dosage?

N R S F VF

6) To what extent do you rely on information from blood glucose testing on increasing your understanding of how illness increases your insulin requirements?

N R S F VF

7) To what extent do you rely on information from blood glucose testing on increasing your awareness of why sweet foods and drinks should mostly be avoided by people with diabetes?

N R S F VF

8) To what extent do you rely on information from blood glucose testing to avoid hypoglycaemia during strenuous exercise sessions?

N R S F VF

9) To what extent do you rely on information from blood glucose testing in understanding the effects of stress on your blood glucose levels?

N R S F VF

10) To what extent do you rely on information from blood glucose testing in choosing an insulin regime that meets your needs?

N R S F VF

**THANK YOU** for your participation

*PLEASE return the questionnaire in the attached stamped addressed envelope to me.*

I.D. NUMBER

## DIABETES EDUCATION PROGRAMME

DATE COMMENCED .....

DATE COMPLETED .....

| PROGRAMME | DATE | COMMENTS/AUDIO-VISUALS/LITERATURE |
|---|---|---|
| 1. GENERAL INFORMATION<br>1.1 "What is Diabetes"<br>1.2 Signs and Symptoms | | |
| 2. HYPERGLYCAEMIA<br>2.1 Causes<br>2.2 Signs and Symptoms<br>2.3 Treatment | | |
| 3. HYPOGLYCAEMIA<br>3.1 Causes<br>3.2 Signs and Symptoms<br>3.3 Treatment | | |
| 4. BLOOD GLUCOSE LEVELS<br><br>Effects of eating/exercise/ medication/stress.<br><br>General principles of good control | | |
| 5. DIET<br>5.1 General nutrition principles, e.g. CHO, fat, protein<br>5.2 CHO - simple vs complex<br>5.3 CHO distribution<br>5.4 Meal spacing - regularity<br>5.5 Weight reduction principles<br>5.6 Alcohol<br>5.7 Hypoglycaemia | | |
| 6. EXERCISE | | |
| 7. STRESS | | |
| 8. MONITORING DIABETES - URINE TESTING<br>8.1 Test name<br>8.2 Test times<br>8.3 Storage<br>8.4 Recording<br>8.5 Technique - Glucose<br>8.6 Interpretation of results<br>Action taken - Glycosuria<br>Action taken - Ketonuria<br>Factors effecting tests | | |

| PROGRAMME | DATE | COMMENTS/AUDIO-VISUALS/LITERATURE |
|---|---|---|
| 9. BLOOD GLUCOSE TESTING<br>9.1 Test name<br>9.2 Test times<br>9.3 Recording<br>9.4 Technique<br>9.5 Cleaning machine<br>9.6 Calibration<br>9.7 Interpretation of results<br>Action taken -<br>Hyperglycaemia<br>Factors affecting tests | | |
| 10. INSULIN - GENERAL PRINCIPLES<br>10.1 Type, storage, therapy<br>10.2 Drawing up dosage<br>10.3 Injection Technique<br>10.4 Care of syringes/needles<br>10.5 Injection Sites<br>10.6 Double Mix Insulins<br>10.7 Regulation of Dose | | |
| 11. ORAL HYPOGLYCAEMIC THERAPY<br>11.1 Name of drug<br>11.2 Action<br>11.3 Side effects | | |
| 12. ILLNESS<br>12.1 Keto-Acidosis<br>12.2 Sick day rules | | |
| 13. COMPLICATIONS - RECOGNITION<br>13.1 Foot care - refer to<br>Podiatrist<br>13.2 Vision - refer to<br>Opthalmologist<br>13.3 Other problems specific<br>to client | | |
| 14. LIFESTYLE COUNSELLING<br>14.1 Occupation<br>14.2 Marriage<br>14.3 Pre-conception counselling<br>14.4 Pregnancy<br>14.5 Travel | | |
| 15. IDENTIFICATION<br>15.1 Medic alert<br>15.2 Card | | |

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