

The Virtual Hospital as a Digital Tool for e-Health

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Abstract— The development of virtual hospitals enables the interoperability of the various medical services offered by different institutions. Due to the experience in the exploitation of previous European telemedicine projects an open Euro-Mediterranean consortium proposes the Virtual Euro-Mediterranean Hospital (VEMH) initiative. The provision of the same advanced technologies to the European and Mediterranean Countries should contribute to their better dialogue for integration. VEMH will provide a platform consisting of a satellite and terrestrial link for the application of medical e-learning, real-time telemedicine and e-health. The methodologies for the VEMH are medical-needs-driven instead of technology-driven. They supply new management tools for virtual medical communities and allow management of clinical outcomes for implementation of evidence-based medicine. As data and computing resources in a virtual hospital are distributed over many sites the concept of the Grid should be integrated with other communication networks and platforms. A promising approach is the creation of an invisible grid, hiding complexity for both application developers and end-users and development of a Grid tools suite. VEMH will provide access to the required quality of medical services depending on the individual needs of each of the partners.

Keywords— Virtual hospital, satellite-based network, real-time telemedicine, health grid

I. INTRODUCTION

Telemedicine aims at equal access to medical expertise irrespective of the geographical location of the person in need. New developments in Information and Communication Technologies (ICT) have enabled the transmission of medical images in sufficiently high quality that allows for a reliable diagnosis to be determined by the expert at the receiving site [1-4]. At the same time, however, these innovative developments in ICT over the last decade bear the risk of creating and amplifying a digital divide in the world, creating a disparity between the northern and the southern Euro-Mediterranean area.

The digital divide in the field of health care has a direct impact in the daily life of the citizens and on their quality of life. In recent years, different institutions have launched several Euro-Mediterranean telemedicine projects. All these projects have demonstrated how the digital divide is only a part of a more complex problem, the need for integration.

Therefore, provision of the same advanced technologies to the European, to the Mediterranean and to the Adhering Countries should be the final goal for contributing to their better dialogue for integration.

In the framework of the EMISPHER project (Euro-Mediterranean Internet-Satellite Platform for Health, medical Education and Research, EUMEDIS Pilot Project 110, see www.emispher.org/, 9/2002-12/2004, co-funded by the EC under the EUMEDIS Programme) a dedicated internet-satellite platform for Telemedicine in the Euro-Mediterranean area was deployed and put in operation [5]. The network currently consists of 10 sites in Morocco, Algeria, Tunisia, Egypt, Turkey, Italy, Greece, Cyprus, France and Germany, (see Fig. 1) and hosts key applications in the field of medical eLearning, real-time Telemedicine and eHealth. The EMISPHER network serves as a basis for the development and deployment of a Virtual Hospital for the Euro-Mediterranean region: the Virtual Euro-Mediterranean Hospital (VEMH)



Fig. 1: Centers of Excellence in the EMISPHER Network

II. MATERIALS AND METHODS

VEMH aims to facilitate and accelerate the interconnection and interoperability of the various services being developed by different organisations at different sites through real integration. This integration must take into account the social, human and cultural dimensions and strive towards common approaches but open and respectful of cultural differences: multi-lateral cooperation instead of aid.

VEMH is not only to justify and demonstrate telemedical demands in the Mediterranean area but also to integrate the medical expertise in this region and to assist the transfer of “know how” from the north to the south and from the west to the east.

VEMH is dedicated to bridging a digital divide by establishing high quality equal access to real-time and on-line services for healthcare for all of the countries of the Euro-Mediterranean area.

Tele-consultation between experts and referring doctors contributes to improved patient care through recommendations for new treatment and timely access to specialist knowledge.

VEMH will provide a heterogeneous integrated platform consisting of a satellite link, such as in the EMISPHER project, and a terrestrial link, like in the EUMEDCONNECT project, for the application of various medical services.

For the communication within the network WinVicos (Wavelet-based interactive Video communication system) and WoTeSa (Workstation for Telemedical applications via Satellite) have been developed. WinVicos is a high-end interactive video communication system with real-time video, still image and audio transmission. The system has been optimized with regard to interactive telemedical applications (teleconsultation, second opinion, telementoring, teleteaching, etc.). For video compression WinVicos uses a hybrid, speed-optimized wavelet-codec (PACC, Deutsche Telekom patent DE 197 34 542 A1).

WoTeSa is the hardware on which WinVicos is operated. The hardware requirements are met by an IBM-compatible PC with Pentium IV processors (>3 GHz), 512 MB RAM, two Osprey video capture cards and two cameras as live video source and document camera. The S-Video and Composite-Video inputs of the Osprey cards can directly be connected with the various medical equipments. Details of WoTeSa/WinVicos have been described in [6].

III. RESULTS

VEMH services and activities are related to the areas eLearning, real-time Telemedicine, Medical Assistance and Fellowship Programmes.

eLearning: In the project a Virtual Medical University will be developed. The leading medical centres integrated in the network provide pedagogical material and modules for synchronous and asynchronous eLearning in their medical specialties (see Fig. 2). The exchange between the partners of various countries and availability of standardised educational modules allows for improved qualification of undergraduate and graduate students, hospital staff, general practitioners, healthcare officers and other professionals in the medical field.

Real-time Telemedicine: VEMH will offer applications in second opinion, tele-teaching & tele-training (demonstration and spread of new techniques), tele-mentoring (enhancement of staff qualification), undergraduate teaching courses, optimisation of the learning curve. These real-time interactive telemedical applications contribute to improved quality of patient care and to accelerated qualification of medical doctors in their respective specialty (see Fig. 3). Thus, this international network of distributed but integrated competence contributes directly and indirectly to improved healthcare.



Fig. 2: eLearning session with transmission of live ultrasound videos from Charité (Berlin) to Ain Shams University (Cairo), Agence Nationale de Documentation de la Sante (Algiers), Faculte de Medicine et de Pharmacie (Casablanca) and University of Cyprus (Nicosia)



Fig. 3: Interactive multipoint tele-consultation during laparoscopy (Charité (Berlin), Ain Shams University (Cairo), University of Cyprus (Nicosia)) in the EMISPHER project

Medical assistance: As tourism constitutes a substantial economical factor in the Mediterranean region and because of the increasing mobility of the population, continuity of care through improved medical assistance is of major importance for improved healthcare in the Euro-Mediterranean region. The introduction of standardised procedures allows for shared management of files related to medical assistance (medical images, diagnosis, workflow, financial management, etc.) and thus for improved care for travellers and expatriates in the Euro-Mediterranean region.

Fellowship programme: VEMH will offer individual grants to 20 young medical doctors coming from the Mediterranean and from accession countries. Each fellow will be trained, for a minimum period of 18 months, in one of the fields of the Virtual Medical University through the tele-teaching and tele-training VEMH services. This training programme will include an internship period in some of the clinical and scientific institutions of the VEMH consortium. The VEMH faculty will constantly monitor the progresses of the fellows and will evaluate them at the end of the training period.

Due to the geographically dispersed character of the Virtual Euro-Mediterranean Hospital, data and computing resources are distributed over many sites. Therefore Grid-based infrastructures, architectures and services become a useful tool for the successful deployment of medical applications [7-8].

Services like acquisition and processing of medical images, data storage, archiving and retrieval, as well as data mining being applied especially for evidence-based medicine are common requirements within the medical applica-

tion domain. In addition, simulations and modelling for therapy planning and computer-assisted interventions, and large multi-center epidemiological studies are typical clinical services that will profit strongly from the development and implementation of suitable Health Grid environments.

The main challenge in the domain of grid-based tools and applications is given by hiding the complexity of the underlying Grid infrastructure from the application developer by integrating higher level tools and services for grid application development (see Fig. 4). A Grid Tools Suite (GTS) needs to be developed that will facilitate and enhance the development of Grid-aware applications. The architecture of the GTS needs to be service-oriented and based on the needs of both application developers and end-users.

IV. DISCUSSION

The methodologies for the VEMH are medical-needs-driven instead of technology-driven. They provide new management tools for virtual medical communities and allow management of clinical outcomes for improved implementation of evidence-based medicine. By the integration of different telemedical solutions in one platform many different medical services shall be supported.

Security of data will be assured by the fact that the communication system adopts a coding algorithm owned by members of the Consortium. The transmitted data can only be decoded by this software. As one of the members of the Consortium owns the software licences, this provides an initial level of data security through the license distribution and management.

The justification of the various VEMH services and applications will be assessed by using a comprehensive evaluation methodology. This will in particular examine

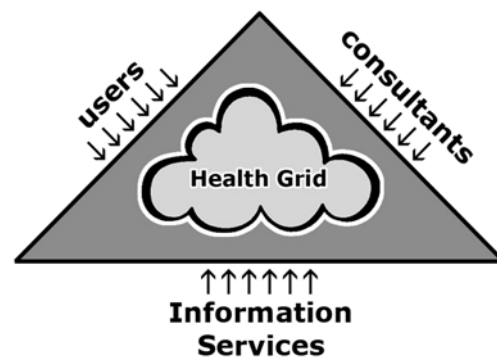


Fig. 4: The “Invisible” Grid for Health Services: Hide the Grid complexity from the application-developers and end-users

various outcomes including clinical, organisational, and economic as well as other relevant outcomes.

The main topic in VEMH will be the work and education of young specialists. The developed platform by the key partners integrated in the project will be open as service platform to everybody. The effectiveness will be measured not on the base of technological aspects but on the visibility and the success of the medical eLearning, tele-teaching, tele-training, tele-mentoring, tele-consultation, etc.

V. CONCLUSIONS

VEMH will foster cross-Mediterranean cooperation between the leading medical centres of the participating countries by establishing a permanent medical and scientific link. Through the deployment and operation of an integrated satellite and terrestrial interactive communication platform, VEMH will provide for medical professionals in the whole Euro-Mediterranean area access to the required quality of medical service depending on the individual needs of each of the partners. For the successful deployment of the various medical services in the VEMH the development and implementation of Health Grid technology appears crucial. The applications in the area of eLearning, Real-Time Telemedicine and improved Medical Assistance contribute to an improved health care in the Euro-Mediterranean area and build the basis for the introduction of evidence-based medicine.

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