

Progress report 2015

Department of Ubiquitous Health Informatics

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Overview

Our mission is to develop systems that integrate patients' health-related information and lifestyle information, and to conduct clinical studies that evaluate the effectiveness of those systems. The systems use communication between measurement devices (e.g., of blood pressure and body weight) and ICT devices such as smartphones, allowing patients to check their health data and automatically share the results with healthcare providers. In order to maximize patient acceptance and use, we have been working on several different projects to examine how those new systems can best be suited to current clinical environments.

Research projects

- *DialBetics: A novel smartphone-based self-management support system for type 2 diabetes patients*

Patients with diabetes are expected to have access to the integral components of diabetes care. Self-management is the core of diabetes treatment because it ties the components of diabetes therapy together, enabling patients to assess and control the interplay of nutrition, physical activity, emotional/physical stress, and medications that are critical with diabetes. There had long been a

need for an effective self-management tool that could automate and standardize much of the counseling process, facilitating self-monitoring of blood glucose, blood pressure, body weight and lifestyle, and particularly diet and exercise. Accordingly, we developed just such a real-time, partially automated interactive system to interpret patients' data—biological information, exercise, and diet content calculated from a message sent by patients—and respond with appropriate actionable findings, helping the patients achieve diabetes self-management. In addition, the safety and clinical effectiveness of the system had to be examined. A one-month, non-blinded, non-randomized uncontrolled study was conducted; it demonstrated that DialBetics was a feasible and effective tool for type 2 diabetes patients who also received insulin therapy. We then evaluated the relation of patients' intake nourishment and urinary sodium to their potassium ratio. The possibility was suggested that the sodium to potassium ratio might serve as a new index of food fiber intake. We started development of an automatic function that can evaluate whether a patient's meal is "good" or "not good"—according to guideline nutritional needs/restrictions of such patients—based solely on image processing of the meal photo routinely

sent by the patients. Because we also recognized the advantage of a synthetic sound that would act as an advice feedback to call the patient's attention to that advice, we investigated use-intention of such a sound with around 30 diabetics. Given the positive result, we investigated implementation, and are going to incorporate this feature into the system. In addition, we supported the research project of a doctor's degree candidate—"Intention of using an ICT-based self-management tool among patients with diabetes: A cross sectional study"—from the department of Adult Health/Palliative Care Nursing. We plan to conduct a further study to apply the use of the system in clinical environments.

- *Gluc>Note: Self-management and recording application for the type 2 diabetes and diabetes spare group*

We started a clinical study of a smartphone application we call "Gluc>Note" for type 2 diabetes and impaired glucose tolerance using ResearchKit by Apple Inc. This application continuously collects data about blood sugar level, blood pressure, weight, active mass and lifestyle including diet, exercise and sleep. This is the first such clinical study in Japan, and we plan to study the effects of Gluc>Note for the next five years.

- *Heartily: Self-management and recording application for arrhythmia*

To investigate the association between arrhythmia and lifestyle, we developed the smartphone application "Heartily" for arrhythmic self-management again using Apple's ResearchKit by Apple Inc. It will be available to the public, and a clinical trial will be conducted.

- *Self-management and Recording System for Dialysis (SMART-D)*

The proper intake of water, potassium and

phosphorus impacts the survival of dialysis patients, and adherence to fluid-intake restrictions is one of the most difficult aspects of the hemodialysis regimen. So the "Self-management and Recording System for Dialysis" (SMART-D) was developed. It featured the essential indicators for dialysis patients, and its performance was verified. A two-week, non-blinded, non-randomized observational study was conducted. Although there was no change in clinical outcomes after two weeks of using SMART-D, most of the participants reported that using SMART-D helped to improve their lifestyle and self-management. Evaluation of SMART-D's effectiveness continues to be the subject of further study in the coming year.

- *Health support study using in Singapore*

For the purpose of preventing development of lifestyle-related diseases in Singapore, a clinical study was performed using a smartphone application to support better self-management of lifestyle. We were brought into this study by NTT Resonant, Inc., which was tasked with it by the Ministry of Internal Affairs and Communications. Our department was asked to supervise the study and analysis the results. A one-month clinical trial for physically unimpaired people suggested the usefulness of using the support application for health care. A clinical trial for diabetics continues.

- *Inspection of the correlation of blood sugar level and expiration acetone measurements*

Current practice makes it necessary to perform urinalysis with a blood test in order to diagnose the ketoacidosis of diabetes. We plan a clinical study to determine whether clinicians can instead use portable expiration acetone measuring equipment which could measure acetone levels for a diagnosis. The clinical trial will be with 100 diabetics.

Future directions

To fulfill our mission, we plan to generalize the findings made in the several clinical studies, and promote ongoing and growing telemedicine service with the use of ICT in the future.

■ Publications in English

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