Mobile Computing Tools as a Medium to Educate and Empower people with Chronic Conditions

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Abstract : A wearable health care monitoring system is proposed. Constant health monitoring can improve the patient's quality of life for various health conditions such as diabetes and obesity, the focus being on prevention rather than treatment. To achieve this individuals and patients need to be empowered and educated with the use of proactive mobile computing tools and technologies such as mobile phones, PDAs, Bluetooth and WAP. Integrating these tools provides a transparent way of monitoring, analysing and modelling their metabolic performance and allows patients to become more responsible for the management of their health conditions.

I. OBJECTIVE

This project aims to empower and educate individuals, patients having chronic conditions(e.g. obesity, diabetes) by providing them with proactive mobile computing tools. These tools will allow them to maintain control of their condition by monitoring, analysing and modelling their metabolic performance and how their condition affects it. The motivation behind this work lies in the pandemic of chronic conditions in the developed world and similar increases in the developing world.

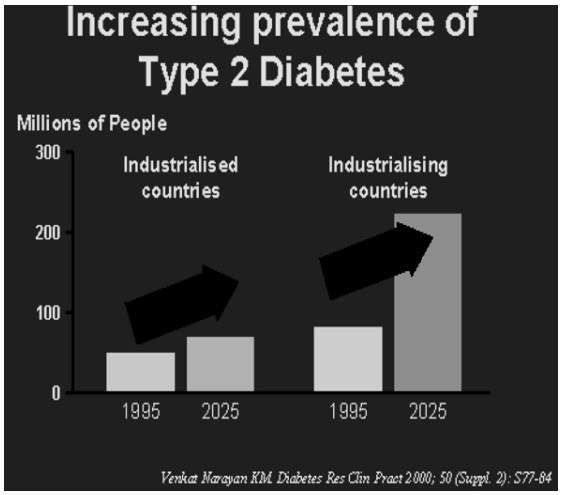

Fig 1: Increasing prevalence of Type 2 diabetes

Today, there are over 171 million people with diabetes [1] and over a billion people overweight, of which over 300 million are clinically obese [2]. With future estimates revealing an increasing prevalence of chronic conditions in both the developed and developing countries (Fig 1), healthcare providers are looking to alternative mechanisms for delivery of care, and by which the quality of care, quality of life and life expectancy can be improved for the patients. With long waiting lists to receive health services, patients need to become more responsible for the management of their conditions and require tools to empower and to educate them to achieve this.

II. BACKGROUND

This paper uses, as an example, the issues surrounding the care of people with diabetes.

There is, without doubt, a severe personal cost to the individual with diabetes. In addition to this heath care providers, such as the NHS, are under severe pressure from the growing burden of treating people with diabetes on a daily basis and dealing with the resulting complications. Also, the shortage in medical professionals such as doctors and nurses has further escalated the problem of faster health care delivery.

In 1997 treating diabetes and its complications cost an estimated 9% of the healthcare budget in the UK. By 2011 that figure is projected to rise to nearly 25% [3]. The NHS across the UK will spend £65.4 billion in 2002-03 [4]. Thus the estimated spend on diabetes and resulting complications is between £5.9 and 10.4 billion. The trend of escalating diabetes prevalence will lead to an immense financial burden on the health service unless preventative measures are taken to control the incidence of diabetes and its complications.

The Diabetes Control and Complications Study (DCCT) carried out with people with type 1 diabetes in the US and Canada proved to be a landmark in diabetes care [5]. The 1998 United Kingdom Prospective Diabetes Study profoundly changed the UK perspective on the management

T. Sobh (ed.), Innovations and Advanced Techniques in Computer and Information Sciences and Engineering, 339–343.

of diabetes [6]. Both studies proved that the level of blood glucose control predicts the onset and severity of diabetes-related complications in diabetes. This means that if a person with diabetes can keep blood glucose levels as close as possible to normal, they can live a normal life span with few, or even no, complications.

In the past good control was achieved through strict regimen and prohibitions. The present, and future, emphasis is on empowering the person with diabetes to manage their condition themselves. In recent years, new formulations of insulin have become available which have been designed to offer the advantages of simpler regimens and better glucose control. These are varied according to the diet and activities of the person with diabetes in an attempt to permit more normal patterns individualised to a persons own habits.

In practice the onus of maintaining good control can be overwhelming. At best, it is a constant balancing act of monitoring blood glucose, keeping control of diet and exercise and calculating how much insulin is required. At worst, people with diabetes can become so disheartened that they feel unable to cope.

The growing number of people in the UK with diabetes, the evidence from the DCCT [5] and UK PDS [6] that tight control of blood glucose levels improves life expectancy and reduces complications in diabetes and evidence that supported self-care improves outcomes has prompted the publication of a National Service Framework (NSF) for Diabetes for England and Wales [7] in conjunction with the Scottish Diabetes Framework [8]. These documents outline the infrastructure to support the drive to raise standards of diabetes care. A key target is for hospital-based clinics to implement an effective IT system, which will allow them to support all aspects of diabetes care.

NHS Scotland [9] provides the following definitions relating to such a system:

"Information Management & Technology (IM&T) is about the information which NHS Scotland needs to deliver effective healthcare, the technology needed to deliver that information to the right person at the right time, and the range of processes such as training and support services needed to make it happen."

"eHealth encompasses much more than the deployment of computer technology. It conveys the message of electronics in support of health and stimulates thought and discussion about the broad range of issues and opportunities that technology offers in the health care setting to both healthcare professionals and patients."

Mobile computing tools, as described in this paper, would be a key component in such IM&T and eHealth systems.

The challenge lies in developing innovative, validated, decision support tools to aid diabetes self-management [10]. Such decision support tools may help patients and their families optimise blood glucose control and reduce the long-term complications associated with poor control of diabetes.

A. Computer based, personalised, diabetes simulator

The mobile computing tools, as described in this paper utilise, and extend, previous work on a computer based, personalised, diabetes simulator in diary format developed as a predictive tool for patients. This simulator was devised with the aim of helping reduce the 'trial and error' involved in diabetes management by allowing patients to simulate and experiment with dietary or insulin adjustments using a software 'body-double' on a desktop or laptop PC.

This 'body double' concept, and underlying mathematical model, was evaluated and refined during 2000/2001 in a field trial involving 43 people with Type 1 Diabetes. The trial successfully proved that under normal conditions the models involved adapted to the individual's metabolism and predicted blood glucose level. [11]

In 2003/4 a further trial was undertaken, involving 19 children with diabetes. The children and their families used the body double software for a number of days. This allowed them to become familiar with the software and for the body double personalisation process to occur. The children then continued to use the software while wearing a MiniMed^{TM} Continuous Blood Glucose Monitor (CGMS). The blood glucose profiles predicted by body double software and measured by the CGMS were then compared. The modelled values of blood glucose were found to correlate well with the CGMS data. The concurrent CGMS recordings provide a large data set to modify and improve the model. Patient feedback has also led to improvements in the usability of the software [12].

The underlying mathematical model is described in a granted UK Patent [13].

B. Need for mobility

Although, the above mentioned simulator works well for people with access to a desktop or a laptop, it has a big constraint in terms of mobility. A person has to have access to a desktop or a laptop at most times to be able to achieve maximum success rates. There also lies the case of people with limited or no access to a computer.

Mobile devices such as mobile phones and PDA's provide a possibility of solving the issue of mobility. It is estimated that nine out of ten people within UK carry a mobile phone [14]. "Smartphones" (mobile phones with higher computational capabilities and resources), come with added facilities for