

## TIMTEM Project: Our Experience in a Remote Area

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### ABSTRACT

We report our experience, begun in 1998 on a small island in the Dodecanese area of Greece, which has been called TIMTEM. The aim of this project was to improve care for people living on islands, creating a model exportable to other rural areas. The operative setting of the TIMTEM project is the island of Tilos (Greece); local authorities take part in it under the guidance of the only physician available on the island. The University of Pisa–Italy (Department of Surgery, Post-graduate School of Emergency Surgery) manages the scientific and organizational part of the project. Tilos is a rocky Mediterranean island with a surface of 64 km<sup>2</sup> and a population of about 500 inhabitants (with a peak of 2,000 tourists in July and August). A physician and a nurse are responsible for the only medical care on the island, and they also dispense drugs. The project was implemented on three phases. During the first phase, a campaign was held to encourage the population to cooperate with clinical data collection; a temporary telemedicine station was established, and a complete screening of the population was performed. The second phase was focused on the application of telesonography. During the third phase, a telematic and/or direct participation for reference hospital physicians (Regional Medical Society–Dodecanese) and for Greek physicians was planned. As well, a fully equipped central telemedicine station in the reference hospital was established under the local jurisdiction. The results of the third phase are still incomplete; the data presented here are preliminary. But all indicators show that the project is exportable to remote areas elsewhere.

### INTRODUCTION

EUROPEAN ISLANDS can be generally considered rural areas. Improving the health of islanders is an important target, which can be achieved by telemedicine. Unfortunately, several barriers still face this practical application.

We report here the initial results from our experience that started in 1998 on a small island in the Dodecanese area of Greece. The aim of the project, which has been called TIMTEM, was to improve the care for people living on is-

lands, which would serve as a model exportable to other rural areas. It was developed as a low-cost solution to health care problems on a small island via telemedicine. The plan was to develop concrete steps, consistent with the motto, “first of all actions, then words.” The project was implemented in three phases; the last one is still in progress. We report here the main features and conclusions of each phase.

In agreement with what was reported at “State of the Art”/Telehealth Symposium, in Michigan, 2001,<sup>2</sup> we believe that the screening

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of the population is necessary for detection of high-risk pathologies, as already shown by our experience. The setting of the TIMTEM<sup>1</sup> project is the island of Tilos (Greece), which has only one physician available on the island to serve the inhabitants and visitors. The project is managed by the University of Pisa–Italy (Department of Surgery, Post-graduate School of Emergency Surgery).

## MATERIALS AND METHODS

### *Project site*

Tilos is a rocky Mediterranean island with a surface of 64 km<sup>2</sup>. It has two main villages, Megalochorio and Livadia (Harbour). From Livadia Harbour, ferry boats regularly sail to Rhodes (hospital center; covering the distance in 4 h), Nissiros, Kos (hospital center), and Athens (high-quality medical specialities). In summer, the island also offers connections via hydrofoils. Tilos has its own heliport, which is open night and day. Mean flight times are 20 min to Rhodes, 20 min to Kos, and 90 min to Athens. The island has now about 500 inhabitants; at the beginning of the project, there were about 300. In the summertime, there are about 1,000 inhabitants (with a peak of 2,000 tourists in July and August). A physician and a nurse are responsible for the only medical aid on the island. They also dispense drugs. Currently, the great majority of emergencies are treated either in Rhodes Hospital or in Athens.

### *First phase*

In the period between October and December 1997 and during the first months of 1998, a campaign was held in Tilos to encourage the population to cooperate with clinical data collection. Local authorities explained to the inhabitants the potential advantages of their co-operation. In April and May 1998, four physicians from the Department of Surgery of Pisa University visited Tilos for implementing phase 1 of the project. A total of 268 (96%) out of the 280 inhabitants were enrolled in the study. These included 129 men and 139 women, with an age range of 3–88 years.

The screening of the population included the following:

- Registry data collection
- Clinical history
- Physical examination
- Blood pressure evaluation
- ECG
- Neck, breast, and abdomen sonography
- Doppler and color doppler sonography, if necessary

ECG was performed with the Cardiovox Device (Cardiovox P12; Aerotel Ltd., Israel.), which was supported by Centro Diagnostico Italiano (Milan, Italy), where a cardiologist provided an immediate report by phone, faxing the printed ECG. Sonography was performed using one fixed and one portable sonographic device; the fixed device was an echo color Doppler (AU3 partner; Esaote Biomedica, Genoa, Italy) with the availability of three probes (3.5 MHz convex; 7.5–10 MHz linear; 7.5 MHz transrectal); the portable one (SSD 500 Aloka) was equipped with a 3.5-MHz convex and a 7.5-MHz linear probe. In case of doubtful interpretation of images, previously stored with the software of the ultrasound devices, they were e-mailed as attachments, using shareware software, to a senior ultrasound operator in Pisa. All basic data and most relevant images were stored in a computerized database to be employed in case of emergency. Medical and paramedical personnel received basic computer training. Physicians also received basic training on the use of ultrasound devices. Teleconsult, when needed, was performed with the remote center (University of Pisa) using phone, fax, videoconference, Internet, and e-mail for image transmission. The remote center was able to provide consults for all specialties (e.g., medicine, surgery, radiology, cardiology, and dermatology).<sup>3</sup> Dermatological and radiological images were placed online using a digital camera. In five cases, teleconsult with submission of either sonographic or dermatological images was performed. Mean time to e-mail images was 3 min. According to the remote consultant, e-mailed images were good enough to allow a diagnosis. The mean time for ECG transmission and for the specialist response was 2 min. The main limit of this phase, apart from the limited technology, was the poor level of technological equipment on the island,

which had no ISDN phone line and no hardware devices. There were no trained people able to use the computer, and nobody knew the possibilities of communication by Internet, e-mail, or teleconsult. To solve this problem, arrangements were made with the Department of Informatics of the Aegean University to have some computers on the island and to teach the local population, at least the personnel involved in health services, how to use them.<sup>4</sup>

### *Second phase*

The second phase was focused on teleultrasonography in remote areas, which, after a real-time transmission of images or using static images, allowed experts to detect pathologies.<sup>5-7</sup> The aims of this phase were to (1) assess the use of dedicated software for ultrasound consult managed by personnel with no expertise; (2) determine the feasibility of ultrasound consult without dedicated connections (ISDN lines, Internet); and (3) assess the response time and clinical effectiveness in critical emergency cases.

From the 24th of July to the 8th of August 2000, 30 ultrasound examinations were performed at the ambulatory clinic of Tilos and transmitted to the Department of Surgery in Pisa. All of them were performed on patients coming to the ambulatory clinic of the island every day by medic and paramedic staff with no expertise in ultrasound diagnosis. This staff was guided at a distance via videoconference to perform appropriate scans for an organ's study. The remote personnel had relied on their guidance to perform ultrasound scans. The expert physician did not interfere with the actual performance of the ultrasound scans. His role also included confirming the diagnosis that was performed at distance. The transmission was made from the remote area by an expert in telematics and software. The following devices were used: (a) an ultrasound system, SonoSite 180 apparatus, with a convex 3.5–5 MHz probe (Esaote Biomedica, Genoa, Italy); (b) two twin computers, one in Tilos and one in Pisa; (c) two standard computers for videoconferencing in NetMeeting (Microsoft); (d) InVIVO Teleconsult Software developed and produced by MedCom GmbH distributed in Italy by EBIT; and (e) an ISDN Line. All ultrasound examinations were

performed with standard scans that are generally accepted for ultrasound examinations in both routine and emergency care. Image quality was good enough for a correct diagnosis. Moreover, in all cases, it was possible to make a diagnosis for both positive and negative findings. The encounter took about 5.43 min (range 1.45–20.45 min) for the direct teleconsult connection and about 12.30 min (range 5.35–32.40 min) for NetMeeting for videoconference. Teleconsult connection included static images and dynamic loop transmission with transmission of scan sequences for organs. The mean transmission time for a 2.0-megabyte file was 5.0 min (mean speed of transmission: 7 kb/sec). Transmission speed depended on loop size and ISDN quality. The mean time for the procedure, after the arrival of the images that were fit for diagnosis, was 9.53 min, including two cases of color images requiring a longer time. The mean time to get a complete diagnosis was 11.06 min.

### *Third phase*

We have recently received a grant for the promotion of our project by the Italian University Ministry, with the participation of Pisa University (International Cooperation in the Mediterranean Area—training and education). The project is also based on an agreement with the Department of Education, Aegean University, and the participation of a private Company (Telemed s.r.l.; Ethicon S.p.A), which provides instrumentation and devices for videoconferencing software (Ebit S@nità) and ultrasound devices (Esaote, Genoa) for a limited period of time (EBIT) and laboratory devices (group CSF, Clinic Analyser 2). The Centro Diagnostico Italiano (CDI) also collaborated with the project, as it did in 1998. In March 2002, local authorities and physicians were contacted by mail and phone. In April 2002, the equipment (computer and videoconferencing) was transferred to the island, and a contract was signed with two students in informatics, who will stay on the island for a longer period. In May 2002, a daily videoconference connection between the remote ambulatory and our center in Italy (Department of Surgery) was initiated. We were joined by the Interuniversity Centre of TeleTeaching in Surgery (Padua, Ancona, Rome, Modena Universities).

The connections were checked (via ISDN) in order to ensure technical quality and functioning (video/sound quality, interaction) as well as ultrasound device and software (Ebit S@nità, Esaote Sonosite) for ultrasound examinations.

The island's inhabitants are now about 500, more than in 1998, when the first screening was performed. We were unable to obtain a complete list of residents from the municipality because there is no such registry. We had a chance to assess the prevalence of high-risk conditions in emergency situations when the resident physician was substituted by a military one, who used the heli-rescue system. After the arrival of the informatics expert, we started to assemble the health data file, fit for local computers, in order to develop a data registry. During the last week of May, with the support of the resident physician, we started screening people coming daily to the clinic. Data<sup>8</sup> were recorded and compared with that of 1998:

- Clinical check up, anamnesis
- ECG (telecardiology with CDI Italy)
- Neck, breast, abdomen, vascular ultrasound, and specific ultrasound with image storing
- Specialist teleconsult when necessary
- Notification of results to the resident physician
- Group teleconsult planning according to speciality (videoconferences for a specialized group, e.g., patients affected by hypertension, diabetes, neurological, and orthopedic pathologies)

These data revealed the following trends:

- Good population response: teleconsult is really very much appreciated and requested
- Lack of drug monitoring for chronic patients
- Detection of different pathologies requiring hospital treatment
- Increase in "first checkups" due to increase in population and tourists
- Good quality image transmission (videoconference, telesonography, teledermatology)
- Good functioning of telecardiology system (CDI)
- Good results with NetMeeting, SMS, and wireless phone
- Need for promoting training for self-man-

aged use of the system among local operators (who have not been very willing, up to now, to handle it)

## RESULTS

The data gathered in the first phase, revealed the following trends:

- Clinical and cardiologic screening showed four out of 268 persons with high-risk cardiologic pathologies.
- Sonographic screening detected two aneurysms of the abdominal aorta with surgical diameter (more than 5 cm).
- Two cases of previously undetected cancer were suspected, and several renal stones and biliary tree stones were detected.

During the second phase, there was a 100% conformity in diagnosis between the examination performed in telesonography and the one performed on the spot by the expert. It was possible, thanks to the results, to consider both diagnostic reliability and feasibility. For interpreting transmitted images at a distance, the basic clinical data must be considered in addition to simple clinical findings. This means that there should be basic medical knowledge and basic ultrasound diagnosis training for the main scans.

Results of the third phase are still in progress, but preliminary findings show 10% of cardiologic alterations requiring, up to now, 10 urgent check-ups at specialized centers in Rhodes, a suspicion of carotid body cancer, and many thyroid nodules. Due to the difficulty of reporting relevant data in terms of Evidence-based medicine, the reader must wait for analyses to be published at the end of this phase of the TIMTEM project.

## DISCUSSION

The rate of participation in the study (more than 95%) is higher than expected. The inhabitants of the island seemed to be well aware of their isolation and mindful of tragic experiences in cases of acute disease. A medical check-up (including a specialist consult, radiological ex-

amination, and blood sample) usually takes at least 3 days (transfer from Tilos to the main island, Rhodes) with high expense. In the first phase, 2% of the population showed pathologies at high risk for acute, severe complications (aortic aneurysm, cardiac diseases), and more than 25% showed minor pathologies (renal stones, biliary tree stones). Patients with severe diseases were immediately sent to the regional hospital for treatment.

This experience revealed the importance of careful preparation of healthcare providers and people for telemedicine. Habits are deeply rooted, and both physicians and patients must be educated in order to deal with the new arrangement. Telematic devices will have to be compatible with the culture of the area.

In the second phase, the lack of ultrasound was addressed, including (a) assemblage in both central and peripheral areas by qualified expert personnel; (b) conformity of ISDN lines to ECC rules; (c) improvement of TeleConsult Software with the possibility of using a Webcam on the same computer for remote control by untrained personnel; (d) basic improvement in technical and technological procedures (such as a professional Webcam); and (e) proper personnel training in the use of the ultrasound apparatus. Telesonography applications included the following:

- Routine remote diagnoses
- Emergency remote diagnoses
- Third level consult for peripheral centers
- Training in remote areas

It is necessary to standardize diagnostic protocols and scans. Personnel performing in remote areas should be able to interpret the images and, above all, be able to create scans in agreement with the reference center.

In the third phase, the clinical mapping of the island came to an end in July 2002, with 430 files collected, representing about 92% of the present population, twice as much as in 1998. In the same period, we were faced with some serious emer-

gencies requiring heli-rescue and with problems of local management deficiencies and operative risks, which must be analyzed in order to plan proper protocols. All these problems are related to inadequate preparation of personnel.

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