

APPLICATION OF TELEMEDICINE TECHNOLOGIES FOR THE DIABETES CARE OF PATIENTS IN GREEK RURAL AREAS

Efthimios Tambouris[†] and Dr.-Ing. Constantin Makropoulos[‡]

Division of Applied Technologies,
National Center for Scientific Research “Demokritos”,
Agia Paraskevi, 153-10 Athens, Greece.

Abstract

This paper presents an integrated health information system to provide health information to the public and to enhance the medical services provided to diabetes patients in a rural region. This information system consists of a Web site and an application for diabetes patients. The application, connecting one hospital with a remote health center via a leased-line network, enables the electronic exchange of medical information and the collaboration between doctors. The network will be integrated in a national diabetes network interconnecting the National Diabetes Center with 12 diabetes centers and 61 outpatients clinics nationwide. Furthermore, the network will be soon upgraded to support ISDN interactive communication for tele-training, tele-diagnosis and tele-consulting. Finally, sophisticated software will be installed to integrate applications both at a hospital-level and at a nation-level. The use of this software will allow doctors to view patients' medical records of various formats (text, image etc.) that are in different geographic locations. The work presented in this paper is part of the Co-operative Health Information Network (CHIN) project of the EU Telematic Applications Programme.

[†] Research Assistant of DAT, tambouris@nh.gr

[‡] Director of DAT, cmakr@nh.gr

1. Introduction

During the last few years, a large number of telemedicine applications have been developed for clinical diabetes care (1-2). In terms of technical background, these applications are often based on well-established and constantly emerging standards like the World-Wide Web (3) and Transmission Control Protocol (4). In terms of interface design and functionality, effort has been made to develop applications that are easy to use. As a result, recent evaluations have shown a large degree of acceptability of telemedicine from both health care providers and patients living in rural areas (5-6).

In this paper we present our experiences with developing an integrated information system to improve health care services in Greece, mainly for diabetes patients. The system provides two categories of services:

- Public access information services (public services)
- Professional access telemedicine services (professional services)

Public services mainly provide (i) information on the healthcare service providers in Greece and (ii) educational material focusing on diabetes. The users include the general public but also doctors, researchers and people with diabetes.

Professional services allow the exchange of medical information between a Hospital in Athens, a Health Care Center and the National Diabetes Center. The users here include the doctors and, at a later phase, those patients that will participate in tele-training courses on diabetes.

In terms of the platform utilised, the application for the public is Web-based to ensure maximum availability and spread of its contents. On the other hand, the application for professionals is not Web-based mainly for two reasons. The first is a concern for security: although significant security mechanisms have been developed (7), these do not yet provide the level of security necessary for transferring medical data (8). The second concern is network reliability and bandwidth: the Internet does not yet provide the level of reliability required for telemedicine.

2. Materials and Methods

Public services are available through a Web server to anyone having an Internet access (<http://www.nh.gr/CHIN/chin.html>). The server provides educational material on diabetes such as treatment, support, actions to be taken in case of an emergency etc. It further provides information on the health care system in Greece with an emphasis on health care service providers (HSP) including hospitals, health centers, health authorities, health promotion and educational organisations, public health bodies and professional societies. Finally, the server provides information on the project itself and telemedicine in Greece.

Except for public services, a number of professional services have been also implemented, or are under development. These services aim to improve the quality of health care services provided to a number of diabetes patients that live in the area of Lavrion. Lavrion is a remote (54 km from Athens) and low-income small town with a significant number of diabetes patients due to environmental pollution from heavy factory and minefield raw material extractions. These patients are treated in the Lavrion Health Center (LHC) that administratively belongs to the General Hospital of Athens (GHA). For their day-to-day treatment, Lavrion patients are often required to take a number of medical exams that cannot be performed locally. They then have to travel to GHA and their medical results are transferred back to LHC by post.

The overall system architecture is depicted in figure 1 and the main stages of our project are shown in table 1.

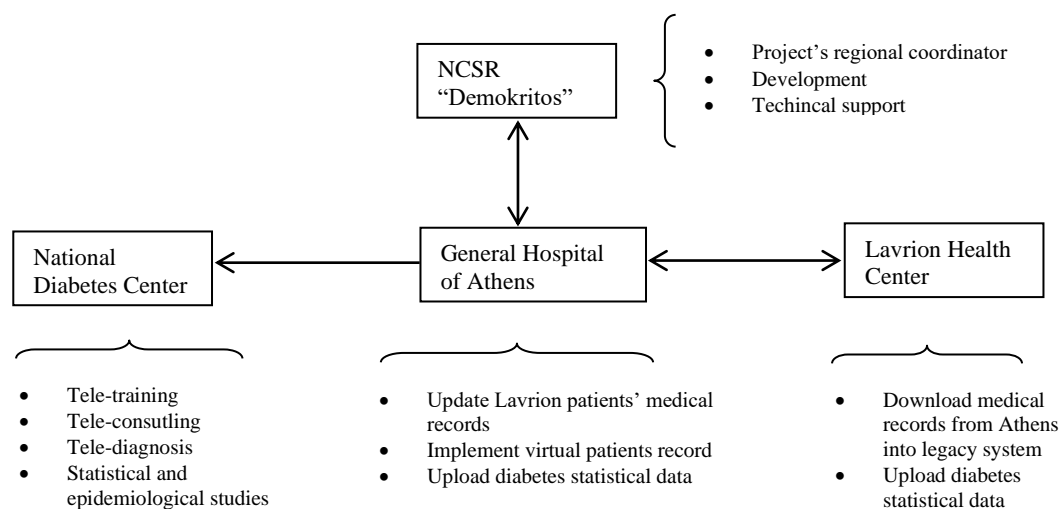


Figure 1. System architecture

Stage	Participants	Connection	Application
1	GHA-LHC	Leased-line	Medical data exchange, doctors' collaboration
2	GHA-LHC-NDC	Leased-line	Local export of statistical data from legacy systems; upload of data
3	GHA-LHC-NDC	ISDN	Tele-training, tele-consulting, tele-education
4	GHA's laboratories	LAN	Virtual patient's record

Table 1. Stages of the project (GHA: General Hospital of Athens; LHC: Lavrion Health Center; NDC: National Diabetes Center)

In the rest of this section, we will present an overview of the project's stages.

In the first stage, we developed an application that runs on a network interconnecting, via a leased-line, legacy software for diabetes patients at LHC with the computing facilities of the laboratories of GHA. This application consists of two modules, one running at GHA and the other at LHC. The module running at GHA, allows doctors to create and update medical records of Lavrion patients. These records are stored in the computing facilities of GHA and contain the results of medical exams that can be only performed at GHA. The module running at LHC, allows doctors to upload these results and insert them into their legacy software. The application further allows doctors from GHA and LHC to collaborate whenever required.

In the second stage, the GHA-LHC network will be integrated in a national diabetes network that will interconnect the National Diabetes Center with 12 diabetes centers and 61 outpatients clinics in Greece (under a national project). For this purpose, we are currently developing interfaces in order to automatically extract medical data from legacy software at LHC and save it in a format that is compatible to the one adopted by NDC. We note that the format is also compatible to the one adopted by European DiabCare Q-Net project (<http://www.diabcare.de>). We further develop the necessary modules to upload data from LHC to GHA and from there to NDC for further processing (e.g. statistical and epidemiological studies etc.) We are currently working on the second stage and have planned to complete all stages until the end of the year.

In the third stage, the network connection will be upgraded to ISDN, hence allowing tele-conferencing, real time tele-consulting and tele-training both for the

doctors and for the diabetes patients of the region. Tele-training will be carried out by experts of the National Diabetes Center according to a pre-defined time schedule.

In the final stage, sophisticated software (WebMed from GMD) will be installed to integrate applications used by different laboratories and Radiology departments within a hospital and even different hospitals. This will allow practitioners from any networked machine to view medical information of patients that reside in different places under the necessary security aspects. This information may be in different formats, e.g. text, images etc.

3. Results and Conclusions

In this paper we have presented an integrated health information system to improve the quality of health care services provided to diabetes patients and the general public in Greece. For public access, we have constructed a Web site with educational material on diabetes and information on health care in Greece including health care service providers. For the administration of the site we have attempted to follow a distributed approach where each health care service provider is responsible to maintain its web pages.

We further developed an application to interconnect legacy software of the health center of a rural area and a hospital in Athens, thus allowing the electronic flow of medical information. The economic and time-saving benefits are evident. We are currently developing another application for the automatic extraction and transfer of statistical data on diabetes from this health care center to the hospital and from there to the National Diabetes Center. These data will be stored in a national diabetes database thus allowing statistical and epidemiological studies. We further plan to upgrade our connections to ISDN thus allowing tele-training for doctors, tele-diagnosis and tele-consulting for diabetes patients and for the population of rural areas. Finally, we plan to install software for the integration of a hospital's laboratories and Radiology departments.

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