Chapter 9
Wireless and Mobile Technologies Improving Diabetes Self-Management

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ABSTRACT

The technological revolution that has created a vast health problem due to a drastic change in lifestyle also holds great potential for individuals to take better care of their own health. This is the focus of the presented overview of current applications, and prospects for future research and innovations. The presented overview and the main goals of the systems included are to utilize information and communication technologies (ICT) as aids in self-management of individual health challenges, for the disease Diabetes, both for Type 1 and Type 2 diabetes. People with diabetes are generally as mobile as the rest of the population, and should have access to mobile technologies for managing their disease. Forty-seven relevant studies and prototypes of mobile, diabetes-specific self-management tools meeting our inclusion criteria have been identified; 27 publicly available products and services, nine relevant patent applications, and 31 examples of other disease-related mobile self-management systems are included to provide a broader overview of the state of the art. Finally, the reviewed systems are compared, and future research directions are suggested.

INTRODUCTION

Type 1 diabetes, also called insulin-dependent diabetes, is typically diagnosed in people under 30 years of age. In this type, the pancreas has stopped producing insulin, so that the patient needs insulin injections. In Type 2 diabetes, which is typically diagnosed in people over 40 years of age, the body stops responding correctly to the insulin produced by the pancreas. This type constitutes

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more than 90% of diabetes cases, and treatment includes oral medication, dietary changes, increased physical activity, and sometimes insulin injections. Self-management of blood glucose can help to reduce long-term complications of diabetes. Important self-management strategies include healthy eating habits, physical activity, and appropriate medication. Long-term effects of diabetes include progressive development of retinopathy with potential blindness, nephropathy that may lead to renal failure and/or neuropathy with risk of foot ulcers, amputations, sexual dysfunction and substantially increased risk of cardiovascular diseases.

Most of the existing self-management tools for chronically ill patients are designed to provide help through interaction with health care workers. Even though this is usually the kind of help that patients want most and that is also the most effective, e.g. (Calfas et al., 2002), (Martinson et al., 2008) and (Shishko, Mokhort, & Garmaev, 2006), it is resource-intensive. A specific change of focus expressed by the European Commission (EC) a few years ago in the Information Society Technologies (IST) programme (European Commission, 2005) was to orient R&D towards one process to integrate and use all relevant biomedical information for improving health knowledge and processes related to prevention, diagnosis, treatment, and personalization of health care.

We first give an overview of mobile diabetes-specific self-management systems and tools, including publicly available systems, prototypes typically designed for research studies, and relevant patents and patent applications. Then, some systems for other chronic diseases are presented – but more briefly, in order to illustrate how technology is applied within the personalized health area in general. The objective of this chapter is to provide updated information about how mobile and wireless technologies are currently used in the context of eHealth, to describe the usability of the technologies in relation to people with a chronic disease such as diabetes, and to suggest sound future directions for coming technologies that support mobile self-management.

BACKGROUND

A search for patient-operated diabetes management software in general, including PC/Internet tools, shows that there are many systems available. No recently updated reviews were found, but a six-year-old study (Park & Daly, 2003) identified 47 Web-based or Windows-based programs for assisting people with diabetes in their self-help regimen, excluding educational and informational software. Few reviews of mobile diabetes systems were found. A search of the Cochrane Reviews database in June 2009 using the search words "diabetes" and "mobile" in all text fields yielded no relevant reviews, but some results with the status "Stage: Protocol". Besides the review by Tatara, Årsand, Nilsen, and Hartvigsen (2009), two more general reviews covering the use of SMS in healthcare by Krishna, Boren, and Balas (2009) and Fjeldsoe, Marshall, and Miller (2009) were found, identifying some additional diabetes-specific mobile systems.

Systems for and studies on self-management tools involving assistance by health care personnel are widespread, e.g. the DiasNet advisory system (Dinesen & Andersen, 2006), the system developed by Axon TeleHealthCare (PA Business, 2008), the telephone-linked care system (Glanz et al., 2002), the PARIS_Diabtel system (Rigla et al., 2006), the TeleObe programme (Schiel, Beltschikow, Radon, & Kramer, 2006), the Internet-based system BioDang (Kwon et al., 2004), and the Healthcare@Home monitoring framework (Subramanian et al., 2008). Our focus is however on patient-operated mobile self-management tools, an area that has exhibited relatively strong growth during the last three years, but is still rather immature. The main reason for the recent growth may be the evolution of mobile phones into small, programmable and function-