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TECHNOLOGY IN DIABETES MANAGEMENT

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ABSTRACT

The onset of Type 2 (non-insulin dependent) diabetes and some instances of Latent Autoimmune Diabetes in Adults (LADA) is becoming quite common amongst the adults. It is estimated that there are around one million people in Australia who have diabetes (type 1 and type 2). According to Diabetes Australia, over 700,000 people are currently registered on the National Diabetes Services Scheme (NDSS) with 6,000 new registrants joining each month (NDSS News - Conquest, 2006). The increase in numbers of the diabetic people will certainly have an impact on the healthcare for the aged. In order to prevent or at least minimize the long term health complications associated with diabetes, a commitment to proper management of the condition from the time of diagnosis is absolutely vital.

This paper has investigated some of the latest technologies available in monitoring and managing diabetes. There is no doubt that the advancement of information technology does and will play a key role in providing a more effective management strategy.

Keywords: Diabetes, Blood Glucose Level, Technology

INTRODUCTION

Diabetes has been known to mankind for many years. Ancient civilizations such as the Romans, Greeks and Egyptians were aware of this condition several hundred years ago. This condition was mentioned for the first time in the Egyptian Ebers Papyrus around 1550 BC (Barclay, 2006). They knew that the urine of certain people tasted sweet (*mellitus* in Latin). As suggested by Rubin (2001), the term diabetes is a Greek word for siphon. That was due to the fact that people with sweet urine passed urine as soon as they drank.

It should be noted that medication, diet and exercise have been recognized as the three main pillars of achieving and maintaining reasonable Blood Glucose Levels (BGL). Inner piece as the fourth supporting column has been put forward by Standen (n.d.). It should be emphasized that monitoring BGL and Blood Pressure (BP) are also important as part of the total diabetes management.

The main purpose of this paper is to investigate how the latest technologies can be utilized in monitoring the progress as a management tool. The following sections will provide information and discuss some of the latest approaches.

MANAGING THE CONDITION

It is generally accepted that a stable BGL which is within a reasonable range can be achieved and maintained through:

1. Appropriate medication (if necessary).
2. Healthy diet.
3. Exercise.

Regular monitoring of the BGL, input (time, distance and heart rate) and output (calories burnt) in exercise should complement the above. The desired outcome will ultimately affect the glycated-haemoglobin (HbA1c) test. This test measures the average of BGL for the preceding three months. Hence, the test indicates to the healthcare professionals how well the patient has been managing his/her diabetes. For further information see American Association for Clinical Chemistry, (2001-2012)

Each of the above actions deserves discussion and research. The benefits of exercise have been cited in the majority of the literature on managing diabetes. For instance, Stanton (2012) suggests that "exercise is just like medication." In fact exercise, in any form, can help with improving the blood glucose levels and insulin function. It also contributes to a significant reduction of cholesterol, blood pressure and body fact. One does not have to engage in special types of exercise and rely on on elaborate equipment and conditions. A modest exercise like walking on a regular basis would certainly have positive effects. Hence, any exercise should be regarded as better than no exercise.

TECHNOLOGICAL AIDS FOR EXERCISE

Doing exercise can sometimes be quite daunting. Technology can assist with providing useful feedback as well as converting a work out session to fun and pleasure.

Mendosa (2003) provides the advantages of using the latest technologies in conjunction with traditional exercises such as walking or working out on a treadmill. He suggests that using gadgets such as pedometers and heart monitors will assist with providing useful feedback as well as making the exercise time more interesting. The author's experience is very much compatible this claim. A heart rate monitor is an ideal tool for monitoring both input (time, distance, and heart rate) and output (calories burnt) in physical activities. The latest heart monitors can be worn like a traditional watch and receive the information from a chest strap. The author has been using a heart rate monitor by Nike which looks and weighs like a sports watch. The transmitter is worn around chest on the rib cage just below the breast pale. The transmitter reads the electrical impulses of the heart and transmits data to the watch. The watch can be programmed to include the user's information such as gender, age and weight. This information is used in conjunction with the heart rate to calculate calories burnt. This kind of information is very useful in knowing the output of a period of exercise and physical activity. In addition to having accurate information of the time spent and distance traveled, the user can monitor their heart rate and adjust the effort accordingly. For instance to have cardiovascular benefits and achieve fitness without increasing the heart rate too much, a safe or desired zone can be programmed by the user. As Mendosa (2006) suggests 50-60% of the maximum heart rate should be a goal for a diabetic person. Working out the maximum is quite straightforward using a rule of thumb as follows:

Subtract your age from 220. For instance the maximum heart rate for a fifty year old person (using this rule of thumb) would be 170. It should be noted that medical professionals do not discourage this particular person to encounter higher heart rates during exercise. For instance, in the author's case going above 130 beats per minute during cycling was regarded as quite appropriate by his General Practitioner. A practical approach to using a heart rate monitor would be to utilize the zone setting feature which allows the user to pre-set several heart rate zones. Every time the user enters or leaves a zone an alarm is sounded to warn for possible adjustments. Table 1 illustrates an example used by the author.

Table 1: An Example of different heart rate zones

Beats per Minute	Suitable for
85 – 99	General Fitness
100 – 118	Weight Loss
119 – 135	Aerobic
> 135	Anaerobic

A portable satellite navigation system can also be an excellent means of monitoring the input. The advantages of such a device are firstly in knowing the exact distance traveled and speed. The device does also provide other useful information such as time and altitude. The author uses a Garmin Foretrex 201 to monitor speed, distance and time for walking and cycling. Knowing and trying to maintain a suitable walking speed would certainly contribute to the benefits of a walking session. For instance, 5-6 km per hour is a reasonable general fitness exercise for the author. Another device which is certainly worthy of mention is fitbit. As suggest by fitbit Inc (2012), it makes every step you take a step toward better fitness. This very compact device with its super sensitive 3D motion sensor can track the user's day down to details that ordinary pedometers cannot. It evens counts the floors climbed. If the user chooses the data can be collected wirelessly by fitbit's website and summary of the achievements are sent to the user in an email. There is also a fitbit iphone app which provides quick and on-the-go access to the statistics. Therefore these types of technologies can help with more informed ways of achieving exercise targets.

Technological Advances in Monitoring Blood Glucose Levels

Personal Glucose Monitors were a Technological Breakthrough in having Personal Control over Glucose Levels. There is no doubt that the advancement of the computer technology in the latter part of the previous century played a significant role in this field. The first personal monitors started to become available in the early 1980s. They have become smaller, faster with large data storage capacities for less amount of money. A personal BGL monitor provides a diabetic person with control over effectively managing the condition. For instance, it would be possible to make necessary adjustment in diet, exercise or medication based on the feedback. This ability to have accurate feedback on a regular basis has both short and long term positive effects in proper management of diabetes. The technology is progressing at a very rapid pace and changing and shaping the tools and equipment we use. It is interesting to note that there are already a few novel ideas which are gradually turning into practical and commercial products. For instance, needle free lancets using laser are becoming available. These devices will take the

finger pricking discomfort out of the BGL testing process. GlucoWatch is another revolution which does not require any finger pricking. The glucose monitor is worn like a wrist watch and tests the BGL by drawing small amounts fluids from the skin. Hence, testing and data collection can be carried out on a regular basis.

A very effective way of analyzing, displaying and graphing BGL data taken by the glucose monitors can be carried out by utilizing specially developed computer software. The data from the portable glucose monitor is uploaded to a computer and the software is used to receive, analyze and output the information. The software can also perform basic Statistical analysis such as calculation of minimum, maximum, mean and standard deviation. Desired lower and upper limits of glucose levels can be set by the user and then the system would display the output graphically (Figure 1). The system would also analyze and depict the data for different times of the day (Figure 2). Pie charts (Figure 3) showing different proportions of BGL are also very useful and effective ways of displaying the historical data for both personal and healthcare professional purposes.

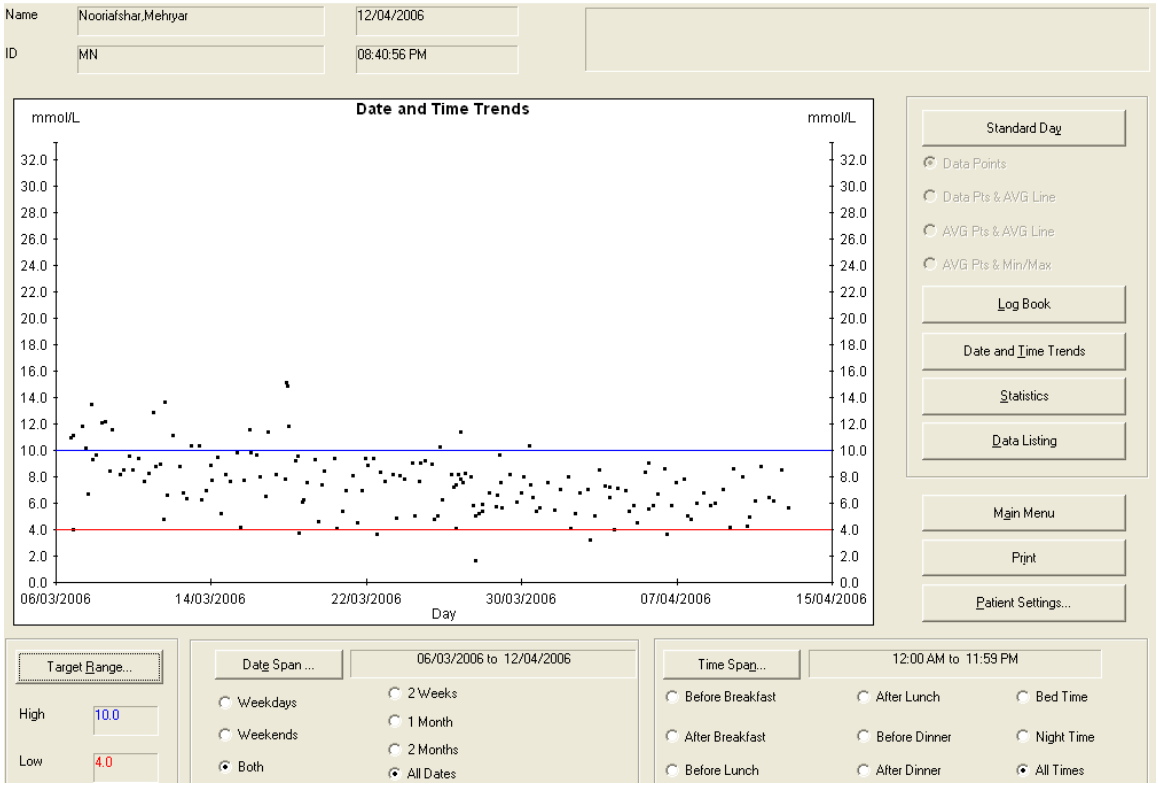

Figure 1: Graphical Representation of Historical BGL Data

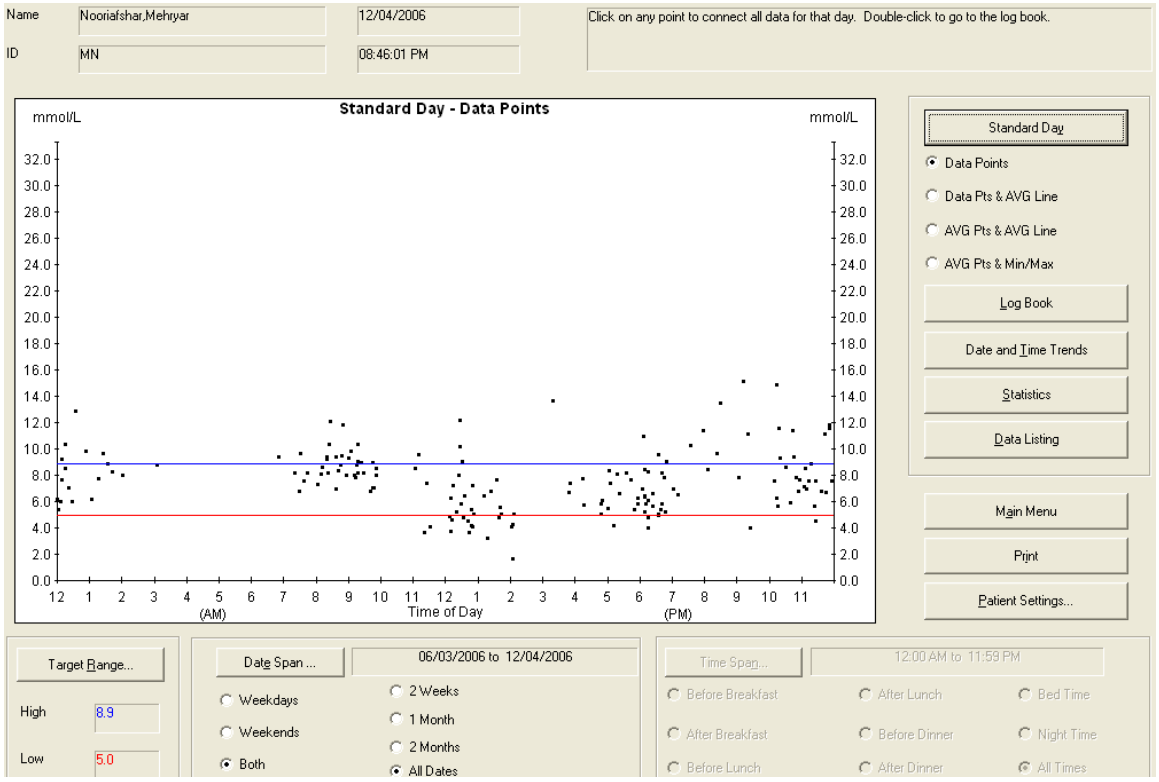

Figure 2 – Graphical Representation of Historical BGL Data for Different Times of a Standard Day

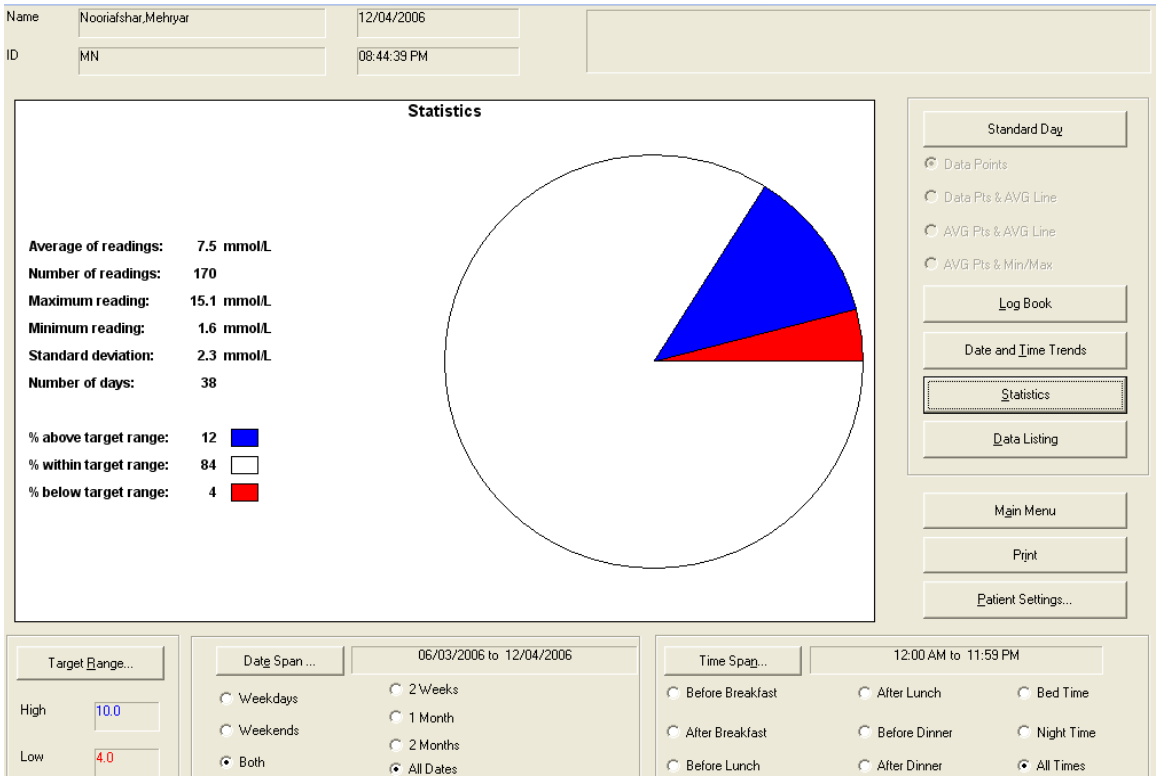

Figure 3: Pie Chart Depicting Different Proportions of BGL Levels for the Historical Data

CONCLUSIONS

The statistics from around the world suggests that diabetes in adults is on the rise. This increase is probably linked or caused by life style, diet or even stress in most, and in particular western, societies. Some of the latest technologies in monitoring and managing Blood Glucose Levels (BGL), and interactive devices used in exercise were identified and discussed in this paper. The use of the latest Blood Glucose monitors in conjunction with special software for data analysis and graphing is an example in monitoring the effectiveness of medication, diet and exercise. Other latest technologies for measuring the input (time, distance, heart rate) and output (calories burnt) of exercise were discussed. Watch-like heart rate monitors and satellite navigation devices are the examples. It is noteworthy to mention that the information technology and related fields are continuing to progress very rapidly. This progress will certainly provide more effective methods and products for diabetes management.

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