

# Connecting Home and Clinician, Treatment of Diabetic Foot Ulcers at Home

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## ABSTRACT

This paper presents the project “Treatment of diabetic foot ulcers at home”, which takes into consideration both computer and health science and combines these in developing a better way of treatment for diabetics with foot ulcers. The project has so far collected data based on field studies and workshops with participation of an enthusiastic group of domain experts. Based on these data, the project now engages in a participatory design process to develop pervasive technologies to connect the patient and relatives with home care staff and experts at the hospital.

## Keywords

Pervasive Healthcare, diabetic foot ulcers, Participatory Design, Telemedicine, HCI.

## 1. INTRODUCTION

Home care is one of the areas of research conducted at Center for Pervasive Healthcare, University of Aarhus. One of the projects at this center revolves around two individual Ph.D. projects: One related to nursing science and one to computer science. Together these two different perspectives spans a synergic platform for a project, in which a multidisciplinary team of clinicians, district nurses, patients and researchers in pervasive computing take part in designing future ways of treating diabetic foot ulcers.

Diabetes is a rapidly increasing challenge in the Western World. One of the most common complications from diabetes is development of foot ulcers [1,2]. Today’s treatment of diabetic foot ulcers is often performed at random, by non-experts and without continuity. The result may be that many patients get their toes, feet or leg unnecessarily amputated [3,4].

This project investigates possibilities for having experts monitor the patients to a further extent than seen today and the question is if we can move experts “virtually” from the hospital to the patient’s home by use of technology?

If the ideas of the project prove successful, it will be possible for experts to follow and guide the treatment online, saving long hospitalization and many visits to the

out-patient clinic and eventually lowering the chance of ending in a situation where amputation is the ultimate solution. Thus, on the long term this new treatment could prove to have an economic advantage as well.[5,6]

The technology needed to enable these improvements requires a media space [7] to let the different parts cooperate. We are currently investigating different architectures for a future system. Obviously one important component in this system will be a shared database/journal that should be accessible for all parts of the care team. Oral and visual communication between the district nurses and the ulcer expert at the hospital would also seem a necessity, in particular does the expert need to examine images of the ulcer in order to produce with advice to the nurse. Research suggests that a sufficient quality in the image can be obtained by a good, “normal” digital camera. [8] Where standard technology is insufficient, e.g. due to usability issues with elderly users, we ask ourselves if pervasive computing will do better. We have already had many ideas, which we shall not elaborate on in this paper, however as an example, we could mention the “intelligent” bandage that help monitor the ulcer by measuring some of the key variable for evaluating the ulcer condition.

## 2. METHODS

The project involves both computer scientific and health scientific issues. This fact calls for a combination of methods from both “worlds”: Quantitative methods (questionnaires) as well as qualitative methods (interviews, field observations) are combined with participatory design (PD) methods from experimental computer science.

Using PD requires an active participation from chosen experts (doctor, nurses, patients, relatives and therapist) throughout the whole process. The group of domain experts (13 persons) have participated in 3 workshops and the engagement has been phenomenal. They find the idea of the project extremely relevant and they want to contribute to the creation of a system to aid diabetics with foot ulcers and their practitioners.

### 3. PRELIMINARY RESULTS

We present problems with today's courses of treatment connected to diabetics with foot ulcers and HCI challenges addressed in the project. These have all been discovered and discussed through field studies, a Future Workshop [9] and a Dilemma Game [10]. Next step is to develop and test alternative courses of treatment by pervasive technology where experts treat patients in their own homes from a distance (for example using videoconferences).

#### 3.1 Presentation of data: Today's situation

In this context we have chosen to focus on 1) the communication, 2) accessibility to expert-knowledge and 3) patients visits in the out patient clinic.

##### 3.1.1 *The communication.*

In today's courses of treatment for diabetics with foot ulcers the connection between the patient and relatives, district nurses and experts at the hospital is organized through the patient and the telephone system. The 3 parts each conduct their own type of journal (notebook, a piece of paper and a record specified to the ulcer.), which causes problems with keeping information updated and synchronized. For instance the notebook (placed in the home of the patient) contains important information the district nurse cannot use in a situation where she needs to confer with the hospital. The telephone communication has shown great insufficiency as lot of time is spent trying to connect to each other. During the workshops it came clear that the different parties possessed limited knowledge about each others work field and daily routines. When is it for example possible to reach each other by telephone?

There is a conspicuous need for a better communication and coordination media between the clinicians, the district nurses and the patient (and relatives), and all participants asked for a shared database to work with.

##### 3.1.2 *The accessibility.*

District nurses experience frustrations when they treat a diabetic foot ulcer because they often don't know how to treat the ulcer optimal and they don't know who to ask: "Therefore I just do as I use to, but inside of me, I know I might be wrong", was said by one of the district nurses who we followed during the field studies. The district nurses sometimes ask the patients general practitioner for advice, although their may not always be experts in diabetic foot ulcers either. The district nurses ask for both a better way to communicate with the doctors and nurses at the hospital, but they also point out that a database to seek information about diabetic foot ulcers and admission procedures, would be a help in their daily life. Experts at the hospital experience that they send patients home for further treatment but they are not certain how their written instructions are received by the district nurses, and the

district nurses experience that they do not always receive sufficient information from the hospital.

##### 3.1.3 *Patients visits to the out patient clinic.*

One of the participants (a patient) told us that when he was working it was difficult for him to go to the out patient clinic because there was a lot of waste time and therefore it could easily take almost a day to get a 10 minutes consultation. All the patients we have meet focus on this problem. Many patients need help with the transportation and they often also wait for this before going both directions. The patients also experience that they also have to wait for the district nurses – "sometimes spending a day." Experts at the hospital point out that the patients are not seen as often as necessary at the hospital because of lack of resources. They also find today's visits of low value for the patients compared to the time the patient spend.

### 3.2 HCI challenges

In designing a future system we have come across many HCI issues that need to be addressed. We are expecting many more, when we engage in the actual interface design

#### 3.2.1 *Internet/technology access*

The typical patient is an elderly person and does not have a computer at home. If the home of the patient is to be equipped with technology, we need to investigate how this can be done unobtrusive - e.g. an OSGi-gateway placed out of sight under the bed or alternatively the district nurse could bring the technology during her visits. However the district nurses already carry up to 3 different bags on their route and some of them are going by bicycle.

#### 3.2.2 *Handling a camera*

A second issue is the use of camera during the consultation. The district nurse would need both hands for examining the ulcer. During our planned participatory design workshops, we hope to come up with a solution to do this while still being able to handle the camera that makes the expert follow the treatment.

#### 3.2.3 *Integrate system with existing technologies*

Combining our system with well known existing technologies (such as the patient's TV-set) might ensure a higher degree of patient compliance.

## 4. DISCUSSION

The aim of this project is to connect the different parties by the use of technology. During this project we have experienced that the combination of methods from computer and health sciences make a synergetic contribution to both the computer science and the health science issues. Traditionally, computer science emphasizes the concepts and theories, and many projects stops with the proof of concept. On the other hand, the health sciences are applied sciences and seek to bring the results to actual use.

Our project, containing both sides, has shown that it is possible to combine the efforts and letting the two worlds contribute mutually.

In the following discussion our opinions go together with those expressed by the domain experts in the project group.

What will be pro's and con's for treating patients at home? The envisioned way of treating patients at home has many obvious advantages – having experts online during the treatment, will make it possible to act on early signs of problems, lowering the risk of severe complications.

Is there a back side of the medal? Both the experts at the hospital and the district nurses will have to allocate more time for the videoconferences, and the district nurses must acquire new skills (handling technology). Technology needs to be purchased. On the short term it is quite possible that the cost of the treatment will increase. However, if the results are fewer hospitalizations and amputations, both of which are great expenses for the society today, the investment would pay off.

A perhaps more important issue is that the health personnel need to learn to “let go” of “their” patients and have trust in the other members of the health team.

In general we see technology as one of the means for preparing the health care sector for the needs of a steady increase of ageing populations in the western world. How will so few experts be able to control so many patients? Will the patients feel less taken care of? We believe that during the video consultations and by getting advice from the experts, the district nurse (and patient) will be trained and will eventually become an “expert” on her own, and thereby the patient will experience the same level of personal contact.

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