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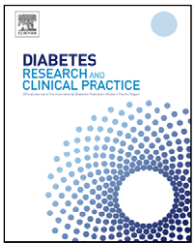

A short message service by cellular phone in type 2 diabetic patients for 12 months

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ABSTRACT

Objective: Investigate the effectiveness of an educational intervention that used both the cellular phone with a short messaging service (SMS) and the Internet on the glycemic control of the patients with type 2 diabetes mellitus.

Methods: Twenty-five patients were randomly assigned to an intervention group and twenty-six to a control group. The intervention was applied for 12 months. The goal of the intervention was to keep blood glucose concentrations close to the normal range ($HbA_1c < 7\%$). Patients in the intervention group were asked to access a website by using a cellular phone or to wiring the Internet and input their blood glucose levels weekly. Participants were sent the optimal recommendations by both cellular phone and the Internet weekly.

Results: Participants in the intervention group had lower HbA_1c over 12 months when compared with the control group. At 12 months the change from baseline in HbA_1c was −1.32 in the intervention group versus +0.81 in the control group. Two hours post-meal glucose (2HPMG) had a significantly greater decline in the intervention group after 12 months when compared with the control group (−100.0 versus +18.1 mg/dl).

Conclusion: This educational intervention using the Internet and a SMS by cellular phone rapidly improved and stably maintained the glycemic control of the patients with type 2 diabetes mellitus.

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1. Introduction

In Korea, the prevalence of diabetes mellitus is reached to 8–10% nowadays, and more than 95% of patients with diabetes belong to the type 2 diabetes mellitus group [1]. Many Korean people with diabetes do not effectively adhere to health care regimens including self-monitoring of blood glucose and therapeutic life-style changes, except for attending a physician several times per year [2].

Control of hyperglycaemia may prevent, reduce or retard the risks of diabetic chronic complications [3,4]. All the interventions for tight glycemic control have been shown to reduce the risk of retinopathy, neuropathy, and nephropathy [5]. On the basis of those findings, the American Diabetes Association (ADA) has recommended that all individuals with diabetes should attempt to achieve near-normalisation of blood glucose levels [6].

Algorithms to achieve near-normalisation of blood glucose levels exist but may be complex and difficult for physicians to follow, to induce the patient's load and stress, lack of public education systems and time constraints. In addition, economic and technical barriers to providing the appropriate

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guidelines for the physician and diabetic patients in the community health system are recognised [7,8]. Therefore, various alternatives have been studied such as systems for computerised decision support [9,10], monitoring of lifestyle and compliance to the medication [11] and provided telephone advices [12,13].

The Internet has established itself as a worldwide communication system that allows a person to contact other people – anywhere, at any time – and to exchange information online. In the website, patients with diabetes could find numerous online education, exercise and nutrition programs. Most of the Internet disease-management programs for diabetes evolved from focusing on emotional support, which provided more information to engage the patients and allowing self-management and counselling [14,15]. So, whenever patients with diabetes want to contact their healthcare providers, the patients can reach to them at the real time and acquire the information using the Internet. However, a few computer-based or electronic-management systems have been reported to improve diabetes care [16,17].

South Korea is one of the most developed countries in the fields of Internet networking. Nearly all families have their own computers and cellular phones and can access the Internet via modem or high-speed network systems. In our previous study, we introduced short-term effects of an Internet-based intervention for type 2 diabetes [18,19] and its glycemic control effects in patients with obese type 2 diabetes [20,21].

The present study evaluated whether an Internet-based intervention system and a short message service (SMS) using cellular phones could improve glycosylated haemoglobin (HbA_1c) levels, fasting plasma glucose (FPG) levels and 2 h post-meal glucose (2HPMG) levels in patients with type 2 diabetes for 12 months.

2. Methods

2.1. Study design

A control group, pre-test/post-test, design was used in this study. Participants were recruited from the endocrinology outpatient department of a tertiary care hospital that was located in an urban city of South Korea. The hospital is a university-affiliated medical centre that has 800 beds.

2.2. Participants

The data were collected from January 2003 to August 2006. Diabetes was diagnosed according to the ADA criteria [22]. The selection criteria required that participants should be able to perform blood glucose self-testing and access websites and have their own cellular phone. Patients were excluded if they had a clinical history of a severe illness, renal insufficiency with a creatinine level >1.5mg/dl or had been using insulin pumps.

For ethical considerations, the research protocol was approved by the Medical Research Ethics Committee of the university hospital. Written consent was obtained from those patients who agreed to participate in the study. Anonymity and confidentiality were guaranteed to participants.

We recruited participants who were able to access the Internet in their homes for this specialised web-based diabetes management system from our outpatient clinic of Kangnam St. Mary's hospital through the hospital bulletin board. Among 111 patients who expressed their intention to participate in our study, 11 patients were excluded due to several reasons. Three patients were excluded due to history of participation in other web-based management programs. Eight patients refused to participate in our study after learning that our program includes frequent access to our homepage. Of 100 patients who participated in this study, 60 completed the final clinical examination. Of the 30 patients randomly selected to belong to the intervention group, five patients were withdrawn from the study because they did not revisit the diabetes center. Four patients in the control group were excluded for not revisiting the diabetes center. Therefore, we report data from the 25 patients in the intervention group and 26 patients in the control group who remained to complete the study protocol. For repeated measures analysis of variance (for an effect size of 0.60, at a power of 0.80 and at an alpha level of 0.05), 25 subjects in each group were required in order to ensure an adequate trial for 1% reduction of HbA_1c levels at post-test compared with pre-test [23].

2.3. The SMS intervention

The goal of the intervention was to maintain blood glucose levels within a normal range ($HbA_1c < 7\%$). The recommendations were made according to the Staged Diabetes Management Guidelines in Korea. Before the intervention, each patient was instructed, for 30 min by a researcher, about inputting data into the website. Patients in the group contacted our website and logged in whenever it was convenient for them. Participants in our study could contact our website at any place where Internet access was possible by cellular phone or wired Internet. They then sent their self-monitored blood glucose levels and drug information, including the kinds and dosages of insulin and oral anti-diabetic medication that they used for diabetes control. These data were transported to our Internet server system, and automatically displayed on the individual electronic chart on our homepage. Patients were able to see the recommendations from their physicians and nurses, as well as the laboratory data, on our website.

The researchers could view the information on each patient, including the blood glucose levels, medication and details of some events that were provided by the patient. In addition to this information, researchers could also view basic personal history, family history, smoking habits, body mass index (BMI), blood pressure and baseline laboratory data. After integrating the above information, the researchers sent optimal recommendations back to each patient, weekly, by a SMS through cellular phone and wired Internet. For example, recommendations included: ''Please, decrease the long-acting insulin by two units''; ''Please add one tablet of sulfonylurea in the evening''; ''Please check the amount that you eat''; ''Lack of exercise may be the cause of the aggravated glucose level'' or ''Your glucose control seems to be good''. The researchers provided the intervention for 12 months. The researchers were endocrinologists and a professor at a nursing college. The 12

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