

satellite telemedicine experience in 1996, during the military mission in Bosnia-Herzegovina. It was necessary to deploy such capability because of the extremely serious damages caused by bombings to the entire system of vital infrastructures, first among the others the health-care system and the communications system. To minimize the impact of such difficult situation and to ensure an appropriate level of medical care to the military personnel deployed to the mission an experimental project was developed. The SHARED (Satellite Health Access from Remote Environment Demonstrator) project was sponsored by the European Space Agency, the Italian Space Agency and the TELBIOS pool. The Italian field hospital and the General Hospital in Sarajevo were connected with medical centres of excellence in Italy, via commercial satellite services. 265 civilians and 55 soldiers were treated, two surgical operations were performed with remote assistance, with a total amount of 600 hours of telemedicine connections, 66 specialists involved, civilians and military medical doctor. SHARED in conclusion is to be considered not only as an extremely innovative contribution provided by Italian Armed Forces, but also as a successful medical support operation.

In 2002 the technological development of such systems required a complete review of the existing machines. All the benefits achieved using telemedicine pushed forward a new project: "ATHENA". In 2003 the Defence General Staff approved and released the project aiming to a significant modernization and adaptation of the entire system.

From 2003 up to now this process has been carried out, resulting in the implementation of an efficient and effective mean for operational purposes.



Fig. 1 – Deployable telemedicine remote stations.

Present situation

The present military telemedicine service is a joint activity. All services, Army, Navy, Air Force and Carabinieri are providing personnel to man the new "master" station and a TOC (Telemedicine Operational Centre) located and operational at the General Military Hospital "CELIO" in Rome.

The remote station is an independent and equipped sheltered clinical station with satellite connection. The medical diagnostic devices comprise one X-RAY system, one X-RAY film digitalizer and one automatic, compact and portable defibrillator. An audio low bandwidth communication system based on Thuraya satellite network is also available.

One remote station is operational in support of our forces deployed in Kosovo. Two remote stations (Fig.1) are ready to be deployed anywhere as required.

Additionally, some remote stations are under development to be installed on board of the major Navy units.

The telemedicine service is fully operational and meet the NATO standard requirements for interoperability. At present satellite connections are still performed via civilian channels, but in the near future a military satellite will primarily be used, while the civilian one will stay as an alternative resource. Table 1 shows some figures collected from 16 September 1996, date of starting of the service to the end of October 2007.

➤	11.891	hours of satellite connections
➤	6.543	hours dedicated to clinical cases
➤	2.001	tele-consultations
➤	1.708	soldiers treated
➤	1.613	civilians treated
➤	336	MEDEVAC avoided
➤	457	specialists in several fields involved

Tab. 1 - Some figures about the overall activity of the Telemedicine Operational Center.

From a purely technical point of view, the renewed telemedicine service is able to provide the following capabilities:

- redundancy of high bandwidth networks provided by military satellite and/or by commercial one;
- redundancy of low bandwidth networks provided by satellite and land lines (telephone data channel);
- redundancy of devices (setting up of backup systems);
- link with other telemedicine networks (national and international);
- establishment of on-site telemedicine environment in some critical emergency departments (Emergency – Intensive care – Orthopaedics – X-rays) at Rome military general hospital, in support of forces;
- establishment of telemedicine remote stations in the area of operation connected to Rome military general hospital and/or other major medical facilities;
- supply of “on-line” diagnosis and therapy systems.

From a medical point of view, the system provides:

- teleconsultation (“second opinion”);
- assistance to medical evacuation (MEDEVAC) of patients from the theatre of operation;

- clinical data acquisition and transmission;
- medical examinations booking system, medical data exchange, compliance with “military multiservice card”;
- medical distance learning ;
- first aid and emergency;
- aero medical and combat search and rescue operations;
- patient/soldier telemonitoring (ongoing experimental phase).

Future development

Modern technology achievements allow many new applications also in the military sphere. Devices like a glove with integrated sensors that transmit vital signals by Bluetooth connection to telemedicine station is a typical example. It is able to provide the following medical data: ECG, body temperature and heart frequency. A t-shirt with integrated sensors allows the continuous monitoring of the same parameters. Data are sent to a telemedicine station in VAN, and then transferred in real time by satellite connection to Main station.

Military Telecardiology

As stated above, nowadays large bandwidth systems using satellite technologies are available even in the remote deployed environments, thus permitting the use of teleconsultation in a variety of medical disciplines. Advanced medical technologies (digital electrocardiogram and echocardiogram machines) in the field of cardiology have been developed and are routine in the management of cardiac patients.

In the military setting, deployed forces in remote locations are comprised of young as well as middle-aged people that are potentially at risk for an acute cardiac event. These deployed sites normally do not have a cardiologist available at the remote medical treatment facility. Often, if two-way voice communication is established, cardiologists can be consulted with a limited view of the patient. The shortage of trained cardiologists coupled with the necessity to minimize the logistic footprint within the military medical service, has and will continue to preclude the regular deployment of cardiologists to missions abroad. Nevertheless, the need for these specialized services during any mission is real and requires a significant effort to be met.

Even after exposure to a toxic agent or after a natural disaster occurs, the possibility to distinguish a cardiac event from other causes of chest pain can be life-saving. Additionally, an appropriate diagnosis is able to improve survival, to reduce inappropriate use of medical resources and movement of patients.

Deployed military personnel are usually young and relatively healthy, but this is not the case for all those who may be provided care by military medical personnel. It is normal for them to provide medical care to local population, that in most cases has no access to any health-care service: women, aged people and babies are often admitted patients to field medical facilities.

Materials and methods

Acute coronary syndromes, like angina and myocardial infarction, and associated cardiac emergency conditions (e.g. arrhythmias) remain the leading cause of death among industrialized nations (in Italy it is reported 44%). Military personnel deployed abroad are not immune from this risk as well.

New diagnostic and treatment modalities, such as portable ultrasound devices and fibrinolytic agents, have significantly improved the survival of the cardiac diseased patients, assuming the diagnosis can be made rapidly.

Associated improvements in advanced medical technology, such as telemedicine, and tele-communications have enabled cardiac patients in remote or austere environments access to specialty consultation, even though the cardiologist may be located elsewhere. This capability has resulted in decreased morbidity and mortality. Cardiac patients in a remote site can undergo testing and evaluation with an electrocardiogram (ECG) or echocardiogram (ECHO) scanned or captured in a digital format, which can then be forwarded over dedicated satellite connections or commercial communications networks to a medical centre for interpretation by a cardiologist. Figure 2 shows an example of ECG scanned in the remote telemedicine station within the military medical facilities and then forwarded to the main station in the Military General Hospital “CELIO” in Rome. Figure 3 shows an echocardiogram that is managed following the same procedure.

Within the Army medical treatment facilities a portable three-channel electrocardiograph machine capable of recording twelve simultaneously acquired ECG traces is available. Soon a new machine, a multi-parameter defibrillator/monitor from the LIFEPAK® series, combining semi-automated and manual defibrillation with capnography, external pacing, 12-lead electrocardiography and other monitoring functions, will be operational at the remote medical treatment facility.

The medical officer who asks for a consultation from a medical facility deployed to a mission sends a request to the TOC in Rome. This request is accompanied by a file containing the ECG captured via the machine mentioned above and scanned. The cardiac specialist is promptly informed and in a few minutes provides his medical assessment with the relevant diagnosis and treatment recommendations. The answer is then forwarded back to the requester.

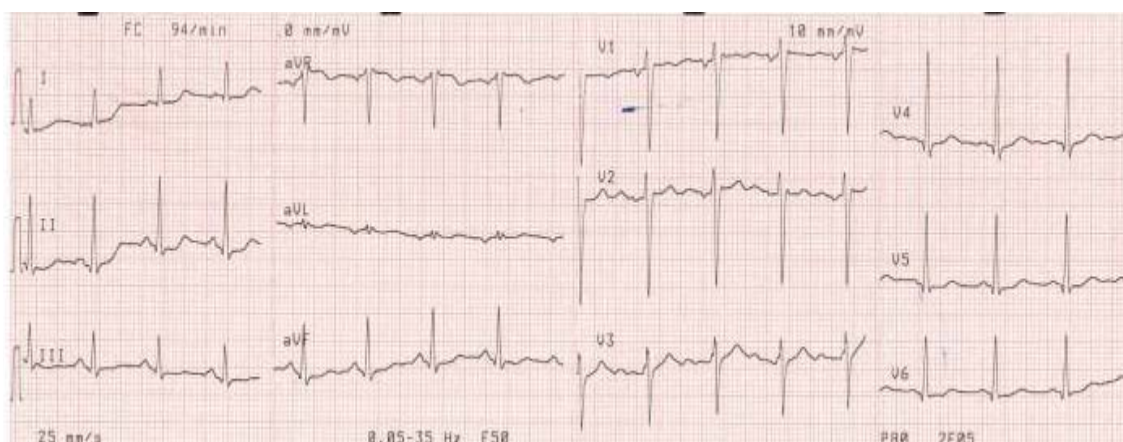


Fig. 2 – ECG from a cardiological teleconsultation.

This capability can be also supplemented with real time transmission of a patient examination with heart sounds (tele-stethoscopy) or video teleconferencing (VTC), as it is performed when required. All together, these modalities augment the medical evaluation and provide the remote medical provider immediate referral recommendations that ultimately can be life-saving.

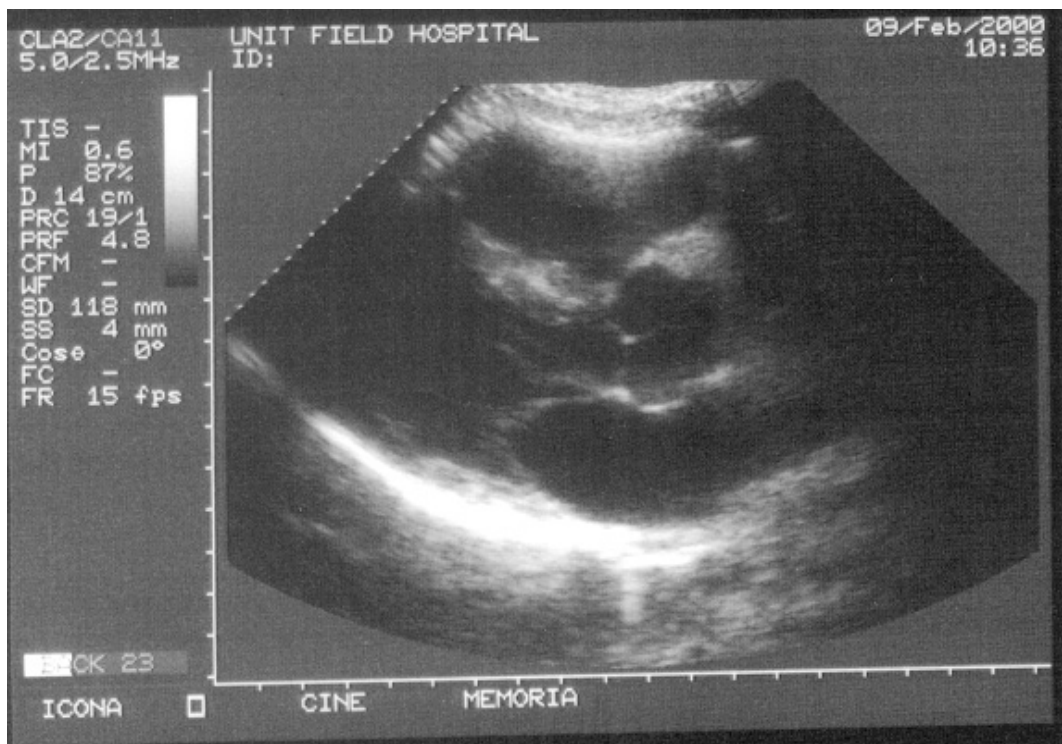


Fig. 3 – ECHO from a cardiological teleconsultation.

Dual use

The duality of the telemedicine system is a feature put in place from the very beginning: a fully integrated military-civilian health service provided a sound and prompt response to the heavily demanding situation during both military and civilian operations in peace-keeping, humanitarian relief and natural disaster missions.

The future developments of this technology will certainly ensure a more and more important role of telemedicine in the dual use perspective.

A big part of the experience gained in the military environment has been already successfully applied to the civilian world, not only in Italy. Many initiatives, both in public and private sphere, are running nationwide. Telecardiology is largely used as a powerful mean to facilitate the monitoring of patients directly at home, thus reducing unnecessary hospitalization and consequently the financial impact to the public health care provider budget.

Conclusions

The wider use of telemedicine, both in civilian and military field, allows for a more frequent exchange of multimedia medical information (images, texts, voice, video etc.) over a long distance. Almost all medical science branches can benefit of the service provided by the advanced technology. Not only medical doctors are interested in using telemedicine, but the whole health care system and organization. Over the last years, many services dedicated to the support of medical care have dramatically increased, particularly in the civilian sphere: telecare, tele-homecare, telenursing, distance learning are only a few examples. In the military sphere, even more than in the civilian one, telemedicine and relevant technologies can be applied. The fast development of these

advanced technologies allows a new approach in finding appropriate solution to the purely medical problems, and to rationalize the organization of health care services. In conclusion, the positive results achieved using telemedicine have encountered the appreciation of all actors which are involved in providing a better quality of health care to patients.

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