# THE ITACA PROJECT: MODELS, ARCHITECTURES AND PROTOTYPES FOR HEALTH-CARE DELIVERY CONTINUITY

S. Silvestri*, M. Rogante*, M. Bufano**, A. D'Aquila***, M. Frusciane***, F. Paone**, R. Giampieretti**** and V. Macellari*

* Istituto Superiore di Sanità, Technology and Health Department, Rome, Italy
** Tecnobiomedica S.P.A. - No Profit Research Company, Rome, Italy
*** Ebit Sanità S.P.A., Genova, Italy
**** Tesan S.P.A. ,Vicenza, Italy

Corresponding author: Velio Macellari, velmac@iss.it. Voice: +39 0649902089

**Abstract: The ongoing ITACA project deals with selected case-studies for the study, development and implementation of a telematic infrastructure interconnecting all the main "actors" of the health care/rehabilitation process, overcoming current fragmentation. The aim of this paper is to report on the models developed, the architecture of the whole system, focussing on the most critical functional blocks of the infrastructure.**

## Introduction

The latest Italian Health Plan has pointed out that the increase in both number and quality of health care assistance performances stems from two main factors, typical of technologically advanced, industrialized societies: growing demand for interventions in support of a better quality of life and ageing of population. At present a re-engineering of the entire Health Care System seems a primary need in order to face new necessities; to this aim focus is centred on the development of new functional models that change the traditional health care delivery process. The Italian Health Plan 2003-2005 shows that cooperation among the actors is necessary in order to guarantee adequate, sustainable levels of health care continuity, overcoming the current fragmentation that is considered [1] one of the main causes of resource wasting.

Particular attention has been devoted to the potential of telemedicine systems, not only to limit travelling for patients and health operators, but to increase accessibility, optimize efficiency of some services and ensure optimal development and utilization of health information by all the stakeholders [2].

It is in this context that the ITACA[1] project (wide Area Telematic Infrastructure for the Continuity of health Assistance) deals with selected case-studies for the study, development and prototype implementation of a telematic infrastructure to interconnect all the main actors of the care/rehabilitation process. The general scheme of the foreseen infrastructure is shown in figure 1. Next to each actor the functional module connecting them to the infrastructure is shown.

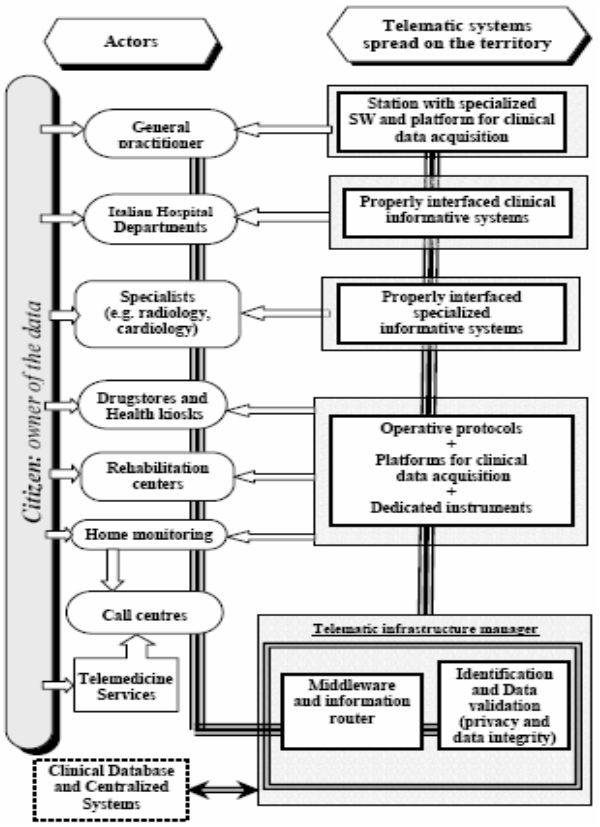


Figure 1. ITACA infrastructure. Left: set of considered actors. Right: functional modules to access the infrastructure.

The ultimate goal of the project is the study and development of prototype hardware/software modules for the implementation of a telerehabilitation service.

## Materials and Methods

The Italian Health Care System has been analyzed in order to identify where the Information and Communication Technology could improve existing

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services by optimizing efficacy and efficiency of the entire care/rehabilitation process [1]; to this aim a model was developed describing the interaction between citizen/patient and the System, after an initial health request. From a functional point of view it identifies the transactions generated by the interaction of different actors involved in specific operative situations.
In order to implement the model we identified and defined:

- the various operative situations
- all the mains actors involved in the care/rehabilitation process
- the information that selected actors intend to share

The model can be analyzed in its functionalities by considering five abstraction levels described in the flow chart below.

*Level 4 - The Decision Level*

At this level the subject has to decide whether his/her health condition is an emergency or not, and if a social service intervention is needed; at present the ITACA project does not deal with these cases. If the request is not an emergency, the patient can interact with a medical doctor, i.e., a general practitioner or a specialist. The patient can define the interaction with the Health System by activating different paths. This level, schematically shown in figure 2, represents the interface between citizens and the Health Care System.

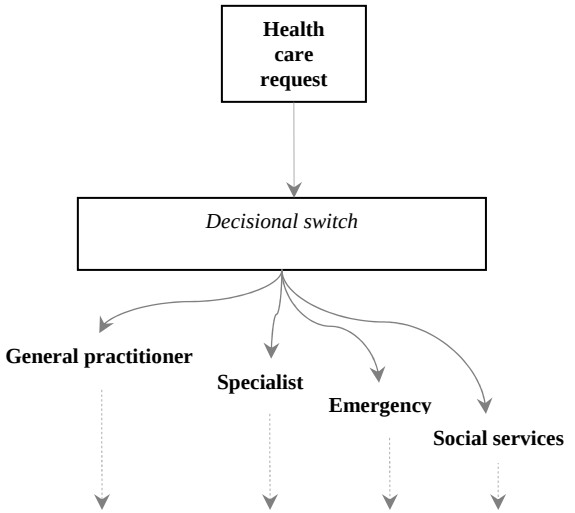


Figure 2. Level 4: the Decision Level. Subject defines an interaction point with the Health Care System

*Level 3 - The Interaction level*

At this level the subject interacts with a general practitioner or a specialist, in order to define his health status and needs. If the doctor is not able to answer to patient's health request on site, s/he activates different health paths and routs patient to other health structures. Here it is the health care operator that manages patient/Health System interaction, by choosing the most appropriate professionals. For example he could route patient for hospitalisation, a clinical examination or to a specialist. Level 3 is schematically shown in figure 3.

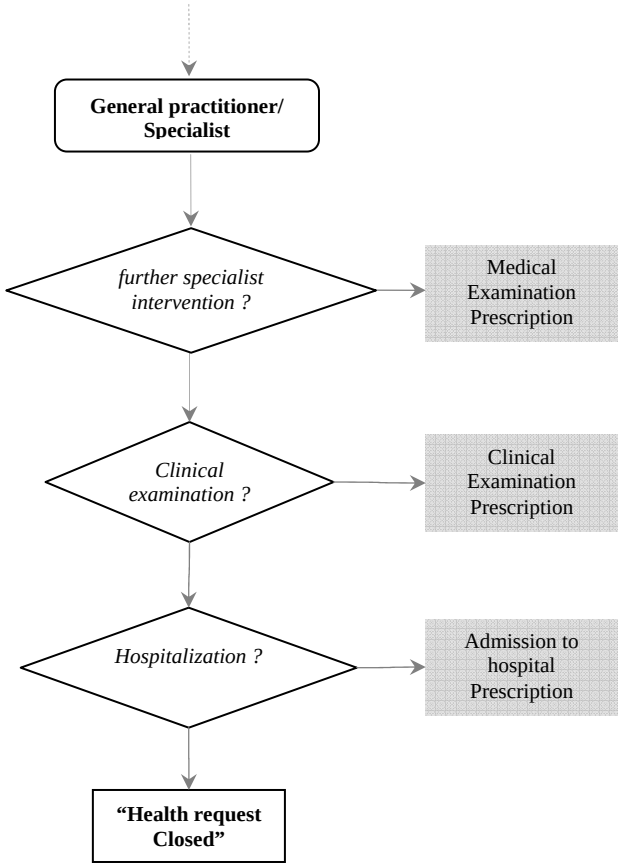


Figure 3. Level 3: the Interaction Level. Patient interacts with a medical doctor and can be routed to other health care professionals.

*Level 2 - The Event Level*

This level contemplates all possible events and procedures that could be generated during the interaction between patient and the Health Care System involving the telematic infrastructure. As an example, the events concerning a medical examination have been identified and formalized:

- Medical report issue and transmission
- Clinical data acquisition and transmission.
- Booking of a medical examination
- Booking hospital admission
- Booking of specific analysis
- Tele-consultation
- Tele-rehabilitation
- Second opinion

For each specific event a software procedure has been implemented, that supports the health professionals: for example if he needs to book a clinical examination, a specific software module is called and activated, by whichthe doctor may book the desired examination at the desired health structure. Figure 4 shows the possible events generated by the example considered.


ISSN: 1727-1983 

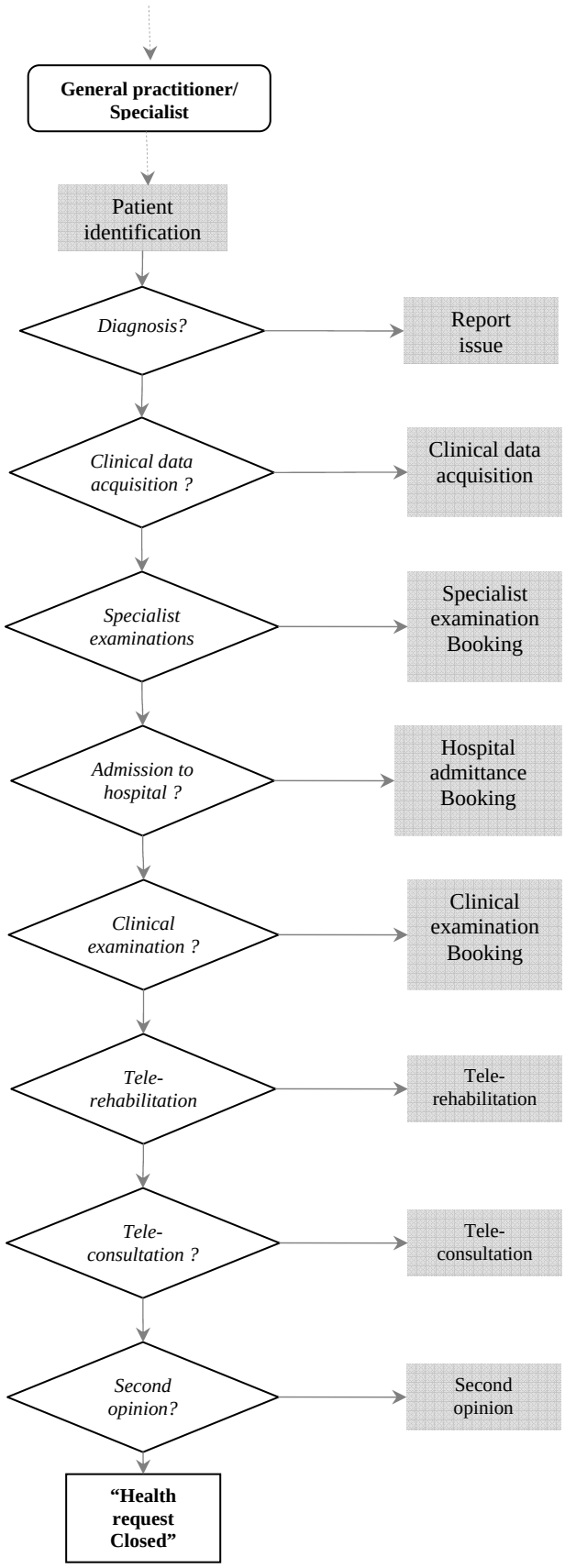


Figure 4. Level 2: the Event Level. Example of possible events generated during a medical examination. Left: set of events. Right: respective software modules.

*Level 1- The Information Level*

This level identifies information exchanged by different actors needing to be interconnected by the ITACA infrastructure. An example is shown in figure 5. In this specific case the specialist sends a medical report to the general practitioner that has previously asked for a specialist examination. The information sent by the specialist is:

- Specialist ID, the unique key used for his identification
- Patient ID, because the received report has to be univocally linked to a specific patient.
- The object to be sent, the medical report in this specific operative situation.

Upon receiving this information, the general practitioner sends an acknowledgement.

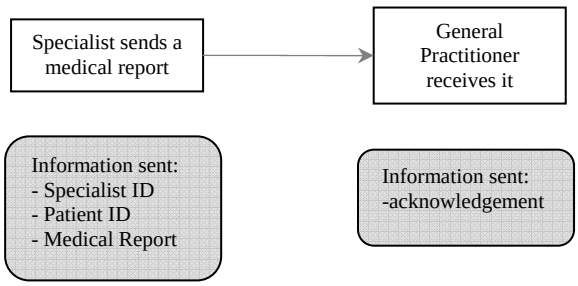


Figure 5. Level 1: the Information Level. After a medical examination the specialist issues a medical report and send it to the general practitioner; smoothed squares include information sent by specific actor

*Level 0 - The Transaction Level*

At this level, shared information that was identified at level 1, is formalized and structured and exchange rules among different actors are defined leading to the ITACA transaction. In order to respect existing standards in telemedicine, the ITACA transaction is HL7 compliant. Figure 6 shows an example of HL7 message, with some of the segments used and the definition of a specific PID (Patient Identification) segment.

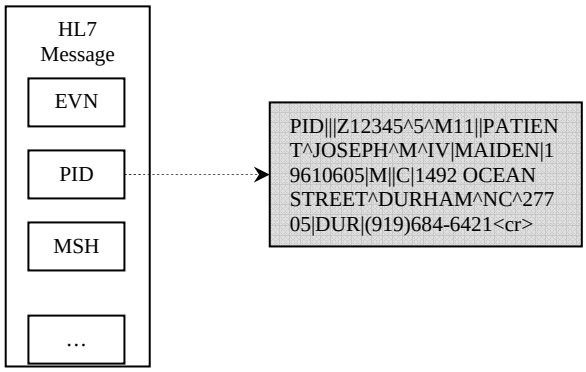


Figure 6. The structure of an HL7 message

The interaction of the patient with the whole set of actors and operative situations defines the ITACA


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transaction framework. In order to properly handle this framework the middleware communication layer of the ITACA infrastructure has been provided with an electronic manager - the Clinical Cooperation Engine (CCE)- which :

a) unequivocally identifies the system user;
b) gives each operator specific attributes to access data and links;
c) manages patient's profile and authorisations for each single user;
d) routes data/messages among the actors depending on the operative situation.

In order to let all the actors access the ITACA infrastructure, dedicated instruments have been designed and developed. These are tailored to the specific functionalities and actions performed by each operator. Focus has been centred on Home Care with the design and development of a telerehabilitation service [3, 4]. The functional schema of the service is shown in figure 7. The main functions of the actors involved [5] are:

- Health Provider sets up, manages and maintains the communication between patients and health care professionals. This module communicates with the Clinical Cooperation Engine.
- The Home Platform has been designed for general use and has a high level of adaptability to different operative situations. It allows the patient to execute the rehabilitative exercises according to the health professional's directives. The platform consists of:
  a) a central console that manages communication with the "Health Manager" and connects with the motor-activity desk and the monitoring unit;
  b) a motor-activity desk designed upon patient's needs to execute both occupational therapy and active physical training, according to health professionals' directives;
  c) a monitoring unit for clinical data acquisition and delivery to the "Health Manager"
- The Health Operator is the medical unit of the system. Generally a therapist, s/he is responsible of the whole rehabilitative process. S/He manages the patient by changing/adjusting the rehabilitative protocols [6].

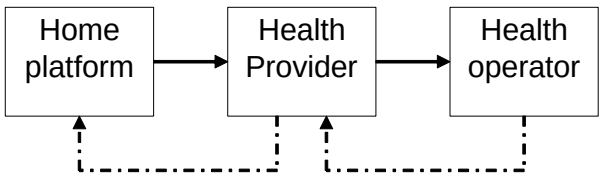


Figure 7. Functional schema of the telerehabilitation service and actors involved. Data flow is bidirectional in order to create a permanent link between patient and health operator.

**Results and discussion**

The model describing the interaction between citizen/patient and Health Care System has led to the definition the ITACA transaction framework. This framework achieves an effective co-operation among patients and the whole set of health care professionals. This assures patients the desired care continuity when passing from one actor to another [1]. The development of the Clinical Cooperation Engine managing HL7 messages -a consolidated standard in telemedicine-, grants the entire system a high level of flexibility and adaptability to different operative applications. As an example the ITACA infrastructure has been used for the development of a telerehabilitation service.

Work is in progress and the entire telemedicine service is under development. A limited but meaningful set of actors has been identified. The limited ITACA transaction framework is managed by a CCE prototype that, from a technical point of view is a client/server application based on an SQL database. Figure 8 shows the structure of the database and the most important tables: Patients, General Practitioners and Systems. The engine is able to route a received message at the required actor by reading the information packed in the HL7 message and matching these with data stored in the database.

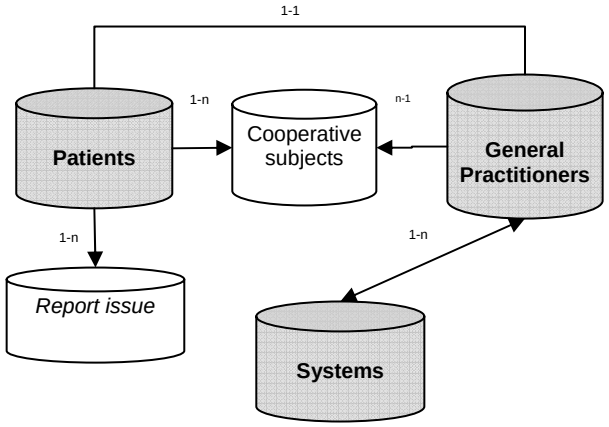


Figure 8. Internal structure of the Clinical Cooperation Engine database.

**Conclusions**

At present the potential of telemedicine systems, that integrate existing information systems and use existing technologies, could actually interconnect all the main actors involved in the care/rehabilitation process. The telematic infrastructure developed in the ITACA project allows an effective cooperation among health care professionals and assures high levels of health care continuity. Actors are stimulated to interact for a close co-operation in health services supply. Health services are not provided by a single subject, but by teams of professionals and different institutions needing a close co-operation in order to assure the best service quality with the available resources. In any case, in this context direct political choices [7, 8] are mandatory in order to change traditional health care delivery process by using modern telemedicine systems, which for some years


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now have only been used in the form of prototypes and connecting a limited set of actors.

The ITACA project expires in January 2006 and the entire telemedicine service is under development.

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