

# HOME GLUCOSE MONITORING IN SINGAPORE — ITS BENEFITS AND PRACTICABILITY

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## SYNOPSIS

Home glucose monitoring has recently been shown to be an effective means of achieving 'tight blood glucose' control in the management of diabetes mellitus. An attempt was made to determine the practicability and benefits of home glucose monitoring in Singapore. Fifteen patients (10 males, 5 females) on insulin therapy were selected. Their mean age was 26.1 years (range 15 years to 39 years). These patients monitored their home glucose using Ames glucose test strips and portable Dextrometer 4 times a day and whenever they did not feel well. Such monitoring can be practically accomplished in a manner acceptable to all except one patient. Motivation, compliance with instructions and an understanding of the objectives of our study are essential on the part of our patients. It was concluded that home glucose monitoring can provide an insight into diabetic regulation that cannot be attained in any other way and can greatly facilitate regulation of diabetes. Good blood glucose control is our best means towards minimising complications in diabetes.

## INTRODUCTION

The use of intensive conventional therapy to improve diabetic control has become of increased interest in recent years. One of the reasons for this is the widely accepted concept that better blood glucose control of diabetes will lower the risk of diabetic complications (1, 2, 3). Several investigators have recently demonstrated that home glucose monitoring (HGM) is an effective means of achieving good blood glucose control (4, 5). The objective of our pilot study is firstly to determine the feasibility and practicability of home glucose monitoring in Singapore, secondly to determine the prevalence of hypoglycaemia with optimal blood glucose control and thirdly the benefits of good blood glucose control.

## METHODS

Patients were taught to measure their own blood glucose using the dextrostix/dextrometer system (Ames). The principle is based on the quantitative reading by a reflectance meter (dextrometer) of the colour developed when glucose reacts with glucose oxidase strips.

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A drop of capillary blood is obtained by pricking the finger tip with a sharp sterile lancet (monolet) and deposited on the impregnated area of the strip. After exactly sixty seconds blood is washed off by applying a steady stream of water to the reagent strip using a wash bottle (placing the strip under a water tap produces variable readings). The strip is then blotted and a reading obtained immediately on the meter. The machine requires a one step calibration procedure to prepare it for routine testing. Standardisation is easy and can be checked against standard glucose solution provided with each kit.

Results are recorded on a standard protocol (Figure 1). All patients were encouraged to obtain at least four blood samples a day before each main meal, before sleep and whenever they had hypoglycaemic symptoms.

**PATIENTS (Tables 1 & 2)**

There were 10 males and 5 females selected for this study. Their mean age was 26 years (range 15-39 years) and the duration of diabetes varied from 1 to 10 years (mean 4.5 years). All patients were on insulin.

Although there was a tendency to select only intelligent patients initially this was checked subsequently. Of the 15 patients, 2 had tertiary education, 10 completed secondary school and 3 had only primary education.

**RESULTS**

**Acceptability:** In spite of the general reluctance of diabetics in Singapore to accept insulin therapy, we were surprised to find that only one patient refused

DAY		DAILY CALIBRATION CHECK COMPLETED Yes <input type="checkbox"/> No <input type="checkbox"/>				
DATE		DAILY STANDARDISATION COMPLETED Yes <input type="checkbox"/> No <input type="checkbox"/>				
		DAILY CONTROLS COMPLETED (Give actual value) 90 mg/dl _____ 250 mg/dl _____				
	BLOOD GLUCOSE VALUE	MEDICATION	DIET/FOOD	EXERCISE	URINE	COMMENTS
12M-4AM						
4AM-8AM						
8AM-12N						
12N-4PM						
4PM-8PM						
8PM-12M						

FIGURE 1. STANDARD PROTOCOL FOR RECORDING RESULTS

H.G.M. He is a senior lecturer in Geography with the National University of Singapore and was afraid of the sight of blood. Of the 15 patients, one failed to complete the project. He is a driver of a transport company and was unable to furnish pre lunch and pre dinner blood glucose profiles.

The other 14 patients obtained profiles on 175 days – a mean of 12 daily profiles a patients. No patient had difficulty in obtaining blood samples and all agreed that the finger prick was less of a problem than they anticipated it to be. All 14 patients wanted to continue with HGM after the project.

**Table 1**

Males	10
Females	5
Mean Age	26 yrs (15 - 39)
Mean Duration of diabetes	4.5 yrs (1 - 10)
All on insulin	

**TABLE 2**

**EDUCATIONAL STATUS**

Tertiary	2
Secondary	10
Primary	3

**Problems Encountered**

Inaccurate readings was usually a result of poor technique. The patient either failed to calibrate the machine, did not check with standards, failed to accurately time the reaction or read the test strips too late. The commonest source of error was a drop of blood that was too small to cover the test area, resulting in a falsely low reading. When proper precautions were taken, HGM with the dextrometer gave reliable blood glucose reading.

**Hypoglycaemia**

A total of 12 hypoglycaemic episodes occurred in 4 patients. Only 2 of them were aware of any symptoms. Figure 2 illustrates the value of HGM in the detection and management of hypoglycaemia. V.L. a 27 year old accountant with a large multinational company in Singapore was diagnosed to have diabetes mellitus eight years ago. He was apparently well controlled on insulin zinc suspension (lente) 26 units every morning. Clinic blood glucose at 9 am varied between 100 to 130 mg%. When he started on HGM he realised that his 'queer feelings' in the afternoons was a result of hypoglycaemia. By reducing his dose to 13 units of IZS (lente) every morning he maintained optimal blood glucose control throughout the day without hypoglycaemia.

**Insulin-Regimes: (Table 3)**

At the onset of HGM, the majority of our patients 11 (79%) were on IZS (lente) insulin once a day, two were on soluble insulin (SI) twice a day and the remaining two on a combination of IZS (L) and soluble insulin given once every morning.

After starting on HGM only four patients remained

on IZS (L) once every morning. The majority of the patients 8 (59%) were on a combination of semilente insulin zinc suspension; [IZS (SL)] and soluble insulin (SI) given twice a day, before breakfast and before dinner.

**TABLE 3**  
**PATIENTS AND INSULIN REGIMES**

Insulin Therapy	Before HGM	After HGM
IZS (lente)	11	4
SI b.d.	2	0
IZS + SI	2	3
IZS (SL) b.d.	0	8
SI b.d.		

Figure 3 illustrates the efficacy of this insulin regime. S.A. a 19 year old pre-University student presented with glycosuria at routine examination prior to national service enlistment. Glucose tolerance test confirmed that he was diabetic and he was started on IZS (L) insulin with good control. His clinic blood glucose was around 100 mg% at 9 am and routine urine examination was free of glucose throughout the day. He defaulted treatment because of severe headaches in the afternoon. When reviewed two months later he had lost about 10 kilograms in weight. After much persuasion he reluctantly agreed to try HGM. He quickly realised that his headaches in the afternoon was due to severe hypoglycaemia in the early afternoons. Within two weeks on HGM he was able to achieve optimal blood glucose control without hypoglycaemia by changing his insulin regime for IZS (L) 52 U every morning to a combination of IZS (SL) and soluble insulin twice a day.

**Improvement in Diabetic Control**

Improved diabetic control was seen in 11 out of 14 patients (79%) who continued with the project. Seven patients consistently achieved blood glucose levels of less than 150 mg% in all 4-5 samples daily. We were however unable to control blood glucose levels in the remaining 3 patients despite HGM.

**DISCUSSION**

This study illustrates that monitoring of blood glucose by patients at home is feasible and practicable in Singapore. It can be accomplished in a manner that is acceptable in most diabetic patients regardless of their educational status. Although others have found this to be the case as well (4, 5, 6) this is surprising because there is a general reluctance of diabetics in Singapore to even accept insulin therapy (7). No one had difficulty in obtaining blood samples, perhaps because each patient was coached individually by a doctor who demonstrated the technique on himself. The use of a finger pricking device (autolet) in conjunction with a specially designed sharp short needle (monolet) greatly simplified matters.

One of the main points that emerged from this study was the usefulness of HGM in the detection and

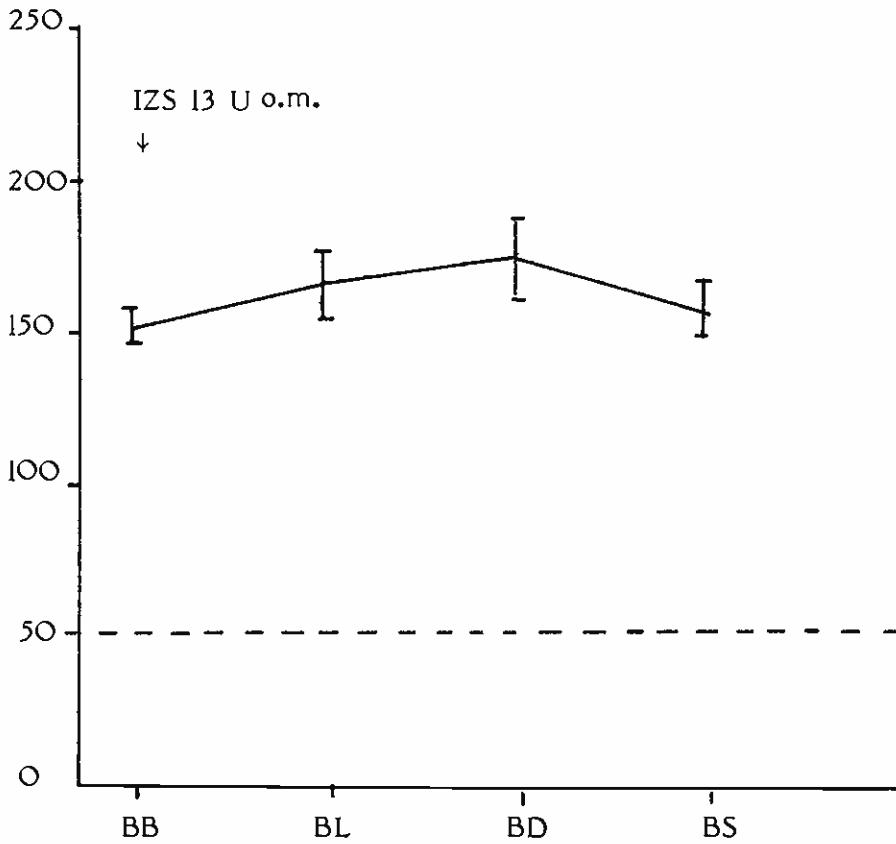
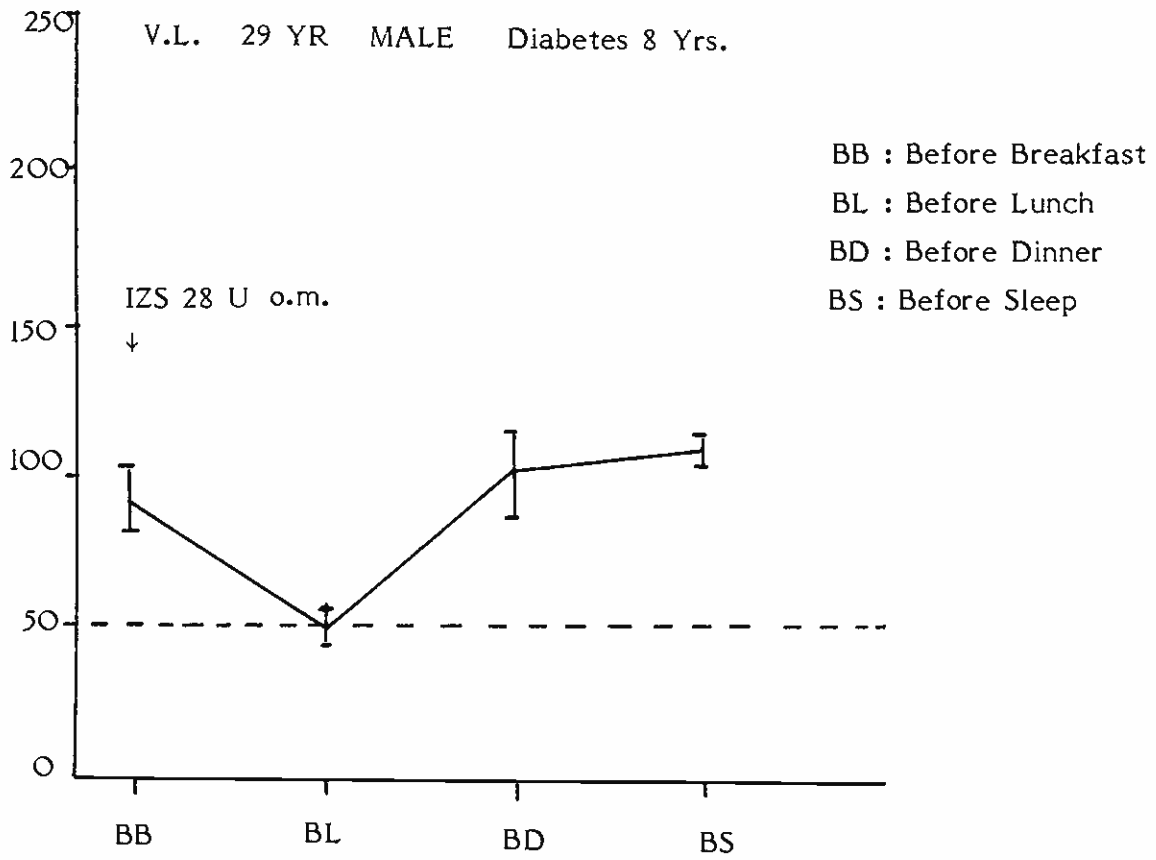


FIGURE 2. HYPOGLYCAEMIA - VALUE OF HOME GLUCOSE MONITORING

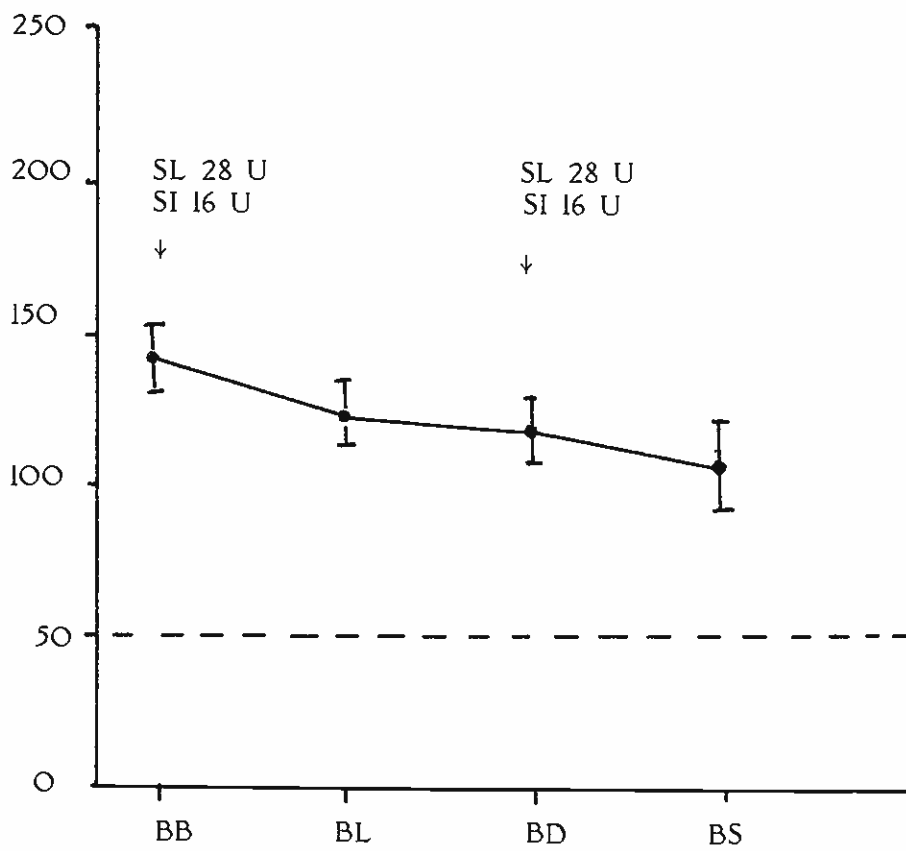
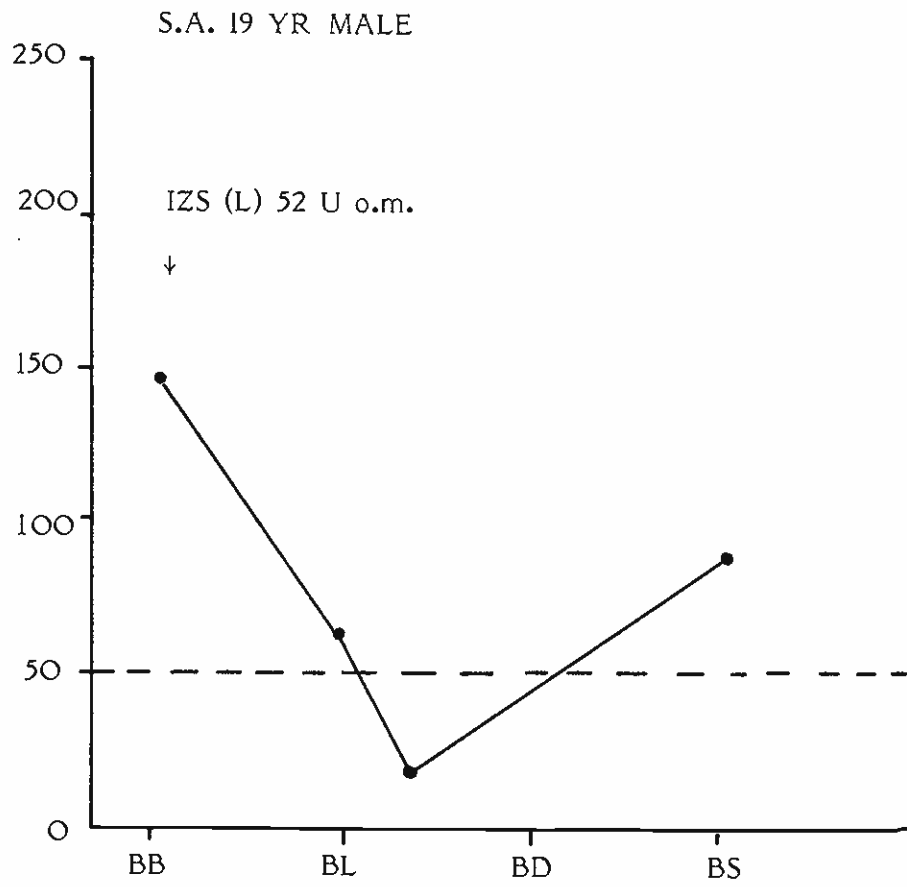


FIGURE 3. EFFECT OF INSULIN REGIME ON BLOOD GLUCOSE

management of hypoglycaemia. This is clearly illustrated by patient V.L. (Fig. 2) and patient S.A. (Fig. 3) who were unaware that their symptoms ('queer feelings' in V.L. and headaches in S.A.) were due to hypoglycaemia until they commenced on HGM. They were able to achieve optimal blood glucose control within two weeks of HGM.

We were impressed that blood glucose could be maintained at all times near or within physiological range without hypoglycaemia in half of our patients who were on HGM. This improvement of control was maintained for more than 6 months of HGM. Motivation of patients is clearly an important factor in both the level of diabetic control achievable and the acceptance of the time consuming task of HGM. Some of our patients have expressed to us that having blood glucose levels regularly available to them provides information that gives them an understanding of their disease that they previously did not have. One of them have even experimented with the effect of exercise on blood glucose on his own initiative. We were however unable to achieve control of blood glucose in 3 patients despite, changing the insulin regime.

Our results show clearly that better diabetic control is more likely to be achieved in insulin dependent diabetics with a combination of an intermediate acting insulin and soluble insulin given twice a day. At the onset of HGM 11 patients were on a single dose of IZS (lente) every morning. After monitoring, the majority were on a combination of IZS (semi-lente) and soluble insulin given twice a day given before breakfast and before dinner because this gave the best diabetic control. Further studies are in progress to determine the effect of various types of insulin and the timing of insulin administration has on blood glucose control.

In conclusion, we have found that home glucose monitoring is feasible and can be practicably accomplished in a manner that is acceptable to diabetics in

Singapore. It is particularly useful in the diagnosis and management of hypoglycaemia in diabetes and can provide insight into diabetic control that cannot be attained by any other way. Motivation and compliance with instructions are essential on the part of our patients. However the daily cost per patient is significant and every effort should be made to lower the cost because good blood glucose control is presently our best means towards minimising complications in diabetics.

#### ACKNOWLEDGEMENTS

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