HEARTFAID

D26 – 2nd Periodic Report
(Activity and Management)

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HEARTFAID

A KNOWLEDGE BASED PLATFORM OF SERVICES FOR SUPPORTING MEDICAL-CLINICAL MANAGEMENT OF THE HEART FAILURE WITHIN THE ELDERLY POPULATION

Project summary	
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Consortium

- UNICAL- Università della Calabria (Italy)
- UNICZ- Università degli studi Magna Graecia di Catanzaro (Italy)
- UNIMIB- Università degli studi di Milano Bicocca (Italy)
- JUMC- Jagiellonian University Medical College (Poland)
- VMWS- Virtual Medical World Solutions Ltd (United Kingdom)
- FORTHNET S. A.- Hellenic Telecommunications and Telematic Applications Company S. A. (Greece)
- SYNAP- Synapsis s.r.l. (Italy)
- CNR- Consiglio Nazionale delle Ricerche (Italy)
- FORTH-Foundation for Research and Technology Hellas (Greece)
- RBI- Rudjer Boskovic Institute (Croatia)
- AUXOL- Istituto Auxologico Italiano (Italy)

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Short Description
The document describes project objectives and major achievements during its second year with an overview on the technical activities by WP and by partner involved with an overview of the financial efforts and costs occurred during the same period.

Change Record		
Version Number	Changes	Release date
1.0	First draft of the Document	14-01-2008
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1.2	Further Contributions	13-03-2008
1.3	Refinement and Final version	18-03-2008

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Executive Summary

A knowledge based platform of services for supporting medical-clinical management of heart failure within elderly population

FP6-IST-2005-027107 - STREP

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Project Objectives

HEARTFAID is a research and development project aimed at devising, developing and validating an innovative knowledge based platform of services, able to improve early diagnosis and to make more effective the clinical management of Heart Failure within elderly population. The project is taking place with the financial support of the European Community, under the Sixth Framework Program, Information Society Technology – ICT for Health.
Chronic Heart Failure is one of the most remarkable health problems for prevalence and morbidity, especially in the developed western countries, with a strong impact in terms of social and economic effects. All these aspects are typically emphasized within the elderly population, with very frequent hospital admissions and a significant increase of medical costs.
HEARTFAID aims to make more effective and efficient all the processes related to diagnosis, prognosis and treatment of the Heart Failure within elderly population.
This general goal is going to be achieved by the development and deployment of an innovative technological platform that:

- integrate biomedical data within electronic health record systems, for easy and ubiquitous access to heterogeneous patients data;

- provide services for healthcare professionals, including patient telemonitoring, signal and image processing, alert and alarm system;
- support clinical decisions in the heart failure domain, by the integration of different approaches for representing the relevant medical knowledge and extracting new knowledge:
  - a knowledge based approach (deductive knowledge) for coding clinical guidelines and clinical best practice;
  - a machine learning approach (inductive knowledge) for extracting new knowledge from the practical clinical experience of suitable case sets.

The system functionalities and services provided by the HEARTFAID platform are sketched in the following figure.

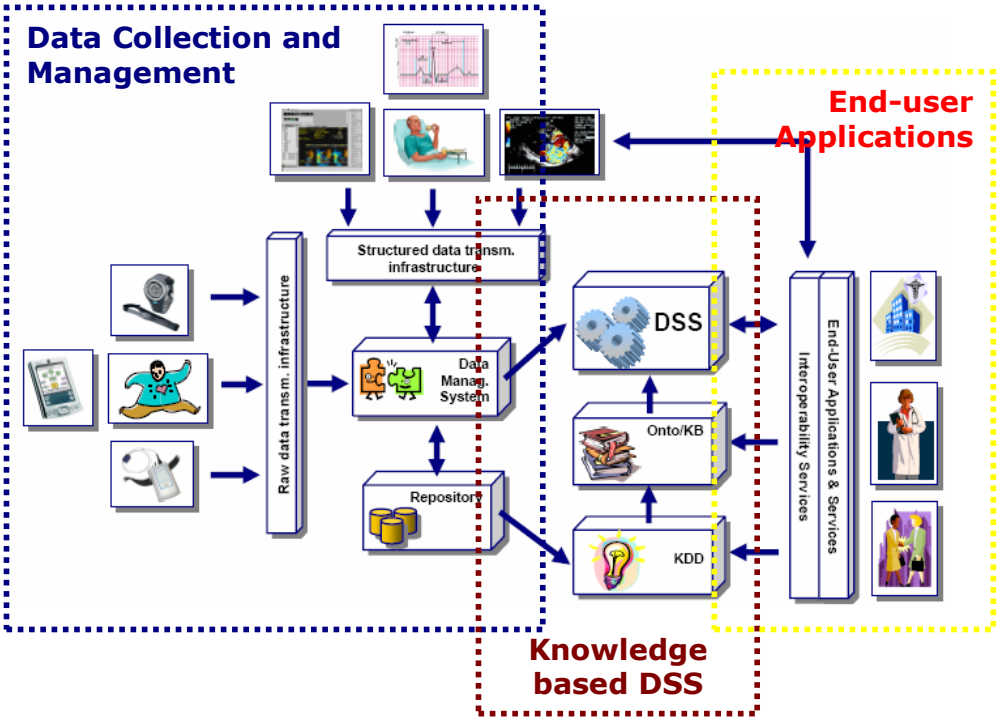


Figure 1. *HEARTFAID System Functionalities and Services*

Expected End Results

In terms of final results, the HEARTFAID platform is characterized by the following technological innovations and realizations:

- middleware infrastructure for interoperability and biomedical data acquisition and integration;
- integration of several approaches for representing and managing the relevant medical knowledge and extracting new knowledge;
- innovative approaches for biomedical signal and image processing;
- clinical decision support of all the key steps in the clinical management of HF patients.

In terms of architectural organization, the HEARTFAID platform is currently under developing on the basis of the following macro components:

- multi-channel data acquisition and transmission infrastructure;

- interoperability/integration middleware and use of clinical data representation and communication standards;
- clinical knowledge generation and management;
- decision support services and biomedical data processing;
- end-user services and applications.

Impact

HEARTFAID strategic impact mainly regards the improvement of the quality of life of Heart Failure patients and the decreasing of the social and economic costs. HEARTFAID applications will bring an important increase of the treatment quality of the individual patient, by ensuring the possibility to personalize the therapy and have a real-time monitoring and assistance of the patient.
On the other hand, the optimization of the clinical processes will assure the control and reduction of the overall economic and social costs of medical care, by decreasing the frequency of hospital admissions.
The following graphic (Fig. 2) gives a "synoptic" view of the "patient-centric" organization and delivery of the services provided by the HEARTFAID platform. Under this respect, the HEARTFAID platform turns out to be an effective and efficient support of a patient-centric Heart Failure Care Program.

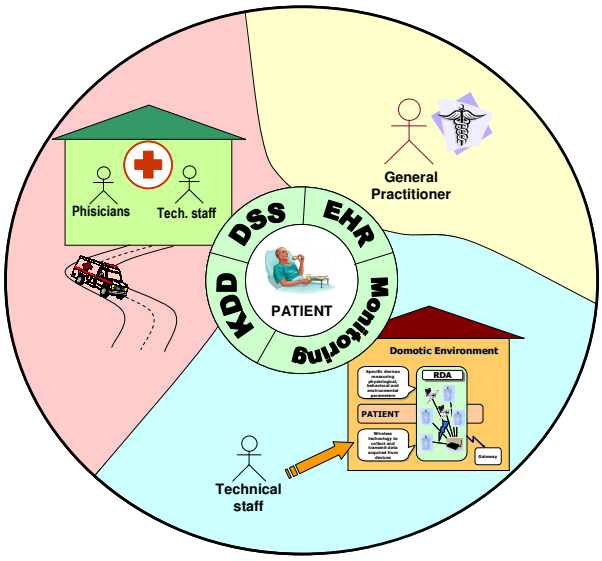


Figure 2. *The patient-centric architecture of the HEARTFAID platform of services*

Using and Disseminating of Knowledge

As far as the "*using knowledge*" issues are concerned, since HEARTFAID is a project mostly implementation oriented, theoretical and methodological work will be rapidly converted to experimental and practical applications. The industrial partners are developing a detailed exploitation plan, based on the following steps: identification of the market segments; detailed business plan; detailed identification of the potential markets and the competitive environment; assessment of benefits by end-users; establishment of a commercial agreement

among partners on the joint commercialization and exploitation after project end; after project completion, development of the prototypes into industrial products.
As far as the "*disseminating knowledge*" issues are concerned, it is of strong interest to the HEARTFAID project and its partners to disseminate its ideas and results to a community as wide as possible. Dissemination is an important interactive interface for the project for getting continued feedback on ideas and concept refinement. Dissemination is performed whenever possible by exploiting the human network of the different partners, but more specific it is doing according to the following points: Internal Dissemination, Project Web Site, User Interest Groups, Conferences Exhibitions, Intermediaries, Scientific and Technical Publications, Concertation and Clustering activities.

Consortium

The Consortium has been established with the aim to get a well-balanced combination providing all needed expertise, at a very high level of specialisation, in different topics. The consortium is based on 11 partners: 6 from Italy (University of Calabria, University "Magna Graecia" of Catanzaro, University of Milano Bicocca, Synapsis S.r.l., National Research Council, Auxologico Institute), 2 from Greece (Hellenic Telecommunications and Telematics Applications Company S.A., Foundation for Research and Technology Hellas), 1 from United Kingdom (Virtual Medical World Solutions Ltd.), 1 from Poland (Jagiellonian University Medical College) and 1 from Croatia (Rudjer Boskovic Institute). As far as the expertise and the contributions to the project are concerned, 4 partners come from the relevant medical domain (Cardiology Divisions of public hospitals), whereas the other 7 are related to the methodological and technological domain.

Work performed and Results achieved during the Second Reporting Period

- Development, implementation and testing of the Data Acquisition and Transmission Infrastructure Prototype. This allowed the effective integration of suitable set of Wireless Sensors to the platform.
- Biomedical and Clinical Data Collection carried out by the clinical partners, by the development and use of a suitable Patient-Medical Health Record (named e-CRF: electronic Case Report Form).
- Development, implementation and testing of the Middleware Infrastructure Prototype for services interoperability and data integration.
- Development, implementation and testing of the procedures for Data Preparation and Data Warehousing.
- Development, implementation and testing of innovative methodologies for Knowledge Discovery within relevant clinical data sets.
- Development, implementation and testing of the Medical Knowledge Base, by exploiting suitable medical ontological approaches and clinical guidelines.
- Development, implementation and testing of the Signal Analysis Toolkit and Image Analysis Toolkit for the relevant features extraction.
- Development, implementation and testing of the Clinical Decision Support System.
- Development, implementation and testing of the Heartfaid Web Portal for the end-user services interaction functionalities.

PERIODIC ACTIVITY REPORT

Section 1 – Project objectives and major achievements during the reporting period

Overview of General Project Objectives

Heart Failure (HF) is increasingly frequent in western world, carrying a high mortality rate and being responsible for a consistent increase in healthcare costs related to the multiple therapeutic interventions and the high frequency of hospital admissions required by these patients. There is therefore an increasing need for a better care, that might be provided not only by highly specialized centers, but also by small hospitals and by field cardiologists, a need that has to be matched with a policy of cost containment.
Progress in technology may offer an important support to make this possible, allowing adequate knowledge to be made available to all health care providers in this field. It might also offer new methods for regular and accurate collection of biological data in patients living in their home environment, making use of sensors, either traditional or wearable, able to provide a continuous monitoring also through telemedicine facilities.
More recent progress might further offer an advanced platform of services for the automated integration between the data collected both at home and in the clinic environment on one side, and the available state-of-the-art knowledge on the other side, providing an artificial intelligence support to clinical decision.
The proper adoption of these tools might help improving the daily care of chronic heart failure patients, through a prompt titration of treatment in response to early detection of even minor changes in clinical conditions, as well as through a reduction of diagnostic and therapeutic errors, by reinforcing the implementation of the most advanced recommendations provided by international clinical guidelines. Such an approach might also help improving the cost/effectiveness of heart failure care facilitating the implementation of a disease management approach, in which therapy, education and follow-up are tailored for each patient by a multidisciplinary team constantly supported by an advanced platform of computerized services guiding the clinical decision through a continuous update of patient's clinical conditions allowed by advanced wireless telecommunication technology.

The HEARTFAID project is currently developing such a technological infrastructure and testing its feasibility and usefulness in the management of chronic heart failure patients, focussing in particular on those with advancing age.
The HEARTFAID platform (HFP) provides information and decision support to make diagnosis and management of individual patients more personalised and effective. It does this by exploiting computational modelling, knowledge discovery methodologies, visualisation and imaging techniques, medical domain knowledge, and effectively integrating and processing biomedical data and information at different levels. In addition it will help develop and define new healthcare delivery organisation and management models for HF, to produce more effective and efficient use of available resources (healthcare staff, healthcare equipment and financial resources).

The main goal of HEARTFAID is to support health care operators in the management of patients with HF and in particular to improve the quality of life for elderly patients, and reduce the number of their hospitalisations. To achieve these objectives, the following requirements must be met:

- easy access to heterogeneous patient data;
- a common user interface of integrated and easy-to-use services for healthcare professionals;
- easy access to formalised clinical knowledge (declarative knowledge, procedural knowledge, and newly discovered knowledge).

In fact, the core of HFP is the Knowledge Level, formalizing all the pre-existing clinical knowledge about HF. Novel, useful and non-trivial knowledge is extracted from the Knowledge Base and the data collected during the project, by using innovative Knowledge Discovery processes.
If the Knowledge Base represents the "heart" of HFP, the "brain" of the platform is the Clinical Decision Support Systems (CDSS). The CDSS has the main goal to provide a valid support to the health care operators and the decision makers operating in the field of HF disease.
To ensure the reliability and the correctness of the whole system, the clinical partners will carry out an intensive validation of the platform functionalities.

In terms of scientific and technological advances provides by HEARTFAID, it is worth while to observe that, differently from other previous and current projects on the management of HF patients, HEARTFAID is specifically characterized by the following innovations:

- acquisition and integration of heterogeneous biomedical data, relevant to the medical domain, of different structure and complexity and coming from different and several sources;
- interoperability/integration middleware and use of clinical data representation and communication standards;
- integration of several approaches for coding the relevant medical knowledge and extract new knowledge: a knowledge based approach (deductive knowledge) for coding the clinical guide lines and the clinical best practice; a knowledge discovery approach (inductive knowledge) for extracting new knowledge from the practical clinical experience represented by suitable sets of cases;
- innovative approaches for biomedical signal and image processing;
- medical decision support level, characterized by functionalities regarding all the clinical management of HF patient: diagnosis, prognosis, therapy planning.

Second Reporting Period (Months 13-24)

As far as the scientific and technical activities are concerned, the second reporting period (months 13-24) of the HEARTFAID project has been mainly characterized by the development, implementation and preliminary testing of the first prototypal configuration of the several components of the platform and their integration.

More specifically:

- Development and implementation of the Ambient Intelligence System for acquisition of the relevant biomedical data, by suitable wireless sensors, and transmission to the platform.
- Development, implementation, testing and deployment of an appropriate Patient-Medical Health Record, namely the "eCRF", "electronic Case Report Form", specifically devoted to the collection and storing of all the clinical data from Heart Failure patient.
- Development and implementation of the middleware infrastructure for data integration and management and systems and services interoperability.
- Development and implementation of the Medical Knowledge Base, by exploiting the clinical best practice and guidelines.
- Development and implementation of "Model" Base, by defining suitable decision making models extracted from the knowledge discovery activities.
- Development and implementation of the Clinical Decision Support System.
- Development and implementation of the Signal Analysis Toolkit and the Image Analysis Toolkit.
- Development and implementation of the Heartfaid Web Portal for the end-user interaction functionalities.

It is worth while to emphasize that the overall architecture of HFP was designed and developed after a careful analysis of the overall problems to be faced and the expectations of the medical users.
In particular, a complete use case was defined for guiding the development activity of the clinical decision making support, by considering many of the integrated services of the platform.
More in detail, we are considering a 65 years old patient, already enrolled in the HFP, former smoker, suffering from hypertension from several years.
The patient was enrolled in the HFP six months ago and, in particular, the telemonitoring services offered by the platform were activated. At the baseline visit, the patient referred a slight limitation of physical activity, since he felt comfortable at rest but ordinary activity resulted in fatigue and dyspnoea. For these reasons, the patient was assigned to NYHA class II. Anamnesis data were also collected, from which it is known that the patient had an acute myocardial infarction five years before and that he underwent to aorto-coronary bypass. The patient had a post ischaemic dilated cardiomyopathy, with associated systolic dysfunction.
The TTE test (performed at baseline evaluation) showed an LVEF equal to 40%, ESV and EDV being respectively 114 ml and 190 ml. The LV end-diastolic diameter was 6.0 cm. The pharmacological treatment consisted in ACE-inhibitor, beta-blockers, spironolactone, aspirin and statin. Neither pulmonary nor systemic congestion signs were present. Blood examinations of renal function and electrolytes were normal. During these six months, the patient has been telemonitored. In particular, the pharmacological therapy has been followed with care and no relevant changes have been identified by the platform.
Suddenly, the patient observes a worsening of his symptoms, with a marked limitation of physical activity. After he fills in a periodic questionnaire suggested by the platform based on Minnesota questionnaire, the changes in the symptoms

are automatically detected and considered relevant. A medical visit is suggested by the CDSS, accepted by the referent physician and immediately scheduled.
At the visit, the NYHA class changes from II to III. No variations in the signs are observed by the cardiologist, apart from a slight worsening of blood pressure (150/90 mmHg) and an increase of 10 beats/min in the heart rate. An ECG is performed to confirm such an increase in heart rate.
The cardiologist, supported by the CDSS, decides however to evaluate other parameters by echocardiography. During TTE examination, the sonographer acquires images and images sequences according to a protocol specified by the platform. Finally the images and the parameters manually evaluated by the sonographer are stored in the platform image archive. The reviewing cardiologist visualizes the echocardiographic images and the estimated parameters. Left ventricle volume and ejection fractions are computed again by automatic methods, exploiting the available image sequences. These values are compared with the historical data of the patient. EDV increases to 210 ml, ESV increases to 145 ml, EF decreased from 40% to 30%. Mild tricuspidal insufficiency is Doppler-detected by its regurgitation. By tricuspidal regurgitation extent, the pressure gradient (mmHg) between right ventricle and right atrium is measured. Pulmonary pressure is then estimated. With this aim, the subcostal view is taken into account, so as to determine Inferior Vena Cava (IVC) diameter and its collapsibility index. The pulmonary pressure is estimated to be 40 mmHg, by using a lookup table with entries consisting in the tricuspidal gradient, IVC diameter and collapsibility index. Since this value indicates a slight pulmonary congestion, the CDSS suggests the physician to integrate the pharmacological therapy with diuretics, for example loop diuretics or thiazides. Further, since there are no up-to-date information about the renal function and electrolytes, the CDSS suggests to start with a safe diuretic dosage and to perform blood examinations, which are scheduled for few days later. The physician opts for a loop diuretics therapy, for quicker beneficial effects.
Back to his home, the patient is monitored in the subsequent days. In particular control of weight, urine output, blood pressure, symptoms are scheduled daily. Blood examinations are scheduled seven days after the beginning of the new treatment. The results of such blood examinations are uploaded to the platform.
An up-titration table for the diuretics is compiled by the CDSS, considering in particular symptoms and electrolytes balance, creatinine clearance, blood pressure, weight slope and urine output. The CDSS also suggests to control weight and urine output daily and to schedule blood examinations weekly. A visit is also suggested in one month, to appreciate the response to the therapy. The physician reviews this program and decides to approve it. After approval, the up-titration table for diuretics is automatically sent to the patient.
One week after, telemonitoring evidences persistence of symptoms; the patient is thus required to continue the up-titration program for diuretics. During the subsequent weeks symptoms get better until the visit. At that visit, the patient refers that symptoms are relieved. NYHA class is moved back to II. However, the CDSS suggests to the physician to explore the possible origins of the change in the symptoms reported in the previous visit (i.e. the probable cause of heart failure decompensation). In particular, with the aim of controlling the ischemic disease, a stress test is scheduled.

Section 2 – Workpackage Progress of the Period

WP2 – BIOMEDICAL DATA IDENTIFICATION AND COLLECTION

WORK PACKAGE: 2
TITLE: BIOMEDICAL DATA IDENTIFICATION AND COLLECTION
START DATE: MONTH 3
WORK PACKAGE LEADER: VMWS
PARTNERS INVOLVED: UNICAL , UNICZ, UNIMIB, JUMC , FORTHNET , SYNAP, AUXOL

OBJECTIVES AND ACHIEVEMENTS OF THE TASKS DUE IN THE PERIOD

TASKS AND OBJECTIVES	ACHIEVEMENTS	ACTIVITIES
T 2.2 –Design and Development of the Data Acquisition and Transmission Infrastructure	• Connectable to the platform devices have been defined • Sensors/Medical devices integration to the HEARTFAID platform succeeded • Development of integrated tool for Patient Records creation completed	Based on the Specifications of the Data Acquisition and Transmission Infrastructure, the partners initially developed mock-ups and necessary software modules in order to integrate the sensors and medical devices to the HEARTFAID platform. Furthermore, the development of the integrated tool designed to interactively and dynamically create Patient Records, continued as planned, compliant with a set of specifications defined by the clinicians. In the final stage of this task, the modules comprising the data acquisition and transmission infrastructure were developed and tested. The task was completed at the end of M18 inline with the DoW.
T2.3- Data Collection	• Homecare and healthcare data collection is in its execution phase	The task has started at M18 and the partners are progressing towards the collection of the relevant biomedical data, involving both homecare and healthcare data.

STATUS OF DELIVERABLES AND MILESTONES OF THE PERIOD

DELIVERABLE	COMMENTS
D19- Prototype of data Acquisition and transmission infrastructure	Deliverable D19 describes the prototype of the Data Acquisition and Transmission Infrastructure based on the outcome of D14 (requirements and specifications). In this deliverable, the technological infrastructure is defined and its various modules are presented in detail. D19 was submitted on time at the end of M18.
MILESTONE	
MS 2.2 – Technological Infrastructure for the acquisition and transmission of the relevant BM data	The technological infrastructure for the acquisition and transmission of the relevant biomedical data has been defined inline with the DoW. The results were reported in D19, which was submitted on time at the end of M18.

Description of the activities of the year

During the second year, the activities of WP2 were related to Task 2.2 "Design and Development of the Data Acquisition and Transmission infrastructure", which ended in M18 and T2.3 "Data Collection", which started in M18 and has run for 6 months during the second year of the project. The detailed activities of the partners regarding these two tasks are presented in the following paragraphs.

T2.2 "Design and Development of the Data Acquisition and Transmission Infrastructure"

- Activity A2.2.1: Definition of the set of sensors to be integrated into the HARTFAID platform

This activity was completed at the beginning of the second year of the project by VMWS and FORTHNET. Due to the fact that the selection of the devices considered as candidates to be integrated to the platform lasted more than expected, FORTH supported the evaluation of the these devices. The outcome of this activity was the definition of the set of sensors that are characterised as connectable to the HEARTFAID platform. This set comprises sensors used in both clinical and personal (home and on-the-move) environments. Each device in the set was analysed by VMWS and FORTH in its capability of transmitting the acquired data to a host and in its semantic interoperability. Furthermore, FORTH identified the data processing that can be performed, based on the output of each device (giving input to WP5).
The detailed list of connectable sensors and devices is reported in the Deliverable D19 "Design and Development of the Data Acquisition and Transmission Infrastructure", which was prepared jointly by VMWS, FORTHNET, JUMC and FORTH.
Moreover, a number of other devices have been identified by VMWS and FORTH as unable to be directly integrated to HEARFTAID due to lack of connectivity and the manual insertion of data from these devices via e.g. web forms was considered as an option.

- Activity A2.2.2: Development of modules for data acquisition

In this activity, VMWS and FORTHNET developed the necessary software modules to enable data acquisition from sensors and devices provided by the clinical partners.
More specifically, regarding medical devices used in the clinical premises and provided by the clinical partners, VMWS developed Java software modules for parsing the relevant information from files generated by vendor provided software and converting to XML messages. Furthermore, an application was developed by VMWS, integrating the above functionality under a unified GUI in order to help clinical partners use the above functionality easily. Also, FORTH performed the acquisition of the ECGs recorded with the Esaote Archimed cardiograph used in the hospital setting of UNICZ. A first version of such interface module has been installed and updated in the cardiology department and the next step will be the integration of such module with the specific signal processing module.

Regarding the in-Home environment, FORTHNET have developed a Java application, called Nurse@Home, which supports data acquisition, over Bluetooth of vital signs from various medical devices installed in the home environment, as well as the implementation of the Minnesota questionnaire.
The data outcomes of the following sensors were analyzed jointly by FORTHNET and FORTH:

1) PulseOximeter Nonin 4100
2) Ambulatory Blood Pressure monitor A&D UA-767PBT
3) Electronic Scale A&D UC-321PBT
4) MagIC Multi-parametric Monitoring Vest (one lead ECG, respiratory rate)

FORTH implemented the communication protocol of the first three devices, while FORTHNET elaborated the integration of these software modules to the nurse@Home application.

Regarding MagIC Monitoring Vest, there had been collaboration between UNIMIB/AUXOL and FORTH, in order to provide the required functionality from both sides to enable the integration of the device to the platform.

Finally, regarding the on-the-move scenario VMWS has developed J2ME and Windows Mobile 5 applications executing Bluetooth client and server modules and achieved communication and data reception from the following devices to the mobile phones.

1) A&D UA-767PBT (blood pressure and cardiac pulse)
2) A&D UC-321PBT (electronic scale)
3) PulseOximeter Nonin 4100
4) FRWD Heartstrap

Although UA-767PBT and UC-321PBT are not considered as portable devices, J2ME module for communication with these devices were developed as backup solutions for the in-the-home scenario in case that a fixed connection between the patient's home and the HEARTFAID platform does not exist.

- Activity A2.2.3: Development of modules for data transmission

For the clinical scenario, the transmission functionality was included by VMWS in the Java application that collects data from the medical devices in the clinical environment.
Regarding the Nurse@Home application for the in-the-home scenario, the required data transmission functionality was included by Forthnet in the application to enable the transmission of XML messages over a DSL connection.
Finally, for the on-the-move scenario, collected data are sent via GRRS network from the mobile acquisition device to an XML gateway, a collection of ASP.NET pages that are responsible for the XML messages generation and transmission to the platform. VMWS developed the gateway functionality for XML generation and transmission. Additionally, VMWS developed functionality for gateway management (definition of platform address, local caching options, manual transmission of selected files in case of transmission failure)

- Activity A2.2.4: Development of EPR

During the second year of the project, Synapsis developed an integrated tool designed to interactively and dynamically create Patient Records, compliant with a set of specifications defined by the clinicians. According to the Grand Vision to move from the EPR towards the EHR (the Electronic Health Record adds general health-related information to the EPR that is not necessarily related to a disease, but on the contrary is centred on the patient), our activities have been focused on the following topics:

1. A centralized patient identity management system that is able to manage and resolve patients' identification between different actors: a Master Patient Index (MPI) with Patient Identity Cross Referencing (PIX) capabilities (in the following simply called MPI);
2. Distributed information Repository able to manage heterogeneous information;
3. A centralized Registry archive where all the metadata related to the patients' information can be stored. The Registry can be used to refer the real clinical/medical information of the patients.

The reference IHE profile that was identified to support our needs, is the Cross-Enterprise Document Sharing (XDS and the new XDS for Medical Summaries, XDS-MS). Tools and technologies based on ebXML standard for the implementation of the Registry and the SOAP messages, and able to support the Cross-Enterprise Document Sharing profile, have been experimented.

Activity A2.2.5: Testing of modules for data acquisition and transmission

The software modules for data acquisition and transmission were tested regarding their proper functionality. The testing procedure involved standalone tests as well as integration oriented tests in order to verify the correct collaboration of the modules. The results of these tests are reported in the Deliverable D19. Furthermore, preliminary demos were presented to the HEARTFAID consortium by VMWS, FORTHNET and FORTH during the STAB meeting in Zagreb (June 2007) and in Cracow (November 2007).

Activity A2.2.6: Integration of eCRF with the platform

eCRF (electronic Case Report Form), developed by JUMC, is a web application, used by medical personnel only (nurses, caregivers and doctors) for manual insertion of measurements and other information to the platform, due to the fact that not all medical devices can be automatically integrated with the platform as it has been described in D19/4.2.1.1.

The prototype of the eCRF application has been deployed on an Apache Tomcat (version 5.5.12) application server running under the control of a Windows 2003 Server operating system. For data storage a MySQL (version 5.0.24) RDBMS server has been chosen.

The main objective of this activity carried out jointly by JUMC and SYNAPSIS was to integrate the current version of the eCRF prototype to the platform by exporting the data as proper XML messages to other components of the platform.

T2.3 "Data Collection"

Activity A2.3.1: Homecare Data Collection

This activity is related to the collection of biomedical data in a sample of home environments utilising the data acquisition and transmission infrastructure developed in T2.2. Initially, there has been a collaboration between the partners involved in the development of the homecare applications (VMWS, FORTHNET) with the clinical partners of the project (UNIMIB, AUXOL, UNICZ and JUMC) in order to assess, at a first stage, the usability of the homecare applications and identify mechanisms in order to realise the data collection in an efficient and consistent way.
Data collection from the home environment has started and UNICZ are collecting, every two weeks, in a small group of patients the following parameters: systolic blood pressure, heart rate, respiratory rate, % of body water, body temperature, in order to achieve an early diagnosis of heart failure decompensation, so as indicated in deliverable 5.
Also, UNIMIB and AUXOL have continued the collection of from CHF patients monitored at home through internet. Via this procedure, the data collection of 30 patients has been completed on a nearly daily basis over a follow-up period of several months. The data obtained are the following: SBP, DBP, HR, Urine output, Water intake, body weight and selected symptoms.
Finally, in JUMC data collection in CHF patients in their home setting takes place on a daily basis and includes change in CHF symptoms (fatigue, dyspnoea, orthopnoea, nocturnal dyspnoea, and peripheral oedema), systolic blood pressure, heart rate, respiration rate, body weight, and change in the pharmacological treatment. These data were collected according to the questionnaire previously agreed between clinical Partners.

Activity A2.3.2: Healthcare Data Collection

Regarding healthcare data collection, a total of 91 patients with chronic heart failure were enlisted in the HEARTFAID project by UNICZ (historical and newly diagnosed cases). The data of this population have been introduced in a database that contains all the heart failure related list of biomedical signs, symptoms and parameters of selected tests (e.g. Electrocardiogram, Holter electrocardiography, Chest X-ray, Echocardiography, Clinical chemistry etc). These data have been filled also in electronic CRF (basal assessments and further clinical evaluations). The clinical assessment in these patients is regularly scheduled every one-two months (and also earlier if clinical conditions are worsening). UNICZ are also providing the storage of digital ECG files in SCP format and the storage of echocardiography images in DICOM format. Thus, the data collection has been amplified and it will be useful for the HEARTFAID project further activity.

Also, UNIMIB and AUXOL recovered from the digital chart of the patients monitored at home additional clinical data recorded in the hospital environment, such as Electrocardiogram, Holter electrocardiography, Chest X-ray, Echocardiography, Clinical chemistry, cardiopulmonary stress testing or 6 min

walking test. These clinical data have been collected over repeated visits during patients' follow-up.

Finally, healthcare data collection in CHF patients took place in JUMC from the ambulatory and rehabilitation unit, according to the eCRF (clinical data from anamnesis, physical examination, laboratory tests, ECG, echocardiography, 24h ECG monitoring, chest X-ray, cardiopulmonary exercise testing, quality of life questionnaire, beat-to-beat blood pressure monitoring). The eCRF application has been deployed at a JUMC's server and is accessible for registered clinical partners on the Internet. Up to now about 50 cases have been enrolled from JUMC site and the appropriate forms for baseline and follow-up visits for these patients are being fulfilled.

Deviation from the plan

The most of the effort in WP2 during the beginning of the second year of the project was put into the process of integration of sensors and medical devices in all the identified environments, in order to enable the proper start-up of Task 2.3 dealing with the collection of the relevant data.
The delay of selection of the relevant devices (already identified at the end of the first year of the project), added some delay to the process of devices integration into the platform. Moreover, since the integration of each device to the platform requires the development of device-specific code to implement the communication protocol (which most of the times is disclosed by the vendor and made available only after signing a Non Disclosure Agreement), the partners had to treat each device independently. This procedure added some overhead regarding the integration of the identified devices.
Moreover, additional technical issues which could not be predicted during the development phase appeared. For example selection of the appropriate Java Bluetooth stack to control the Bluetooth communication, given the available Bluetooth transceivers was an issue that had to be resolved in order to enable the data acquisition. Also, concerning the on-the-move scenario, the emulated software did not execute as expected at the various target devices, even in cases where the mobile manufacturers did not indicate so, resulting to a slower development than expected.
In order to cope with this overhead, the partners decided

- to handle the process of device integration according to a best effort approach which mainly focused on the final-stage integration of only the necessary devices and a first integration approach for the rest of the devices.
- to extend the device integration procedure

By following this strategy, the partners managed to integrate all the necessary devices in the platform and a smooth transition between T2.2 and T2.3 was achieved.
Finally, this delay in the devices integration has some impact on the integration of secure data transmission mechanisms. It was agreed among the partners to use HTTP during data transmission for the current software version, where the main point of interest was functionality and compatibility. However, the absolute necessity for secure communication is acknowledged and the use of HTTPS will be adopted in the final version.

WP 3 – MIDDLEWARE, INTEROPERABILITY AND INTEGRATION

WORK PACKAGE: 3
TITLE: MIDDLEWARE,INTEROPERABILITY AND INTEGRATION
START DATE: MONTH 2
WORK PACKAGE LEADER: SYNAPSIS
PARTNERS INVOLVED: VMWS, FORTHNET, CNR, FORTH

OBJECTIVES AND ACHIEVEMENTS OF THE TASKS DUE IN THE PERIOD

TASKS AND OBJECTIVES	ACHIEVEMENTS	ACTIVITIES
T 3.3.1 –Early mock-up prototype implementation	The task has successfully achieved its scope to design a mock-up prototype of the Integration Middleware that will guarantee the integration among the different modules of the HF platform of services.	The activities of subtask T3.3.1, started at month M6, have been completed during the reporting period, with a slight delay of one month with respect to the project Gantt. During the reporting period we have evaluated some open source software framework implementation of SOA and ESB architectures to develop the prototype. The study of the available technologies have last more than what was expected, thus introducing a slight delay in the conclusion of the task. The most adequate solutions for the purposes of the HF project have been selected among the available technologies and adopted for the implementation of the early mock up prototype of the integration middleware. This mock-up was presented during the General Assembly Meeting held in Zagreb on June 2007. The first prototype was presented at the General Assembly Meeting held in Krakow on November 2007. In that occasion, the specifications to integrate the other modules of the platform have been accurately discussed with the technical partners.
T3.3.2 – Prototype Refinement	The Integration Middleware prototype was refined in order to adequately support the integration of the external modules, by adopting standard encoding and standard protocols for data representation and exchange.	Due to the delay of subtask T3.3.1, the activities of this task had to start with a slight delay with respect to the Gantt of the Project. Specific refining issues have been discussed and formalized at the GA Meeting held in Cracow. These specifications have been used to refine the Integration Middleware prototype in such a was as to better support the integration of the external modules of the platform. Moreover, adequate standards for data encoding and standard protocols for information exchange, have been selected and adopted to guarantee the correct integration of the different modules into the HEARTFAID platform of services. The activities of this subtask have been concluded during the last reporting period.
T3.4 - Interoperability Middleware	The task successfully achieved the goal	The activities of Task T3.4, started at month M8, have been carried out during the reporting period. Although from the Gantt of the Project it was expected this task to

	to design the architecture of the Interoperability Middleware, to define the functionalities that should be provided and to implement a first prototype that will be presented at the next review meeting to be held in Milan next April.	be completed within the reporting period, the activities will be carried out also during the beginning of the next reporting period, with a slight delay on the timetable. According and in strict correlation with the studies performed in Task T3.3.1, we have studied and evaluated adequate technologies for functional service composition, such as the ebXMLRR that is the reference implementation of ebXML. The investigated technologies have been adopted to implement a first part of the Interoperability Middleware architecture, that was successively refined with the goal to be adapted to the needs of the underlying levels. Some troubles have been encountered while integrating the different services available from the external/pre-existing modules into the platform. However, these problems will be overcome within the next review of the project.

STATUS OF DELIVERABLES AND MILESTONES OF THE PERIOD

DELIVERABLE	COMMENTS
D20- Clinical Standards and first middleware prototype	Delivered with a slight delay of one month with respect to the due deadline.
D28- Integration and Interoperability middleware prototype	Expected to be delivered within 45 days from the deadline (M24).
MILESTONE	
MS 3.2– Early mock-up prototype implementation of the Data Management and Exchange System	A preliminary prototype of the Data Management and Exchange System able to interact with external devices for data measurements and with an alarm/notification system, was implemented and presented at the General Assembly Meeting held in Zagreb in June 2007.
MS 3.3- HEARTFAID middleware prototype	The HEARTFAID Middle prototype is being refined. The final version is expected to be achieved with a slight delay of a couple of months due to the problems encountered in defining all the protocols and standards for integrating the different modules into the platform.

Description of the activities

During the reporting period, the activities of subtasks T3.3.1 e T3.3.2, started respectively at month M8 and M19, have been completed, while the activities of task T3.4, stated at month M8, have been continued and will be completed in the next reporting period.

T3.3: Integration Middleware

This Task, has the goal to design and develop a Data Management System that is responsible to guarantee the following features:

- all the data flowing within the entire platform is compliant with the standards identified in Task 3.2

- management of the heterogeneous repository allowing the organization of raw data, laboratory data, structured information (EPR, data entry services, and so on), multimedia/other data (reports, images, ultrasound signals, and so on).

These objectives will be achieved through the following two subtasks:

T3.3.1: Early mock up prototype implementation

A first instance of the architecture has been deployed at the beginning of the reporting period, in order to evaluate the feasibility of the solutions identified, with particular reference to the technologies selected: Service Oriented Architectures, Enterprise Service Bus architectures, and Open Geospatial Consortium specifications as reference information model.

In this period we accurately evaluated and tested the most common open source frameworks implementation for web services, such as Apache Axis, Axis2, XFire, JAXWS, Celtics, Glue, JBossWS. In the first evaluation phase we have analysed the provided features, the supported standards and the security aspects. After this preliminary study Apache Axis, Celtics and Glue have been disregarded as not suitable for the purposes of the HEARTFAID project. The evaluation continued taking into account performances, installation and deployment easiness and embedding ability. Finally, the alternatives have been reduced to two choices: Axis2 and XFire.
As far as the ESB is concerned, two open source framework implementation of messaging bus compliant with Java Message Service (JMS) specification, have been experimented: OpenJMS and JBoss Messaging.

The first prototype was then further refined, by consolidating the adoption of the Service Oriented Architecture, the Enterprise Service Bus, and Open Geospatial Consortium specifications.
Concerning the web services architectures, we implemented both the two open source framework experimented, that is Axis2 and XFire, which have been adopted in the prototype.
As far as the ESB is concerned, we adopted both the two implementations of messaging bus: OpenJMS and JBoss Messaging.

The prototype implemented provides the external systems with a communication protocol that is flexible and based on the XML standard. The adopted protocol allows these external systems to be easily integrated into the HF platform as well as to interact each with the other through the platform itself.
In particular, we have integrated the prototype with some devices that have been selected in the context of WP2 as suitable for the purposes of the HF project, with a prototype of the CDSS, as well as with a notification system able to rise an alert message that can be sent to a set of recipients using different mechanisms (such as e-mail or SMS).
In other words, this prototype is able to acquire and store the real time measurements provided by the medical devices, to process the received data according to the Decision Support services implemented and, if it is the case, to generate an alarm by sending a message to a set of recipients using the notification system.

All the interactions with this Data Management prototype are web based and, therefore, both the set of devices for data acquisition and the notification system can be installed anywhere, assuming that an Internet connection is available.

Concerning the integration of the CDSS, an investigation activity was aimed at assessing the different data formats handled by the CDSS and other platform components and, hence, the usefulness of *data mappers* to be implemented for a better integration. Communication protocols were debated between SYNAP and CNR, and a strategy based on XML messages was chosen as the most suitable.
In addition, interoperability issues related to diagnostic data storage and sharing were addressed. A deep analysis of imaging standards was carried out and highlighted DICOM (*Digital Imaging and Communications in Medicine*) as the most assessed and used standard.
Concerning data communication, the IHE (*Integrating Health Enterprise*) initiative was carefully investigated. In particular, the IHE Cardiology Technical Framework was taken into account and a decision was made about the adoption of a DICOM image archive implementation which integrates IHE actors. Results of the investigation were reported in deliverable D20.

The first prototype was shown in a demo session at the General Assembly Meeting held in Zagreb on June 2007.

This prototype was then refined according to the issues raised in Zagreb, and finalised. The issues related with the interoperability with the other modules to be integrated in the HF platform, have been faced within task T3.3.2 – Prototype refinement.

T3.3.2: Prototype refinement
Due to some delay introduced by the subtask T3.3.1, the activities of subtask T3.3.2 have been started with a slight delay of one month with respect to the Gantt of the project. Nevertheless, the activities have been completed during the reporting period.

The activities carried out have been focused on the formalization of the technical aspects related with the integration of the other modules of the platform (such as the CDSS, the Alarm System, the Ambient Intelligence platform, and so on) with the core system of the platform, i.e. the Integration Middleware. During the technical meetings held in Pisa and in Livorno, which have involved the partners CNR, FORTH, FORTNET, UNICAL and SYNAPSIS, the technical aspects related to the integration of these modules have been accurately investigated and discussed.
The result of these activities was a set of technical specifications that needed to be implemented to adequately support the integration of the existing external modules with the Integration Middleware.
During the General Assembly Meeting held in Krakow on November 2007, the technical aspects of the integration have been finalised and it has been possible to complete prototype by integrating the CDSS, the Alarm System, the Ambient Intelligence platform, and the eCRF.
The prototype will be shown during the next period at the second project review to be held in Milan on April 2008.

T3.4: Interoperability Middleware

As reported in the DoW, the Interoperability Middleware will be responsible of guaranteeing a seamless integration among the end-user services of the HEARTFAID Platform. The activities of this task, started at month M8, continued during the reporting period.

A preliminary set of functional services and applications offered to the final-users, have been identified in the framework of WP6. These set of services need to be composed in a transparent manner from the end-users' point of view.

By implementing the technologies investigated in the previous RPs, a first kernel of the prototype has already been developed as well a mock-up of the Interoperability middleware general architecture. In addition, a first integration with an existing commercial EPR was implemented.

The preliminary prototype developed is composed of the following modules:

- a module to access an external archive of demographic data (typically belonging to the Health Information System of a clinical structure) in order to uniquely identify the patient who is being enrolled in the HF study or whose physiological data is being acquired within a monitoring context;
- a module to interact with the documental repository to store and recover clinical reports/documents, which is able to rebuild the clinical history of a patient;
- a fully configurable module, that upon an external request to recover a complex set of information, is able to identify and recover the necessary data both from the HF internal repositories (i.e. either the internal database or the documental repository) and from an external Health Information System, to combine the available information and finally report the answer.

This prototype represents a first step toward the definition of the HF Electronic Health Record that will be accessed using the functionalities that are being defined in the context of WP6.

After this preliminary validation of the approach we noticed that the task of integrating the Heartfaid software module grew, in complexity, far beyond the simple point-to-point interconnection. Thus we analysed in more deep details the computer science literature that represents the state of the art in arguments like *Message Oriented Middleware, Service Oriented Application, Enterprise Portals and Enterprise Service Bus* which represent the key concerns in *Enterprise Application Integration.*

Particular attention has been paid to the main features of an integration middleware, that are mainly:

- Non intrusiveness
- Pervasiveness

- Standards adherence
- High distribution and event-driven programming model
- Autonomy and Federation
- Security and reliability
- Remote configurability
- Incremental adopting

In the Heartfaid project, the basic application modules that will need to be integrated are:

- The **AmI-platform:** an Ambient Intelligence framework that handles the storage and monitoring of observational data acquired by sensors and interacts with environmental actuators. It has been developed by SYNAP in conjunction with FORTHNET and VMWS who delivered the sensing infrastructure.
- The **eCRF:** a web based Electronic Patient Record (EPR) that offers native user interfaces for input and edit patient related demographic and clinical information. It has been developed by JUMC.
- The **groupSMS:** an application for sending short messages to mobile phones with handling of addresses lists and accounting. It is developed by FORTHNET.
- The **CDSS:** a Clinical Decision Support System developed by CNR in conjunction with RBI who designed the clinical ontology of the system.
- The **HFP:** an image analysis and archiving toolkit used at CNR for implementing algorithms for the analysis of clinical images.

Other modules will be developed for granting the functionality that is missing: a *Master Patient Record and a Documental Repository as described in the reports of previous months, a Meta-data Registry, an Orchestration service and the Heartfaid Enterprise Portal.*

In order to prove the effectiveness of the integration proposals, a subset of the possible use cases has been selected for an early prototype implementation. The first mock-up consists of the integration of sensing facilities installed in the home of a patient with the ambient intelligence core provided by SYNAP. Observations will be fed together with clinical information to a Decision Support System and upon receipt of particular response codes from this DSS a proper alarming and alerting system provided by FORTHNET will be activated.

Observations flowing from the sensor network are acquired by the AmI core which stores them in an XML database and generates alarming requests to be sent when the observations are tagged with alarm information.

The significant effort devoted to the definition and the design of a sound architecture for the Heartfaid Integration Middleware has been enforced by a comprehensive set of use cases.

The use cases represent a significant subset of all those that Heartfaid plans to implement during the entire project lifetime. In particular:

- **A user authentication and profiling** use case shows how a user of the Heartfaid system can access a set of services through an Enterprise Portal. The list of services may require the user to be logged and could be tailored to the user's profile.
- A **global patient enrolment and consistent identification** use case states a uniform and homogenized way of enrolling a new patient into the Heartfaid system through the Enterprise Portal and how to grant a consistent and global accepted identification mechanism for the patient.
- The **AmI enrollment use case** shows how monitoring or sensing resources can be assigned to patients for home and on-the-move monitoring.
- **Reporting of clinical, observational and demographic information** will describe how information coming from the clinical database of the eCRF module, observational information coming from the Ambient Intelligence module and demographic information of the patient can be automatically and flexibly integrate into visual reports by a proper Display service module. Those visual reports can be generated interactively or automatically and represent high value information that can be presented, stored or emailed by the middleware.
- The **automatic decision support for alarming and alerting** use cases shows how to install (enrol) alarming and alerting services that are able to decide through the DSS module when to trigger alarm notifications related to the status of a patient and how to handle this notifications (send emails, SMS, audits).
- **Handling of imaging data** has to describe the Heartfaid system level interaction with the services of storing and retrieving DICOM images produced and analyzed by the Imaging module.

These use cases represent the basis for implementing the reference workflows that HEARTFAID aims to support at the end of the project. As reported in the unsolicited "HEARTFAID Scenarios document" as well as in Deliverable "D23 - User needs analysis and functional specifications of the HEARTFAID platform services", three environments have been identified in which the platform should be able to support the reference workflows: the medical environment (i.e. Primary and Secondary care contexts), the patient environment (i.e. the patient's home) and the research environment (i.e. the context in which addition data are collected for research purposes.

After having analysed in deep details the computer science literature that represents the state of the art in arguments like *Message Oriented Middleware, Service Oriented Application, Enterprise Portals and Enterprise Service Bus* which represent the key concerns in *Enterprise Application Integration*, we have implemented the technologies that have been considered suitable for the purpose of the HF project.

In addition to the external modules, specialized modules have been developed to guarantee the correct functioning of the Middleware: a *Master Patient* Index to guarantee the unique identification of the patients, a *Documental Repository* to store the reports produced within the platform, a *Meta-data Registry* to locate the available resources, an *Orchestration service* to control the workflows within the

platform and the *Heartfaid Enterprise Portal* to integrate the different functionalities and exhibit them to the final user in a friendly fashion.

The following functionalities have been implemented:

- User authentication and profiling
- Global patient enrolment and consistent identification
- Acquisition of demographic and clinical data
- Patient search according to different search criteria
- AmI sub-enrolment
- DSS sub-enrolment
- Managing of available devices for Home monitoring
- DSS activation with alerting functionalities
- Handling of imaging data (to be completed in the next reporting period)

Deviation from the plan

Task T3.4 will be completed in the next reporting period with slight delay with respect to the Gantt of the project. This delay was caused by the delay in completing the Task T3.3.1 and by some problems that had to be faced concerning the adoption of suitable standards and protocols for the integration of the external modules into the prototypes and for the exchange of data among the components of the HEARTFAID platform of services.

WP 4 – KNOWLEDGE REPRESENTATION, DISCOVERY AND MANAGEMENT

WORK PACKAGE: 4
TITLE: KNOWLEDGE, REPRESENTATION, DISCOVERY AND MANAGEMENT
START DATE: MONTH 8
WORK PACKAGE LEADER: RBI
PARTNERS INVOLVED: UNICAL , SYNAP , CNR , FORTH

OBJECTIVES AND ACHIEVEMENTS OF THE TASKS DUE IN THE PERIOD

TASKS AND OBJECTIVES	ACHIEVEMENTS	ACTIVITIES
T4.1 – Implementation of a suitable data warehouse for knowledge discovery	a) functional specification of knowledge discovery goals, b) specification of the data transformation process for long numerical sequences and short data sequences, c) descriptor specification for the KD process	a) specification of requirements for the HF platform data warehousing in order to enable KD process for retrospective data and data collected by the platform b) analysis of concepts of knowledge warehousing in health care c) analysis of HF platform decision support requirements d) experiments with data sequences and their preparation for KD e) implementation of the Pentaho business intelligence platform for medical tasks f) data warehousing for retrospective data g) off-line warehousing of platform data
T 4.2 – Data understanding preparation	a) specification of the data preparation process for KD b) implementation of the methodology on two retrospective datasets	a) retrospective data have been transformed to the standard Weka (arff) form b) data have been cleaned manually by elimination of obvious outliers and sparsely populated attributes c) automatic noise detection procedures have been tested d) based on data understanding a large set of possible classification KD tasks for ANMCO data (more than 50) has been implemented e) some algorithms for complex feature construction has been tested f) data preparation for continuously measured patient data has been performed
T 4.3 – Implementation of knowledge discovery in database processes	a) analysis and upgrading of kernels for the Support Vector Machine algorithm b) implementation of Random Forest algorithm and its preparation for the web service c) formalization of contrast set mining approach by Subgroup Discovery d) application of different data	a) formalization of contrast set mining approach and extensive experiments on various medical domains b) experimental work with Subgroup Discovery methodology for descriptive induction tasks c) development of advanced strategies for the optimal selection of the best performing kernel functions. d) semidefinite programming has been tested for SVM approaches e) survival analysis methodology has beeen studed f) Random Forest algorithm has been implemented in C# language g) analysis of retrospective ANMCO data set by different data mining tools h) HF severity modeling by descriptive induction approach i) construction of a novel HF severity scale by the methodology for detecting most relevant attributes

	mining methods on retrospective data and patient data collected by the platform	j) unsupervised clustering experiments with data collected by the platform k) RF methodology application for hospitalization, economic cost, and quality of life prognosis based on ANMCO dataset
T 4.4 – Ontologies and medical knowledge representation in the domain	a) development of 10 sets of rules presenting the HF related operational knowledge b) development of in total 38 interconnected plans for signs, symptoms and diagnosis assessment and treatment as well as 15 plans for medications prescription and dosage c) integration of the HF knowledge base with the decision support system	a) application of HF ontology terminology for the construction of rules related to 1) HF diagnosis 2) alternative or additional diagnosis 3) HF severity assessment 4) HF general treatment process based on severity assessment 5) HF medications, contraindications, adverse effects & additional treatment rules 6) prognosis estimation for HF patients 7) non-pharmacological management and recommendations 8) specific medication prescription and dosage 9) acute decompensation of congestive heart failure 10) HF cause and CAD risk factors b) transformation of the procedural knowledge in the OWL form and its integration with the descriptive HF ontology c) development of the Closed World OWL Syntax Interpreter and its integration into the decision making process d) automatic extraction of patient data from the platform repository and their integration into the OWL ontology as factual knowledge e) integration of the Interpreter into the Protégé tool f) implementation of the web service for automatic presentation of the decision support results together with their explanations

STATUS OF DELIVERABLES AND MILESTONES OF THE PERIOD

DELIVERABLE	COMMENTS
D21- Functional specifications of data warehouse implementation and data preparation	Prepared on time. The deliverable has about 90 pages.
D22- Ontologies and knowledge representation	Prepared on time. The deliverable has about 130 pages and includes CD with most relevant results.
D29- Models and Methods for knowledge discovery	Prepared on time. The deliverable has about 120 pages.
MILESTONE	
MS 4.1-Ontology and knowledge representation	The work has been done on time. The results are: descriptive HF ontology, procedural knowledge in the form of rules, procedural knowledge in the ontological form, set of 53 interconnected medical plans for handling HF patients. The knowledge is prepared for integration with DSS.
MS 4.2- KDD implementation	The work has been done on time. The results are: analysis and upgrading of kernels for the Support Vector Machine algorithm, implementation and testing of Random Forest algorithm, formalization of contrast set mining approach, and testing of Subgroup Discovery algorithm. Extensive experimental work on different HF domains has been done on the retrospective datasets and the data already collected by the platform. Random Forest and Subgroup Discovery algorithms have been prepared for inclusion into the web based KD service.

- **Description of the activities of the year**

The work has been concentrated around two main topics: development of the HF knowledge base for the decision support purposes and the implementation of knowledge discovery tools and their application on retrospective data and data collected by the platform.

In the work related to the development of the knowledge base we have started from the HF ontology developed in the first year. An overview on the existing ontologies in medicine and an analysis of the interoperability and integration issues related to ontologies have been done by FORTH. Changes were made, new terms were added, data types were used, and the ontology was organized in a set of core ontologies integrated by an upper ontology. The work has been done by CNR.
HF ontology has specified the taxonomy for the development of a large set of medical plans describing medical procedures related to the HF. The plans have been developed both in the graphical and the textual form. The work has been done by RBI.
After that we started with the transformation of information contained in medical plans to the form of production rules. The transformation is necessary because that is the form of knowledge that can be used by the decision support system. In the process we have used also human interpretation of guidelines for congestive and acute heart failure, Heartfaid deliverables, as well as other medical knowledge sources, including, but not limited to UMLS (Unified Medical Language System), Mayo clinic web site and Open Clinical web site. In the work we had strong support of medical partners. The work has been done by RBI, AUXOL, UNIMIB, and JUMC. The work resulted in 10 sets of rules.
It followed technical presentation of the procedural knowledge in the ontological form. In this way procedural knowledge has been integrated with the descriptive domain knowledge. In parallel we continued to upgrade the content and the quality of the HF ontology. The work has been done by RBI, FORTH, and UNICAL.
In order to test the quality of the developed knowledge base and in order to enable integration of the knowledge base into the decision support system we have at first developed the Closed World OWL Syntax Interpreter and integrated it into the Protégé tool. After that we have developed a web service that enables presentation of the decision support results for real patient data. Decisive step in this process has been automatic extraction of relevant patient data from the platform's database and their integration into the ontology in the form of factual knowledge. The work has been done RBI.
Finally, we have tested the performance of the knowledge base on a few real patients and iteratively corrected the knowledge base. The work has been done by UNICZ, RBI and UNICAL. This work has to be intensively continued also in the third year.

In the work related to the knowledge discovery systems we started by specification of the data warehousing requirements necessary for the preparation of the patient data for the data mining tasks. The work included implementation of the Pentaho system, specification of the transformation procedures for long and

short data sequences, and complete descriptor specification for all relevant patient data. The work has been done by RBI and SYNAPSIS.
The data preparation and transformation tasks included specification of the data preparation process for knowledge discovery and implementation of the methodology on two retrospective datasets. Special attention has been devoted to data understanding, data cleansing, and handling unknown attribute values. The work has been done by UNICAL and RBI.
In parallel we have prepared the knowledge discovery tools. UNICAL concentrated on Support Vector Machines and development of kernel especially appropriate for medical data analysis. RBI worked on subgroup discovery and survival analysis methodologies. Additionally Random Forest and subgroup discovery tools has been implemented in the form that it can be integrated into the on-line web based service. Its performance has been extensively studied.
Finally all these tools have been tested on a few retrospective data. The most of the work has been done with the ANMCO data set that includes more that 17,000 HF patients. Based on this dataset more than 50 different classification tasks have been defined. Special attention has been devoted to HF severity modelling. As the result of a few different methodological approaches, specially based on the results of ranking the attributes, a novel HF severity scale has been defined and its characteristics are evaluated by the descriptive induction approaches. The work has been done by RBI, UNICAL, and FORTH.
The work will continue also in the third year. Up to now we have used different tools independently. Now we will start to compare their performances on HF datasets in order to define optimal approaches for real platform related tasks. At the first place a comparative analysis of different methods for attribute ranking and selection of the most relevant patient properties has to be done. Additionally an effort in the appropriate visualization of the results is necessary both for application in the off-line descriptive analysis as well as for the implementation into the web service. The experimental work will continue on retrospective HF data and the patient data collected by the platform.

- **Deviation from the plan**

In Task T4.4 "Ontologies and medical knowledge representation in the domain" we had to do some extra work that have not been foreseen by the description of work. The work was necessary in order to enable a) inclusion of procedural knowledge into the HF knowledge base and b) integration of the knowledge base with the decision support subsystem. These both tasks turned out as very relevant for the performance of the platform and present a significant deviation from the plan. The reason that these tasks had not been included in the original plan is that knowledge representation and decision support on so represented knowledge are generally unsolved artificial intelligence problems and before the actual start of the work it was not clear how the solution should look like. Finally, in order to solve the problems we had to test and develop some completely new approaches that potentially present relevant results also outside the frame of this project. It follows a detailed description of reasons and results of these deviations.

By the original plan it was expected that the larger part of the work related to task T4.4 will be the construction of the HF ontology. We have done the work partially already during the first project year. Although significant effort has been invested

in this work and although the result was the large very specific HF ontology, after its construction it became obvious that its construction is not enough for effective decision support purposes. The ontology is a nice descriptive presentation of the HF domain but presentation of knowledge about relevant decision tasks (like severity assessment, medication, or treatment suggestions) has been missing. In this situation we had to find a solution for this problem.

The first thing we have done has been construction of in total 53 different medical plans representing medical procedures related to the HF. The plans have been developed both in the graphical and the textual form. The plans have been developed by the help of our medical partners and from available medical literature. The intention was to formalize and systemize medical procedural knowledge. The work has not been foreseen by the description of the work and it presents the first significant deviation from the plan.

After development of medical plans it became clear that these plans cannot be accepted by any existing decision support system. In this situation the only solution was transformation of procedural knowledge into the form of rules. The transformation was not trivial and after significant effort the work resulted by ten sets of rules. In this situation we could build the rules into an expert system and build an expert system based decision support tool. This would mean the abandonment of the basic idea of ontological knowledge representation that was foreseen by the original plan. The alternative was to use the semantic web ontology form OWL for the ontology representation and SWRL (Semantic Web Rule Language) for rule representation. This is currently a very modern approach to knowledge representation. The only problem that turned out was that semantic web assumes open world concept of logic while for our decision support purposes we need the closed world concept. The basic difference is in the way that negations are handled. The consequence is that existing and publicly available reasoners like Pellet and Racer could not be used for reasoning. In order to solve the problem we decided to code the procedural knowledge together with the descriptive knowledge into the OWL ontology. In order that this type of knowledge can be used by the decision support subsystem we had to develop original Closed world OWL Syntax Interpreter (COSI). The development of this interpreter is the second significant deviation of the plan. The interpreter is part of the current demo for the decision support functionality.

WP 5 – DATA PROCESSING AND DECISION SUPPORT SERVICES

WORK PACKAGE: 5
TITLE: DATA PROCESSING AND DECISION SUPPORT DEVICES
START DATE: MONTH 5
WORK PACKAGE LEADER: CNR
PARTNERS INVOLVED: UNICAL, SYNAPSIS, FORTH, RBI

OBJECTIVES AND ACHIEVEMENTS OF THE TASKS DUE IN THE PERIOD

TASKS AND OBJECTIVES	ACHIEVEMENTS	ACTIVITIES
T 5.2– Design and development of models and methods for signals and images processing	Methods for ultrasound, magnetic resonance and X-ray images analysis, and for ECG signals processing. Customized DICOM server for storing, managing and retrieving diagnostic images.	The activity has concentrated on the design and implementation of methods for processing and analysing diagnostic signals and images. By exploiting the careful investigations carried out in the first year and reported in deliverable D15, a set of algorithms have been assembled in a signal and image toolkit for: ▪ ECG waveform modeling and ECG pre-filtering; ▪ QRS detection and classification; ▪ chest X-ray images processing and geometrical parameters evaluation; ▪ ultrasound apical image sequences analysis, by segmentation of the left ventricle and the extraction of quantitative parameters (e.g., ejection fraction). For the mock-up prototype of the data processing toolkits, an implementation activity has been accomplished by using several libraries such as Matlab, ITK, VTK, FLTK and ImageJ. Moreover, for better illustrating the usefulness of data processing within HF patients' management, a complex scenario has been ideated and used for the mock-up of HEARTFAID Clinical Decision Support System as well. Thanks to its completeness, such a scenario has been selected as representative of the entire project; currently under development will be finalized at the end of the third year. Aiming at integrating the data processing toolkits within the platform, the problem of accessing data to perform signal and images analysis has also been addressed, leading to the idea of a HEARTFAID Image Archive. Several open-source implementations of DICOM standard databases have been investigated for selecting the most suitable for our requirements. As a result, a Java based implementation of DICOM, proposed by DCM4CHE, has been installed, customized and made available to the clinical partners for collecting relevant cases. Such a database has been also equipped with a simple and easy-to-use web-viewer for clinical access to patients and imaging studies. Moreover, an ECG viewer, with zoom and caliper options, has been developed for facilitating measurements on the ECG examinations. It has been installed at the Catanzaro validation site.
T5.4-	Careful design of	Following the deep investigation and specification

Implementation of the Decision Support System	all the functionalities of the HEARTFAID Clinical Decision Support System and development of the most important ones in a mock-up prototype for the comprehensive scenario that has selected as showcase of the system and should be finalized at the end of the third year.	activities of the first year, resulted in the definition of the requirements and functionalities of the HEARTFAID Clinical Decision Support System (CDSS), the work has been carried on by firstly designing all the components of the CDSS. This has required the definition of all the data formats used inside and outside the system, their standardized versions and their mapping; moreover the most suitable tool for developing each component has been selected. Afterward, for setting up an early prototype, a complex scenario has been defined, in strict cooperation with the medical partners, by considering an episode of an HF patient clinical course, which involves the main functionalities of the entire HEARTFAID platform and, also, triggers the application of all the CDSS components. Such a scenario has been selected as a showcase of the project and will be finalized at the end of the third year. A large amount of the implementation activities has been dedicated to the development of the showcase functionalities by distributing the load among the involved partners. Several issues have been addressed for each CDSS component and can be summarized as follows: - Ontological Knowledge Base: ▪ integration and improvement of the ontologies developed within WP4; ▪ elicitation and refinement of inference rules; - Model Base: ▪ development of computational reasoning methods for patients' decompensation early detection; ▪ analysis of the ANMCO dataset for prognosis assessment; ▪ integration within the CDSS; - Inference Engine: ▪ evaluation and test of different languages and inference modalities; ▪ consistency checking of a preliminary set of rules; - Strategy Controller: ▪ first integration of all the components; ▪ design of communications with the Middleware. The implementation activities have been carried out by using Protégé and Swoop for the ontologies; SWRL and Jena for inference rules and engine; Java (JSP and servlet) and XHML for a web-based user interface developed for testing all the integrated components and functionalities for four user contexts.

STATUS OF DELIVERABLES AND MILESTONES OF THE PERIOD

DELIVERABLE	COMMENTS
D30- Models and Methods for Signals and Images Processing	D30 summarized the activity carried out during the second year to develop the methods for processing diagnostic signals and images, and extracting relevant features from them as agreed with the medical partners. All the algorithms are described and detailed in the deliverable along with a server DICOM customized for storing, managing and retrieving the medical images collected from the medical partners.

MILESTONES	COMMENTS
MS 5.1-Early mock-up prototype of both the signals/images processing and decision support services	Some algorithms for signal and image processing or parts of them were developed for testing their functionalities and their conformity to users' expectations. Several libraries served the purpose, namely Matlab, ITK, VTK, FLTK and ImageJ. An early prototype of the CDSS was set up for testing the basic functionalities of the system, selecting the best developing directions, and testing the communications protocols with the platform middleware.

- **Description of the activities of the year-**

During the second year, the work concentrated on the development of both the toolkit of methods for diagnostic signals and images processing and HEARTFAID CDSS. The deep methodological and technological investigations of the first year and the requirements and functionalities specified in the Deliverable D15 were used as basis and reference.
In particular, the activities were aimed at accomplishing tasks 5.2 and task 5.4, both started at the beginning of M11. Details can be found below.

Task 5.2 - Design and development of models and methods for signals and images processing

The activity addressed the development of methods for supporting the analysis of signals and images relevant in HF management. In particular, both the routine clinical environment and the innovative research workflows were taken into account.
The signal processing task saw FORTH mainly involved and focused on the analysis of ECG examinations. To this end, an algorithm for ECG waveform modeling, ECG pre-filtering and QRS detection was designed and developed. More precisely, the QRS detector is based on a pre-filtering of a two-lead ECG with a moving average linear filter in the 5-15 Hz band followed by a derivative filter applied on each channel. A complex signal is then generated summing the absolute value of each derivative signal and an adaptive threshold method is applied. The method features, in particular, a best channel selection algorithm based on a noise rating system. The method was tested on MIT database, giving satisfactory results with a PPV=99.81% and a sensitivity=99.76%. The method was also adapted to process the ECG data acquired at the HEARTFAID validation site in Catanzaro. Such data consisted of short-time 12 leads recordings with 500 Hz sampling rate, instead of 30 min and 2 leads recordings with 360 Hz sampling rate available in MIT-BIH database. The results were excellent with no real false positive or false negative. The porting in C of the algorithm developed in Matlab, originally planned for performance and integration purposes, was considered unnecessary since a double check on both the available datasets revealed very satisfactory performances (sensitivity, Positive Predictive Value and execution time).
In addition, an algorithm based on a two-step Decision Tree was designed and implemented for the identification of the dominant beats in the recording. The algorithm tested on the MIT-BIH Arrhythmia database produced very satisfactory results with a Sensitivity of 98.84%, a Specificity of 95.12%, a Positive Predictive Value of 99.45% and a Negative Predictive Value of 90.22%. Activities will go

further by testing and adapting the QRST classification algorithm on the data set provided by Catanzaro, the evaluation of the averaged dominant beat and its saving in the SCP-ECG format.

Dealing with diagnostic imaging, CNR mainly worked on the analysis of chest X-ray and ultrasound (US) images for extracting relevant diagnostic parameters. Such modalities are generally used within the routine clinical practice. More precisely, US image sequences (2 and 4 chambers views) were collected from clinical partners and elaborated by, first of all, segmenting the left ventricle. A suitable initialization method for an active contour was obtained by mimetic criteria.

Supporting research workflows was also addressed and algorithms for segmenting magnetic resonance images and reconstructing the left ventricle were designed and developed.

In view of the early mock-up of HEARTFAID data processing and decision support services, a comprehensive showcase was selected and described thus allowing the study of interactions among the HEARTFAID CDSS and the data processing functionalities. The activity for the showcase implementation focused, within task 5.2, on the integration of methods for signal and image processing for parameters extraction in an automated or semi-automated fashion (for example for the computation of ejection fraction from ultrasound data).

In this framework, the problem of accessing data to perform signal and images analysis was also addressed, leading to the idea of a HEARTFAID Image Archive. Hence, a preliminary but careful analysis of echocardiography workflows was carried out for identifying the requirements for such an archive. Results highlighted needs for:

- DICOM (*Digital Imaging and Communications in Medicine*) network services
- Web access to DICOM objects
- Easy development of web interfaces for Image Archive Management
- Easy development of web interfaces for image uploading
- Implementation of IHE actors
- Extendibility to meet HFP needs (interaction with CDSS and Image Analysis Tools)
- Multi-platform or platform independent development.

Among different open-source implementations (CONQUEST, DCMTK, DCM4CHE), the Java based implementation of DICOM proposed by DCM4CHE was chosen according to the previous requirements list. Besides being an image archive, DCM4CHE provides a toolkit of standalone applications and methods to make network communication and interface development easier.

In the current installation at the CNR, DCM4CHE has an underlying MySQL database, though other choices (e.g. PostgreSQL) are conceivable.

The image analysis modules was conceived for interacting with the HEARTFAID Image Archive through standard DICOM network services (e.g. using C-FIND to retrieve images and C-STORE to save the resulting annotated images, according to DICOM terminology). Indeed, such modules were meant to be smoothly integrated in the final showcase so as to achieve easy access to the platform services, without altering substantially the routine workflow or increasing the operators' workload. To this end, the problem of accessing echocardiographic images (and more generally DICOM images) within a web-browser was addressed. Existing open source DICOM web-viewers were evaluated, including

ConQuest WADO service, DCM4CHEE WADO service, Xero and Oviyam. None of them was fully satisfying for deployment inside HEARTFAID platform. For this reason, a simple though efficient web-viewer was developed, using the JAVA implementation of DICOM standard provided by DCM4CHE. This application can be called from other applications inside HEARTFAID platform and allows for the selection of the patient context (i.e. direct visualization and retrieval of the studies of a particular patient).

Task 5.4 - Implementation of the Decision Support System

The activities focused on the realization of HEARTFAID CDSS in accordance to the requirements detailed in D15. The first steps towards this end were the evaluation of the results of the interrelated WPs, the definition of the work program, and the load distribution among involved partners. Several meetings were organized by CNR with SYNAP and UNICAL (i.e. in May, June, September and October). Moreover, a member of the CNR staff spent one month at FORTH between May and June with the aim of discussing several problems related to the CDSS prototyping. In the same period, a meeting was held in Crete (with two CNR members and two FORTH members) for evaluating the adoption of some Machine Learning techniques as computational reasoning methods (i.e. the Bayesian Networks). Some e-meetings were held between CNR and RBI between June and July for debating the integration of the ontology developed within WP4.

A computer scientist from the SYNAP staff worked until the middle of June for evaluating the ontology resulted from the WP4 activity and for studying how to develop the inferential reasoning tools. An engineer of the UNICAL staff came to work to Pisa and is still working at implementing the basic functionalities of the CDSS inference apparatus.

An operational strategy was agreed as a result of the coordination and cooperation activities and several issues were planned. In particular, each component of the CDSS, functionally defined in D15 (i.e. the Strategy Controller, the Meta Knowledge Base, the Model Manager, the Model Base, the Inference Engine and the Domain Knowledge Base), was carefully designed by detailing its scope, interactions, data handled, data format, and technologies required for development. Due to the differences among the data formats manipulated by the different components, the development of some *data mappers* was planned for integration and harmonization purposes. Decisions regarding the most suitable languages and tools were made and can be summarized as follows:

- Java as the eligible developing language;
- the eXtensible Mark-up Language (XML) for a message-based interaction between CDSS and the other platform components, in particular the Middleware;
- the Web Ontology Language (OWL) for integrating and extending the ontologies;
- the Semantic Web Rule Language (SWRL) for defining and adding rules to the Knowledge Base;
- Jena for realizing the inference engine;
- the Predictive Model Mark-up Language (PMML) for implementing the Model Base;
- a standard API, such as Java Data Mining API, for querying the Model Base.

RBI implemented and tested Closed world OWL Syntax Interpreter (COSI). The interpreter was intended for testing consistency and correctness of the developed

knowledge base. Additionally, the interpreter may be used as an interface between the HF knowledge base and the decision support subsystem. The unique property of the interpreter is that it uses closed world assumption in contrast to all other publicly available reasoners intended for reasoning from the knowledge presented in the ontological form and using OWL syntax. The basic difference is in the way that negations are handled. The interpreter has a possibility to give explanations about the reasons for obtained conclusions. Currently the interpreted is tested on the real patient data collected by the platform.

For making the work more effective and focused, a complex scenario was outlined by CNR and UNICZ for prototyping both the CDSS and the data processing toolkits (see task 5.2). It regarded a worsening event during a HF patient's clinical course and depicted a complete situation that entails almost all the CDSS functionalities, i.e. telemonitoring, visits/examinations scheduling, data exchange management, signal and image processing, therapy planning, and drug uptitration suggestions. This way, all the components of the CDSS architecture were involved in the development and could be then tested. For these reasons, such a scenario, termed the *patient's management showcase*, was selected as the project showcase and will be finalized at the end of the third year.
For the end of the second year, another showcase was planned mainly related to patients' telemonitoring and integrates some basic functionalities of CDSS.
Most of the activities carried out by CNR, UNICZ and UNICAL were focused, and will be focused in the remaining of the duration of this task, on developing the *patient's management* showcase. In particular, several meetings were held with the clinical partners (i.e., in July, and e-meetings in September and October) for eliciting the necessary pieces of knowledge, which were firstly encoded in natural language format as a set of *if-then* conditions. The correctness of the elicitation activity was also checked out. A careful analysis was then performed for assessing whether all the concepts and rules were contained in the ontology and the knowledge base developed within the WP4. This highlighted the necessity of modifying and extending the taxonomical ontology. First of all, data types were considered fundamental for a coherent representation of the domain concepts and properties. Also, terminology and definitions were checked and matched with existing, well-known medical ontologies (e.g., Medical Subject Heading, Unified Medical Language System,...). Moreover, for pursuing inference efficiency, it was decided to develop a suite of core ontologies (related to patients, diagnostic procedures, therapeutic suggestions, and so forth) integrated by means of an upper ontology; this way, when applying the ontology, it would be not necessary to transfer to the inference engine all the ontological data but only those involved in the context at hand. Reachability analysis of the rules in the knowledge base was considered useful for identifying these subsets of data. Preliminary tests performed on rules formalization highlighted some limits of SWRL language while showing the suitability of the Jena rule formalism. For this reason the former language was discarded and the work proceeded by using only the Jena tool. Preliminary work on the showcase implementation was performed by including other platform components, such as a tiny user interface, developed for testing the CDSS performance. XHTML/JSP, servlet and web services based technologies were used. A preliminary set of functionalities were set up in a preliminary demo by integrating all the CDSS components and including a web-based user interface featuring four user contexts.

Computational models for difficult decisional problems were studied and tested. A method based on a multiple classifiers approach was devised by UNICAL for the early detection of patient's decompensation by integrating the results of a Support Vector Machine (SVM) and a Decision Tree. Such a method was integrated and exposed to the platform as a web service by CNR for both the *patient's management* showcase and the showcase of the second year. The latter showcase also involved the CDSS for checking the validity of a set of telemonitored measurements.

In addition, UNICAL and FORTH studied the problem of prognosis assessment by analyzing the ANMCO dataset. Two issues were addressed:

(i) the prediction of re-hospitalization;

(ii) the prediction of the first of any type of adverse event.

The classification task was defined for 3 time thresholds 12, 18, and 24 months: for each threshold *t*, prediction regarded whether a patient would be re-hospitalized (a. above) or have any adverse effect (b. above) before or after time t.

The re-analyses included the application of advanced feature selection methods based on Markov-Blanket techniques and Bayesian Network theories, such as HITON. HITON is able to theoretically guarantee (in the sample limit and under certain broad distributional assumptions) that it will select a minimal subset of variables with the maximum predictive power. It was shown to significantly outperform in biomedical tasks univariate methods and improve the performance of classifiers such as Simple Bayes and Decision Trees. For the analysis, both polynomial and radial-basis SVM classifiers were employed.

The experimental protocol, used to produce the best classification model possible while at the same time provide an unbiased estimation of its performance, included double nested cross-validation. The protocol allowed the simultaneous optimization of the parameters of feature selection and SVM learning and the unbiased estimation of performance. Also, analysis already started within WP4 was extended with the production of the Receiving Operating Characteristic Curves (ROC) and calculation of the Area under the ROC curve (AUC) as a metric of performance. The scripts, code and tools for all the above analyses were installed and/or implemented and partial results are already available.

In addition to the above, novel methods were investigated for learning prediction models in the presence of survival censored data. This research would hopefully lead to improved methods for learning from the ANMCO dataset and similar learning tasks and to scientific publications.

The DICOM server, set up within the Task 5.2, was also integrating by CNR within the long-term showcase for accessing and analysis the stored images. Besides, suitable tools were prepared by FORTH for facilitating the doctors in properly performing the required measurements on the ECG examinations. In order of doing that, an ECG viewer with zoom and caliper tools was adapted to the "dialectal" SCP-ECG implementation of the ECG files acquired by the Archimed 4210 cardiograph. Such a viewer was installed in the clinical site of Catanzaro.

- **Deviation from the plan**

Although in accordance to planning, CNR had no person months within task 5.4, the activity carried out was not limited to simply coordinate the other partners, but can be accounted as three person months of implementation of the CDSS.

Anyway, only a really limited deviation to the cost budget is reported, as explained in the next chapter of this document.
All the activities were completed in line with the Gantt.

WP 6 – END-USER APPLICATION AND SERVICES

WORK PACKAGE: 6
TITLE: END-USER APPLICATION AND SERVICES
START DATE: MONTH 10
WORK PACKAGE LEADER: FORTHNET
PARTNERS INVOLVED: UNICAL, UNIMIB, JUMC, SYNAP, CNR, FORTH, RBI

OBJECTIVES AND ACHIEVEMENTS OF THE TASKS DUE IN THE PERIOD

TASKS AND OBJECTIVES	ACHIEVEMENTS	ACTIVITIES
T 6.1 - Design end-User Services Interaction Functionalities	**1.** The **Graphical User Interface** (GUI) has been developed.	The **Graphical User Interface** (GUI) developed has been specifically engineered in order to adhere to the multitude of functionalities and services the HEARTFAID platform is designed to accommodate.
	2. The **Front-End** of the HEARTFAID platform has been completed.	**The Front-End** design of the HEARTFAID platform has been finalized. The High Level Services, necessary for facilitating user interaction with the HEARTFAID platform, have been developed and actualized. The Front-End's intuitive hierarchical structure conforms to a user-friendly and user-oriented approach that allows users to attain the desired outcome with the minimum amount of effort.
	3. The specific **functionalities and services**, available through the HEARTFAID Front-End, have been identified and incorporated into the User Interface.	Most of the identified **functionalities and services**, attainable via the HEARTFAID Front-End, have been assimilated into the available User Interface. The latter is designed to be adaptable to modifications to current suggestions of DSS invoking queries.
	4. Security matters have been addressed and End-user services of various access levels have been arranged.	In line with the **Security** concerns raised, user profiles have been developed and appropriate functionalities for each user profile have been contrived. Double user authorization requests have been bypassed by exploiting appropriate acknowledgement techniques.
	5. A **static prototype** has been developed in order to demonstrate the concepts and approach of the desired User Interface.	**The static prototype** developed, successfully implemented the concepts and approach of the suitable User Interface. Our tests disclose the importance of robustness and stability to the development of a reliable UI.
T 6.2- Development of end-user application and services	**The instant Alert & Notification system** intended for the HEARTFAID platform, has been implemented and a working prototype has been developed, tested and deployed.	The **instant Alert & Notification system** implements an appropriately adapted variant of the Short Messaging System (SMS). The latter is being utilized in order to provide the HEARTFAID platform with the enhanced one and two-way

		communication services for the mobile user, available over a GSM network. Two instant communication prototypes has been substantiated, examined and validated. The first is based on an automatic sms alert generation whereas the second on a manual, user-driven request.
T 6.3 – Knowledge discovery system for web-based data extraction and analysis	**1.** A **blueprint** of the appropriate **attributes** relevant to the knowledge discovery process has been prepared. **2. The contrast set approach** on retrospective data has been evaluated. Various subgroup discovery algorithms have been investigated. **3.** The **Random Forest Approach** has been tested and implemented. Multiple experiments pursuing to substantiate the web based applicability of the developed Random Forest Engine have been performed.	Different types of available patient data have been identified and the **applicatory attribute construction algorithm** has been specified. A user guided approach has been considered in the implementation of the web based knowledge discovery process. The **contrast set approach** on available retrospective data has been tested and assessed. Results on the suitability of the approach towards a web based application have been obtained. The performed experiments pursuing the optimal knowledge discovery method, implemented the **Random Forest Approach**. A task scheduler has been designed which combines the tasks of retrieving the required data from an auxiliary database and initiating the knowledge discovery process.
T 6.4- Integration of Services	**Integration & Interoperability** between the different services provided by the middleware platform has been set a first priority issue.	Special provisions have been considered in order to ensure that the integrated platform will be **accessible anywhere/anytime** from either desktop or mobile devices. A variety of tests and verification analyses have been performed. More needs to be done and we are, currently, in the process of designing and preparing efficient testing methods in order to guarantee the optimal operation of the platform.

STATUS OF DELIVERABLES AND MILESTONES OF THE PERIOD

DELIVERABLE	COMMENTS
D23-User needs analysis and functional specifications of the HEARTFAID platform services	The analysis of the prerequisites of the implementation has been performed along with the development of organization and management models for the optimal operation of the platform services.
D31- Knowledge Discovery Systems	The KD method has been determined. The Random Forest (RF) approach has been singled out of the possible resolutions due to its advanced characteristics and implementation potential. RF integration to the Front-End has also been examined. The Security aspects of the system have been analyzed.
MS 6.1-Early Mock-up prototype of the HEARTFAID web-based platform of services	A first prototype has been developed which incorporates the actualized KD system, the electronic Case Report Form along with the unified registration process for the end users.

Description of the activities of the year

T6.1 – Design End-User Services Interaction Functionalities

The Front-End layer of the HEARTFAID platform is the Graphical User Interface (GUI) that conforms to the common conventions of most popular web applications. The Front-End is divided into modules and sub-modules. Cross-references between sections have also been incorporated, where they enhance usability. The HEARTFAID middleware platform supports a multitude of functions to assist data entry and retrieval, promoting meanwhile intelligent deduction methods.

Implementing clean interfaces to connect software components has been quite an important task of the project. Considering that in many cases the project encompasses distributed computing resources (e.g. software like processes, data or hardware resources like, for instance, embedded micro or nano-devices, gateways, servers or storage devices) the design complexity for component interfaces grew rapidly involving mechanisms for inter-processing communication, design of information exchange protocols, remote service requests and remote service discovery, synchronization, as well as the general handling of heterogeneity. One of the main priorities in the design of the front-end was to adapt an intuitive hierarchical structure, in order to allow users to reach the desired functionality with the minimum possible effort, keeping always in mind that most of these users are not familiar with various technological aspects.

Many groups of people will be affected by the services HEARTFAID offers. These groups have been individually identified and classified into user profiles, to assist in user rights and accessibility management. The user groups range from specialized nurses and general practitioners, up to specialized doctors, the patients and their relatives. The requirements of each user profile have been studied separately and the facilities to be offered are based on the conclusions drawn from the analysis that took place earlier.

T 6.2 – Design of End User Applications And Services

The instant communication method of the Short Messaging System (SMS), is being utilized in order to provide the HEARTFAID platform with the enhanced one and two-way communication services available over a GSM network for mobile users.
The main issues for the alert and alarm service have been the existence of an advanced user profiling method along with the appropriate cognitive techniques that should be in place in order to dynamically compose and send alert and notification messages to HEARTFAID users according to their attributes and their individual personal profile.

Depending on the values of the measurements received by the HEARTFAID platform from the appropriate sensors (please refer to the section on Data Acquisition-WP2), several alarms may be raised. If an alarm is fired in the middleware platform, the notification process is triggered. The appropriate message is formulated, including the measurements that caused the alarm and

other assistive data. The message may be sent by SMS or e-mail, depending on the means selected by the patient or the care-taker.

The SMS notification module offers a clear-cut XML-based communication interface, through which authorized clients may submit their requests. The whole process is fully automated and commences with the reception of a well-formed XML document, containing the message subject, the message body and the message recipients. The SMS notification module manages the XML unmarshaling, the SMS marshaling and the dispatch and monitoring of the SMS.

When the message arrives at its destination, the patient, care-taker or clinician is able to view the informative description of the alarm on their mobile phone quickly and easily and, thus, proceed to the appropriate actions.

T 6.3 – Knowledge Discovery System for Web-Based Data Extraction and Analysis

The Knowledge Discovery System aims at appropriately exploiting a suitably organized data repository in order to derive valid and relevant results. Important is the possibility to export and present the output in an intuitive and user-friendly manner, enabling the user to make the best possible decision out of the available resources. Knowledge Discovery is not a trivial process and may encompass many, sometimes self-conflicting, components. Since the required features stand on the premise of comprehensive input parameters, reasonable execution time, high output quality and rapid database scanning, the appropriate algorithm to base the data mining tool has been chosen to be the Random Forest (RF). The latter assimilates such characteristics that satisfy all the imposed prerequisites as well as introduces features (such as missing data handling, classification error balancing) that have the potential of enhancing the Knowledge Discovery process.

The Random Forest approach has been incorporated into the Web service by making use of the task scheduler which is responsible to execute and manage tasks. The main principle behind the integration of the RF engine into the web interface is the level of intuitiveness of the tool as well as the ease of use and the graspable display of the output. The KD service is implemented as a series of interconnected web pages or web forms. The task scheduler executes data mining tasks on specified data in a given order and priority. The scheduler has the ability to execute multiple jobs at the same time (multitasking) depending on the number of processors and available memory.

The Contrast Set Approach on retrospective data has been considered and evaluated. Various subgroup discovery algorithms have been considered and assessed.

T 6.4 – Integration of Services

The use of iFrames has been incorporated so as to bypass possible double authorization requests from the various services that are invoked. The use of iFrames has some security related issues which are being dealt with, along with the general security principles that have been a priori set for the platform to

operate, by the introduction of the appropriate security policy. The security policy model that has been adopted by HEARTFAID that describes the properties that a system should possess in order to implement a satisfactory secure transient association is the Resurrecting Duckling Policy. Each device a user invokes gets imprinted on either the server or the gateway and thus gets authenticated for HEARTFAID.

Methods for the optimal device, user, platform interaction have been considered and many tests have been performed involving medical appliances of various specifications and development vendors. More tests in that direction are being considered and an improved model for the better interoperability between software and hardware is being evaluated.

WP 8 – DISSEMINATION AND EXPLOITATION

WORK PACKAGE: 8
TITLE: DISSEMINATION AND EXPLOITATION
START DATE: MONTH 1
WORK PACKAGE LEADER: UNICAL
PARTNERS INVOLVED: UNICZ, UNIMIB, JUMC, SYNAP, CNR, FORTH, RBI, AUXOL

OBJECTIVES AND ACHIEVEMENTS OF THE TASKS DUE IN THE PERIOD

TASKS AND OBJECTIVES	ACHIEVEMENTS	ACTIVITIES
T 8.1 – Dissemination Activities	Scientific publications. Partecipation to conferences and workshops. Interaction with professional medical associations. Project Web Site. Press releases.	The dissemination activities of the second reporting period of the project have been carried out according to the planning defined in the deliverable D6. In particular, the activities have been run on the basis of the following issues: - Internal Dissemination: each partner has organised internal dissemination activities (seminars, press releases, relevant information published on the own web site), with the aim to improve the general awareness about Heartfaid within their own institutions. - Project Web Site: all public deliverables are available on the site. Special pages are under construction and will be devoted to the dissemination of the results of the project. - Conferences Exhibitions and Scientific Publications: as it has been reported in the next table, many partners have presented the project at European and national conferences and exhibitions. Moreover, some scientific papers have been already published or submitted to peer review journals. - Clustering and Concertation Meetings: an important clustering activity has been organized by the consortium with other FP6 e-Health projects. - Intermediaries: contacts have established with the following health care professional associations with the aim to keep informed about the Heartfaid activities: ANMCO (Italian Association of Hospital Cardiologists), SIC (Italian Society of Cardiology), SIMI (Italian Society of Internal Medicine), EMA (European Medical Association).
T 8.2- Exploitation Activities		- The exploitation activities have been started by the assessment of the new organization and management model proposed in the deliverable D8. - Analysis and evaluation of exploitable “parts” of the current project’s results.

STATUS OF DELIVERABLES AND MILESTONES OF THE PERIOD

DELIVERABLES	COMMENTS
D 32- Second Report on Dissemination activities	Completed in line with the Annex I

DISSEMINATION EVENTS

Date	Channel	Event	Place/ Country	Partner Respons.	Nature and size of audience
12-13 Feb. 2007	Oral Presentation	Int. Conf. on Personal Health Systems Internal Meeting with the ref. of MyHeart and ACGT	Brussels Belgium	UNICAL FORTH	Members of FP6 e-Health projects About 8 partecipants
March 2007	Oral Presentation	Internal Meeting of the Italian Association of Hospital Cardiologists	Rome Italy	UNICZ	Medical Doctors About 20 partecipants
15 April 2007	Oral Presentation	Italian Society of Cardiology Advanced School in Nursing Science	Amantea (Cosenza) Italy	UNICZ	Medical Doctors and Nurses About 50 partecipants
19-21 April 2007	Oral Presentation	Sicily and Calabria Congress of Italian Society of Internal Medicine	Vibo Valentia Italy	UNICZ	Medical Doctors About 100 partecipants
21-25 May 2007.	Paper Presentation	MIPRO - International Convention 2007	Opatija, Croatia	RBI	150 participants
22-25 May 2007	Paper Presentation	PAKDD 2007, 11th Pacific-Asia Conference on Knowledge Discovery and Data Mining	Nanjing, China	JSI + RBI	350 participants
8-10 June 2007	Oral Presentation	ICMCC 2007 (Int. Council on Medical and Care Compunetics)	Amsterdam, The Netherlands	VMWS	150 partecipants
20-22 June 2007	Invited presentation	pHealth 2007	Porto Carras, Chalkidiki, Greece	FORTH	50 participants
25-28 June 2007	Paper Presentation	ITI 2007, 29th International Conference Information Technology Interfaces	Cavtat, Croatia	RBI	200 participants
26-30 June 2007	Paper Presentation	MEDICON 2007, 11th Mediterranean Conference on Medical and Biological Engineering and Computing	Ljubljana, Slovenia	JSI + RBI	250 participants
07-11 July 2007	Paper Presentation	11th Conference on Artificial Intelligence in Medicine AIME2007	Amsterdam, The Netherlands	RBI	100 participants
18 July 2007	Conference	International Conference of mass-data analysis of images and signals in Medicine, Biotechnology and Chemistry MDA 2007	Leipzig Germany	CNR	

3 August 2007	Message to the official web site	Croatian Cardiology Society	Zagreb, Coroatia	RBI	Croatian Cardiology Society
20-23 August 2007	2 Oral Present.	7th Open German-Russian Workshop on Pattern Recognition and Image Understanding	Ettlingen, Germany	CNR	200 participant
20-28 August 2007	Poster Presentation	ACAI 2007 Logic for Artificial Intelligence	Leuven, Belgium	RBI	50 participants
17 Sept. 2007	2-hours long seminar	DSP Application Day, University of Milan, Department of Computer Science and Communication. Seminar on "Methods for image processing" featuring the description of the activity carried out within HEARTFAID Project as example	Milan, Italy	CNR	~100 participants (computer science students and researchers)
30 Sep. - 3 Oct. 2007	2 Oral Presentations	Computers in Cardiology 2007	Durham, NC, USA	FORTH	300 participants (engineers, computer scientists and cardiologists)
4 October 2007	sharing the results	Stanford University Medical Center	Stanford, California, USA	RBI	Partners on the project of etiology of congestive heart failure
23-24 October 2007	4-hours long seminar	"HEALTH CARE" module of the Master in Computational Science organized by NEC-CESIC. Seminar on "Biomedical image processing" featuring the description of the activity carried out within HEARTFAID Project as example	Cosenza, Italy	CNR	~20 participants (students)
13-15 Dec. 2007	Paper Presentation	AITIM 2007 National Congress of the Italian Association of Medical Informatics	Bari Italy	UNICAL	About 100 experts among medical informatics and medical doctors
15-18 Dec. 2007	Paper Presentation	National Congress of the Italian Society of Cardiology	Rome, Italy	UNICZ	About 100 medical doctors and cardiologists
18-20 Dec. 2007	Paper Presentation	4th Workshop on Semantic Web Applications and Perspectives (SWAP 2007)	Bari, Italy	CNR – UNICZ-UNICAL	140
09 January 2008		Meeting of Cracow Division of Polish Hypertension Society	PL	JUMC	Physicians, about 100 persons
13 January 2008		Meeting of Department's staff	PL	JUMC	Medical staff, about 20 persons

22-23 January 2008	Paper Presentation	First Workshop on Image Mining. Theory and Appplications. In conjunction with VISAPP2008	Funchal, Madeira, Portugal	CNR	30
28 January 2008	Invited talk at Ludwig Boltzmann Institute for Traumat.	"Computational intelligence in healthcare and medicine: examples from HEARTFAID project"	Vienna, Austria	RBI	30 medical doctors
30 January 2008	Conference presentation	"Medical knowledge representation within heartfaid platform" HealthInf 2008	Funchal, Madeira, Portugal	RBI	20 conference participants and similar EU project representatives
30 January 2008	Organiz. of the Event and Paper Presentation	Int. Conference on Health Informatics HEALTHINF2008 – Special Session on Knowledge Discovery and Decision Support Systems in Health Information Systems	Funchal, Madeira, Portugal	CNR FORTH UNICZ UNICAL	About 30 experts in e-Health issues

Table 1: Deliverables List

Del. N.	Deliverable Name	Work Package	Due Date	Delivery Date	Lead Contractor
D18	5th Quarterly Report	WP 0	Month 15	15/06/2007	UNICAL
D19	Prototype of Data acquisition and transmission Infrastructure	WP 2	Month 18	14/09/2007	VMWS
D20	Clinical Standards and first middleware prototype	WP 3	Month 18	16/11/2007	SYNAP
D21	Functional Specifications of data warehouse Implementation and Data Preparation	WP 4	Month 18	14/09/2007	RBI
D22	Ontologies and knowledge preparation	WP 4	Month 18	14/09/2007	RBI
D23	User needs analysis and functional specifications of the HEARTFAID platform services	WP 6	Month 18	16/11/2007	FORTHNET
D24	6th Quarterly Report	WP 0	Month 18	14/09/2007	UNICAL
D25	7th Quarterly Report	WP 0	Month 21	14/12/2007	UNICAL
D26	2nd Periodic Report	WP 0	Month 24	18/03/2008	UNICAL
D27	2nd Periodic Report on the distribution of the Community Contribution	WP 0	Month 24	18/03/2008	UNICAL
D28	Integration and Interoperability middleware prototype	WP 3	Month 24	20/03/2008	SYNAP
D29	Models and Methods for Knowledge discovery	WP 4	Month 24	15/03/2008	RBI
D30	Models and Methods for Signals and Images processing	WP 5	Month 24	15/03/2008	CNR
D31	Knowledge Discovery Systems	WP 6	Month 24	18/03/2008	FORTHNET
D32	Second Report on Dissemination Activities	WP 8	Month 24	19/03/2008	UNICAL
D33	8th Quarterly Report	WP 0	Month 24	15/03/2008	UNICAL

Table 2: Milestones List

Milestone N.	Milestone Name	Work Package	Due Date	Delivery Date	Lead Contractor
MS 0.2	2nd Periodic Report	WP 0	31/1/2008	18/03(2008	UNICAL
MS 2.2	Technological Infrastructure for the acquisition and transmission of the relevant BM data	WP 2	31/7/2007	14/09/2007	VMWS
MS 3.2	Early Mock-up prototype implementation of the Data Management and exchange System	WP 3	31/7/2007	15/11/2007	SYNAP
MS 3.3	HEARTFAID Middleware prototype	WP 3	31/1/2008	20/03/2008	SYNAP
MS 4.1	Ontologies and Knowledge Representation	WP 4	31/7/2007	14/09/2007	RBI
MS 4.2	Knowledge Discovery in Database Turning	WP 4	31/1/2008	14/03/2008	RBI
MS 5.1	Early mock-up prototype of data processing	WP 5	31/7/2007	14/09/2007	CNR
MS 6.1	Early mock-up prototipe of HEARTFAID web-based platform of services	WP 6	31/1/2008	20/03/2008	FORTHNET

Section 3 – Consortium Management

WP0 – PROJECT MANAGEMENT

WORK PACKAGE: 0			
TITLE: MANAGEMENT			
START DATE: MONTH 1			
WORK PACKAGE LEADER:UNICAL			
PARTNERS INVOLVED:UNICZ, UNIMIB, VMWS , FORTHNET, SYNAPSIS, CNR, RBI			
MEETINGS	PLACE	DATE	ATTENDANTS
WP 0 Meeting	Milan	19/02/ 07	UNICAL/UNIMIB/AUXOL
MB & STAB Meeting	Milan	20-21/02/07	Hosting:UNIMIB/AUXOL Attendants MB & STAB
1st Review Meeting	Brussels	27-28/03/07	Coordinator:UNICAL Attendants:MB & STAB
MB & STAB Meeting	Zagreb	24-25/06/07	Hosting : RBI & Dr. Krstacic Attendants:MB & STAB
MB & STAB Meeting	Krakow	8-9/11/2007	Hosting: JUMC Attendants:MB & STAB

OBJECTIVES AND ACHIEVEMENTS OF THE TASKS DUE IN THE PERIOD

TASKS AND OBJECTIVES	ACHIEVEMENTS	ACTIVITIES
T 0.1 Overall management of the Consortium	Good interaction and coordination among all the partners.	Thanks to the excellent cooperation given by each partner, including the ones who have no man month allocation for this WP, UNICAL settled a Consortium network that will meet project requirements and no substantial delay has been reported during the second year of activity. The task has been carried out guarantying communication of management information to the Consortium, collection of management reports and feedbacks from all partners. The task has been carried out virtually (mainly through e-mails) and non-virtually, through direct phone calls and meetings, ensuring a punctual answer to internal management questions and issues. Thanks to a strong cooperation and contribution of the entire Consortium through WP leaders, it has been possible to forward the due documents on time, except for a slight delay in D20 and D23, mainly motivated by a better refinement of some important parts of the deliverables. Preparation for the reporting period in terms of practical aspects, collection of contribution, financial information for the 2nd periodic management report, filtering information between the Consortium and the Commission
T 0.2 Co-ordination of	Definition of the coordination	The task has included the co-organisation of the steering meeting and the collection of all reports.

the Consortium Activities	strategies within each WP and interaction between WP leaders and coordinator.	involved within each WP. Permanent communication with the Consortium for all enquiries and information Commission and Consortium related. Evaluation of possible co-operation with other projects and programmes . Overall management of Deliverables of all WPs, collection of all related material with the contribution of all WPs and of the entire Consortium.
T 0.3 Management of contractual, legal, financial and administrative procedure of the consortium,		The task has been ensured and, when necessary, provided information to the Consortium while an internal 6 moths cost statement has been collected. The activities of this task became more intense at the outcome of the first periodic Report and consequent pre-financing handling and its distribution and towards the second reporting period. Collection of 6 months internal cost statement: as stated in Heartfaid Consortium Agreement the coordinator has collected the above mentioned forms from each contractor to monitor the expenses from the start of the project Finally, each partner has been responsible for all other direct issues with the coordination unit within the deadlines.
T 0.4 Internal Communication infrastructure	Development of the Project web Site	The communication infrastructure for supporting the overall project management has been established by the improvement and extension of the services and functionalities provided by the project web site. The internal communication infrastructure has been realized by the services and functionalities provided by the Internal side of the Project Web Site. Further support has been realized by audio conference services.

LIST OF WP0 DELIVERABLES AND MILESTONES OF THE PERIOD

DELIVERABLE	DUE DATE	COMMENTS
D18 5th Quarterly Report	Month 15	On time
D24 6th Quarterly Report	Month 18	On time
D25 7th Quarterly Report	Month 21	On time
D26 2nd Periodic Report	Month 24	On time
D27 2nd Periodic Report on the distribution of the Community Contribution	Month 24	On time
D33 8th Quarterly Managerial Report	Month 24	On time
MILESTONE	DATE	COMMENTS
MS 0.2 – 2nd PERIODIC REPORT	Month 24	With deliverable D26 of this periodic report details have been defined and reported .

General Comments

Management activities for the period reported have concentrated on the tasks above mentioned in order to ensure the smooth running of the project.
Through the collection of information and feedbacks from each partner and each work package, UNICAL has been able to send due reports to the Commission.

Involvement from the Consortium:
All partners have been actively involved in WP0 activities of the year, in particular JUMC, RBI, UNIMIB and AUXOL organized HEARTFAID MB & STAB meetings during the year .
The meeting held in Zagreb has been co-organized by RBI and External Advisors Goran Krastacic and Nada Lavrac and attended by Dr. Krstacic personally.

Future meetings

MEETINGS	PLACE	DATE	ATTENDANTS
MB & STAB Meeting	Milan	18-19/02/08	Hosting:UNIMIB/AUXOL Attendants MB & STAB
Review Meeting	Milan	11/04/08	Organisers:UNIMIB/AUXOL/UNICAL Attendants:MB/ PO/ Reviewers

Appendix 1 – Plan for using and disseminating the knowledge

HEARTFAID is a research and development project aimed at devising, developing and validating an innovative knowledge based platform of services, able to improve early diagnosis and to make more effective the clinical management of heart diseases within elderly population.
In very general terms, the project aims at a broader availability and extension of IST applications and services. In particularly, by exploiting the up-to-date scientific achievements on knowledge representation, management, discovery and decision support systems, the main project goal is to develop new systems and services that are able to effectively integrate and process relevant biomedical data and information for improving medical knowledge and processes related to the clinical management of Heart Failure (HF) patients.
Moreover, according to the overall vision of the IST priority in FP6, HEARTFAID project proposal aims to contribute in developing innovative intelligent environments that enable ubiquitous, effective and efficient management of citizens' health conditions and supporting health professionals in coping with major health challenges. In particular, HEARTFAID provides healthcare professionals with access to timely relevant information at the point of need (i.e. different types of health care delivery environments), with a set of functionalities and services for acquiring up-to-date relevant medical knowledge that will provide a reliable support to healthcare professionals in their daily medical and clinical operations, enabling new ways of working as well as improved patient quality.
Under this respect, it is of strong strategic importance for HEARTFAID to devise and effectively implement exploitation and dissemination strategies, with the aim to emphasize the overall impact of the project's results.

Section 1 - Exploitable knowledge and its Use

As far as the "***using knowledge***" issues are concerned, since HEARTFAID is a project mostly implementation oriented, theoretical and methodological work are currently being rapidly converted to experimental and practical applications. Furthermore, the knowledge and experiences gained from practical experiments are going to be used by the HEARTAFAID partners for defining the next generation of products and services in the relevant domain.
More specifically, the industrial partners are developing a detailed exploitation plan, based on the following steps: identification and evaluation of the most promising exploitable "parts" of the project results; identification of the market segments; detailed business plan; detailed identification of the potential markets and the competitive environment; assessment of benefits by end-users; establishment of a commercial agreement among partners on the joint commercialization and exploitation after project end; after project completion, development of the prototypes into industrial products.
At the end of the second year of activity (second reporting period), the obtained results which could have an exploitable relevance are the following:

- Data acquisition and transmission infrastructure from home care environment (Ambient Intelligence System).

- e-CRF (electronic-Case Report Form): integrated informative tool for the collection and storing of all the clinical data and information of the Heart Failure patient.
- Medical Knowledge Base: integrated tool which implements and codes the descriptive and procedural medical knowledge of the heart failure domain.
- Clinical Decision Support System for the management of the chronic heart failure patient.
- Signal Analysis Toolkit for the management, processing and features extraction of the ECG signals.
- Image Analysis Toolkit for the management, processing and features extraction of the EcoCG images.

Section 2 – Dissemination of knowledge

As far as the "***disseminating knowledge***" issues are concerned, it is of strong interest to the HEARTFAID project and its partners to disseminate its ideas and results to a community as wide as possible. Dissemination is an important interactive interface for the project for getting continued feedback on ideas and concept refinement.
The dissemination activities of the first reporting period of the project have been carried out according to the planning defined in the deliverable D6. In particular, the activities have been run on the basis of the following issues:

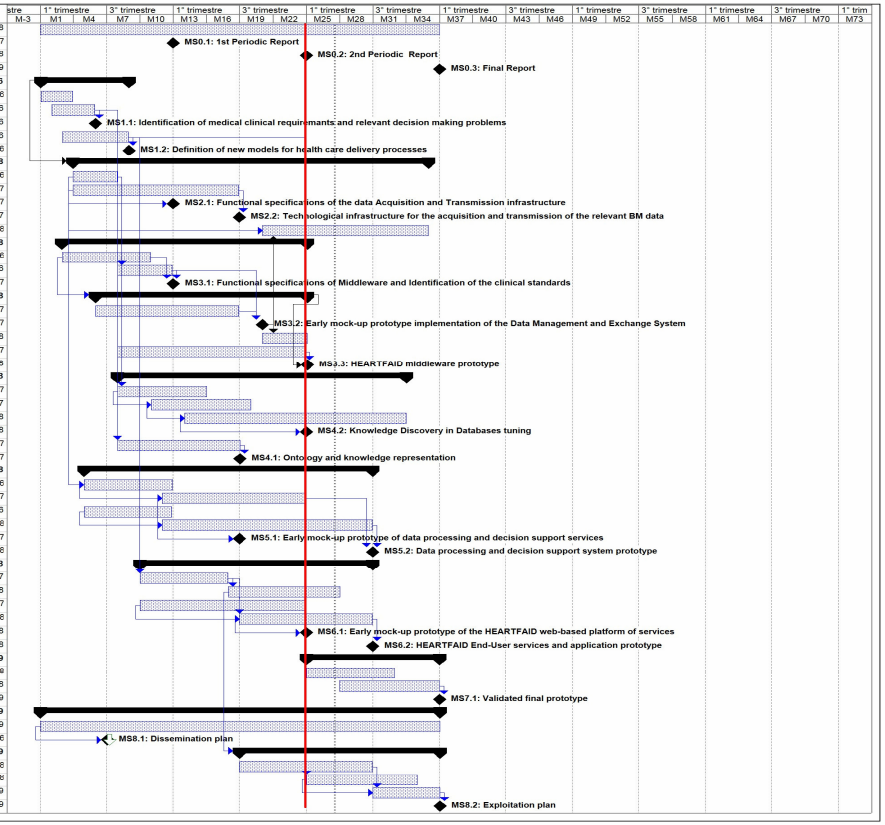
- Internal Dissemination: each partner has organised internal dissemination activities (seminars, press releases, relevant information published on the own web site), with the aim to improve the general awareness about Heartfaid within their own institutions.
- Project Web Site: the project web site has been established and is currently under revision and improvement. All public deliverables will be available on the site. Special pages are under construction and will be devoted to the dissemination of the results of the project.
- Conferences Exhibitions and Scientific Publications: as it has been reported in the next table, many partners have presented the project at European and national conferences and exhibitions. Moreover, some scientific papers have been already published or submitted to peer review journals.
- Clustering and Concertation Meetings: the coordinator partner has participated in clustering and concertation meetings organized by the Commission.
- Intermediaries: contacts have established with the following health care professional associations with the aim to keep informed about the Heartfaid activities: ANMCO (Italian Association of Hospital Cardiologists), SIC (Italian Society of Cardiology), SIMI (Italian Society of Internal Medicine), EMA (European Medical Association).

The plan for the next future activities is mainly characterized by the further improvement and realization of the following specific activities:

- Heartfaid Project Web Site, with improvement of the pages dedicated to dissemination and community.
- Conference Exhibitions and Scientific and Technical Publications.
- Clustering and Concertation events especially among FP6 and Fp7 e-Health projects.
- Professional Associations, by enhancing and consolidating the contacts at national and European levels.

PROJECT BARCHART AND STATUS

ID	Nome attività	Durata	Inizio	Fine
1	**WP0:Management**	787 g	dom 01/01/06	mer 31/12/08
2	MS0.1: 1st Periodic Report	0 g	lun 01/01/07	lun 01/01/07
3	MS0.2: 2nd Periodic Report	0 g	mar 01/01/08	mar 01/01/08
4	MS0.3: Final Report	0 g	gio 01/01/09	gio 01/01/09
5	**WP1: HEART FAILURE DOMAIN ANALYSIS**	**175 g**	**lun 02/01/06**	**ven 01/09/06**
6	T1.1 - SoA analysis of the medical and clinical processes in the domain	65 g	lun 02/01/06	ven 31/03/06
7	T1.2 - Problem statement and formulation of the relevant Decision Making pr	86 g	mer 01/02/06	mar 30/05/06
8	MS1.1: Identification of medical clinical requirements and relevant decision m	0 g	gio 01/06/06	gio 01/06/06
9	T1.3 - Organization and management models for the Healthcare delivery	132 g	mer 01/03/06	mer 30/08/06
10	MS1.2: Definition of new models for health care delivery processes	0 g	ven 01/09/06	ven 01/09/06
11	**WP2: BIOMEDICAL DATA IDENTIFICATION AND COLLECTION**	**699 g**	**sab 01/04/06**	**lun 01/12/08**
12	T2.1 - Identification of all BM, signs and symptoms relevant to the hearth fail	87 g	sab 01/04/06	lun 31/07/06
13	T2.2 - Design and development of the data Acquisition and Transmission infr	327 g	sab 01/04/06	ven 29/06/07
14	MS2.1: Functional specifications of the data Acquisition and Transmission inf	0 g	lun 01/01/07	lun 01/01/07
15	MS2.2: Technological infrastructure for the acquisition and transmission of th	0 g	dom 01/07/07	dom 01/07/07
16	T2.3 - Data Collection	327 g	lun 03/09/07	lun 01/12/08
17	**WP3: MIDDLEWARE, INTEROPERABILITY AND INTEGRATION**	**484 g**	**mer 01/03/06**	**gio 03/01/08**
18	T3.1 - Middleware requirements and functional specifications	176 g	mer 01/03/06	lun 30/10/06
19	T3.2 - Identification of the clinical standards for representation and communic	109 g	mar 01/08/06	gio 28/12/06
20	MS3.1: Functional specifications of Middleware and Identification of the clinic	0 g	lun 01/01/07	lun 01/01/07
21	**T3.3 - Integration Middleware**	**417 g**	**gio 01/06/06**	**gio 03/01/08**
22	T3.3.1 - Early mock-up prototype implementation of the Data Manageme	283 g	gio 01/06/06	ven 29/06/07
23	MS3.2: Early mock-up prototype implementation of the Data Manageme	0 g	lun 03/09/07	lun 03/09/07
24	T3.3.2 - Prototype refinement	89 g	lun 03/09/07	gio 03/01/08
25	T3.4 - Interoperability Middleware	370 g	mar 01/08/06	ven 28/12/07
26	MS3.3: HEARTFAID middleware prototype	0 g	gio 03/01/08	gio 03/01/08
27	**WP4: KNOWLEDGE REPRESENTATION, DISCOVERY AND MANAGEMENT**	**569 g**	**mar 01/08/06**	**mer 01/10/08**
28	T4.1 - Implementation of a suitable data warehouse for knowledge discovery	176 g	mar 01/08/06	lun 02/04/07
29	T4.2 - Data understanding and preparation	196 g	mer 01/11/06	mer 01/08/07
30	T4.3 - Implementation of Knowledge Discovery in Databases processes	436 g	gio 01/02/07	mer 01/10/08
31	MS4.2: Knowledge Discovery in Databases tuning	0 g	mar 01/01/08	mar 01/01/08
32	T4.4 - Ontologies and medical knowledge representation in the domain	241 g	mar 01/08/06	lun 02/07/07
33	MS4.1: Ontology and knowledge representation	0 g	lun 02/07/07	lun 02/07/07
34	**WP5: DATA PROCESSING AND DECISION SUPPORT SERVICES**	**568 g**	**lun 01/05/06**	**lun 30/06/08**
35	T5.1 - Identification of representation features for signals and images process	176 g	lun 01/05/06	ven 29/12/06
36	T5.2 - Design and development of models and methods for signals and imag	282 g	ven 01/12/06	lun 31/12/07
37	T5.3 - Requirements and functional specification of the Decision Support Sys	174 g	lun 01/05/06	mer 27/12/06
38	T5.4 - Implementation of the Decision Support System	413 g	ven 01/12/06	lun 30/06/08
39	MS5.1: Early mock-up prototype of data processing and decision support ser	0 g	lun 02/07/07	lun 02/07/07
40	MS5.2: Data processing and decision support system prototype	0 g	lun 30/06/08	lun 30/06/08
41	**WP6: END-USERS APPLICATIONS AND SERVICES**	**458 g**	**dom 01/10/06**	**mar 01/07/08**
42	T6.1 - Design of the End-User Services Interaction functionalities	175 g	dom 01/10/06	gio 31/05/07
43	T6.2 - Development of End-User applications and services	220 g	ven 01/06/07	mer 02/04/08
44	T6.3 - Knowledge discovery system for web-based data extraction and analys	327 g	dom 01/10/06	lun 31/12/07
45	T6.4 - Integration of Services	262 g	lun 02/07/07	lun 30/06/08
46	MS6.1: Early mock-up prototype of the HEARTFAID web-based platform of s	0 g	mar 01/01/08	mar 01/01/08
47	MS6.2: HEARTFAID End-User services and application prototype	0 g	mar 01/07/08	mar 01/07/08
48	**WP7: TESTING AND VALIDATION**	**263 g**	**mar 01/01/08**	**gio 01/01/09**
49	T7.1 - Deployment of the prototypes in suitable clinical settings	175 g	mar 01/01/08	ven 29/08/08
50	T7.2 - Clinical validation	197 g	mar 01/04/08	mer 31/12/08
51	MS7.1: Validated final prototype	0 g	gio 01/01/09	gio 01/01/09
52	**WP8: DISSEMINATION AND EXPLOITATION**	**788 g**	**dom 01/01/06**	**gio 01/01/09**
53	T8.1 - Dissemination activities	788 g	dom 01/01/06	gio 01/01/09
54	MS8.1: Dissemination plan	0 g	lun 03/07/06	lun 03/07/06
55	**T8.2 - Exploitation activities**	**395 g**	**lun 02/07/07**	**gio 01/01/09**
56	T8.2.1 - Investigation of new models for Heathcare Processes	262 g	lun 02/07/07	lun 30/06/08
57	T8.2.2 - Cost/benefits analysis	220 g	mar 01/01/08	ven 31/10/08
58	T8.2.3 - Exploitation plan	133 g	mar 01/07/08	gio 01/01/09
59	MS8.2: Exploitation plan	0 g	gio 01/01/09	gio 01/01/09



PERIODIC MANAGEMENT REPORT

Section 1 - Justification of Major Cost Items and Resources

UNICAL

UNICAL Costs (for the second year)

	EU contribution	UNICAL contribution
Personnel	**85129,00**	**46940,00 (10 MM)**
of which subcontracting	**1105,99**	**0,00**
Equipment	**548,83**	**6500,00**
Travelling	**12787,15**	**2000,00**
Other costs	**1773,40**	**0,00**
Indirect costs	**19826,48**	**0,00**
TOTAL	**120064,86**	**55440,00**

UNICAL personnel by work-package (Man/Months)

WP's	EU Contribution	UNICAL Contribution
WP0	4 planned 4	3
WP4	12,2 planned 11	3
WP5	9,6 planned 6	3
WP6	1 planned 1	0
WP8	3 planned 3	1
TOTAL	**29,8 planned 25**	**10**

Explanatory note on major costs

Major costs have been for personnel costs and travelling. Direct Costs refer to:

- **Personnel** costs for additional supporting of research and technological development innovation activities and consortium management activities. They concern about the establishment of 5 temporary contracts for 5 external personnel contribution (29,8 MM), with a total gross amount of Euro **85129,00**. The subcontracting of Euro 1105,99 is motivated by a small external contribution for the development of the Project Web Site.
- **Travelling** costs for the participation of internal and external personnel to the Steering Meetings of the project, to specific technical and management meetings with other partners, to national and international conferences and workshops related to the activities of the project, to the participation of clustering and concertation meetings. The total amount is **Euro 12787,15**.
- **Equipment** costs have been charged according to the following depreciation formula (typically used by UNICAL): **A/B x C x D**, where A period of use, in months, for the project; B depreciation period; C equipment cost; D use, in percentage, of the equipment for the project.
- **Other costs** are related to consumables and services.

It is important to observe that the total costs reported for the second year of activity include also some costs related to activities carried out during the first reporting period but effectively charged during the second year (see the following note on the Adjustment of the previous period).

The contribution of UNICAL to the project in this second year was the following:

- The internal personnel contributed of total 10 MM: 7 MM of associate professors, 1 MM of assistant professor, 1 MM administrative director and 1 MM administrative secretary.
- Travelling costs for the participation to steering meetings, technical and management meetings, international conferences.
- Partial usage of already available equipments: 4 Personal Computers, 2 Laser Printer, 1 Video Projector.

Deviations from the cost budget and from person-month budget

The deviations from the cost and person-month budget are related to more effort in terms both of financial and personnel resources dedicated to the WP4 (12,2 MM planned 11 MM) and WP5 (9,6 MM planned 6 MM).

Adjustment to previous period

According to the results of the Audit Certificate procedure, the following table reports the ***new correctly computed total costs of the first reporting period***:

TABLE-A	**RTD**	**M.of C.**	**TOTAL (euro)**
	(A)	**(D)**	**(F)= A+D**
Direct costs	€ 39.811,93	€ 9.668,80	**€ 49.480,73**
of which subcontracting	€ 8.294,93		**€ 8.294,93**
Indirect costs	€ 7.962,39	€ 1.933,76	**€ 9.896,15**
SUBMITTED TOTAL COSTS	**€ 56.069,25**	**€ 11.602,56**	**€ 67.671,81**

It is worth while to observe that the subcontracting of Euro 8294,93 refers to 2 temporary contract for personnel, which, substantially, refer to technical activities carried out under the direct supervision of UNICAL, in the relevant UNICAL premises, with the personnel cost comparable to the normal cost of temporary internal personnel. These 2 temporary contracts have been actually classified as "subcontracting" only for "formal" reasons, due to their legal definition (occasional temporary contracts: "contratti occasionali" in Italian).

The following table reports the ***budget approved by the EU Commission for the first reporting period*** (according to what has been reported in the UNICAL Financial Statement of the first reporting period):

TABLE-B	**RTD**	**M.of C.**	**TOTAL (euro)**
	(A)	**(D)**	**(F)= A+D**
Direct costs	€ 66.817,84	€ 13.000,00	**€ 79.817,84**
Indirect costs	€ 13.363,56	€ 2.600,00	**€ 15.963,56**
SUBMITTED TOTAL COSTS	**€ 80.181,40**	**€ 15.600,00**	**€ 95.781,40**

The following TABLE-C reports the differences between TABLE-A and TABLE-B. These differences are justified by the following facts:

1. The last part of payments of 3 temporary contracts for personnel covering activities of the first reporting period has been effectively issued during the second year.
2. According to the Note of the "EU Commission Research Directorate General" on Jan 10, 2008 [RTD/A.4/JMSR/MB/VM (2007) Adonis D/567923], which stated the non-eligibility of the "IRAP" (Italian Tax on temporary contracts) as direct cost, IRAP was incorrectly charged as direct costs during the first reporting period.
3. VAT on travelling and lodging expenses was incorrectly computed as direct costs during the first reporting period.

Therefore, the following adjustment to the first reporting period has been reported on the UNICAL Financial Statement of the second reporting period:

TABLE-C	**RTD**	**M.of C.**	**TOTAL (euro)**
	(A)	**(D)**	**(F)= A+D**
Direct costs	-€ 27.005,91	-€ 3.331,20	**-€ 30.337,11**
of which subcontracting	€ 8.294,93		**€ 8.294,93**
Indirect costs	-€ 5.401,17	-€ 666,24	**-€ 6.067,41**
ADJUSTMENTS TO THE PREVIOUS PERIOD	**-€ 24.112,15**	**-€ 3.997,44**	**-€ 28.109,59**

Note that the same adjustment has been reported on the next Table 3 "Budget versus Actual Costs".

UNICZ

	EU contribution	UNICZ contribution
Personnel	**7.690,92 (of which 6246,26 Adjustment)**	**66.000,00 (12 MM)**
Equipment	**0**	**75.000,00**
Travelling	**3.543,82**	**0**
Indirect costs	**2.246,95 (of which 1249,25 adjustment)**	**0**
TOTAL	**13.481,69**	**141.000,00**

UNICZ personnel by work-package

WP's	EU Contribution	UNICZ Contribution
WP0	0.5 (planned 0.5)	1
WP2	1 (planned 1)	5
WP4	3 (planned 0)	1
WP5	0	4
WP8	2 (planned 2)	1
TOTAL	**6.5 (planned 3.5)**	**12**

Explanatory note on major costs

Major costs have been for travelling and personnel costs.
Direct costs refer to Research and Technological development innovation (see section A, form C) and they have involved:
Personnel costs:

1) a contract for the activity of one specialized person that has been involved in WP4 during the 2nd year. The same will be involved in WP5 activity for the last year of the project;
2) the last part of the contract stipulated in the 1st year of the project, for one specialized doctor involved in WP2 activity, **(see Adjustment note)**

Travelling costs for the Heartfaid meetings. For the 2nd year project meetings, only one staff member, Doctor Angela Sciacqua, has travelled and only for project meetings, in particular:

1) Milan, 20-21 February, 2007
2) Bruxelles 26-28 March, 2007 (1st year review)
3) Zagreb 21-23 June, 2007
4) Krakow 8-9 November, 2007

Among the travelling costs, we also account for the expenses related to Crete Meeting (July 9-12, 2006), which have been charged during the second year.

The UNICZ contribution to the 2nd year was the following:
Personnel: one full professor and one executive physician have cooperated for 5 MM each and one executive physician for 2 MM;

Equipment: partial usage of two desktop PCs with printers, two laptops, two electrocardiographs, M- and B-mode sonographer, 24-hours Holter electrocardiography, bioimpedance analyzer, consumables.

Deviations from the cost budget and from person-month budget

We had to add 3 MM for supporting WP4 activity, with additional, not planned, 3 MM, for supporting the development of ontology to early detection of heart failure decompensation; WP2 activity, biomedical data collection, this activity was more binding than planned, we gave 5 MM, as UNICZ contribution; WP5 activity about the implementation of the Decision Support System, in fact the involvement of clinical support is crucial for this activity, thus we gave 4 MM as UNICZ contribution.

Explanatory note:

Adjustment to P1

Following our last year reporting period, on Form C an adjustment of **€ 7495,51 (contract of € 6750 of which € 6.246,27 direct costs , € 1249,25 overheads)** is stated since in the first year we did not claim the part of the contract. In the first year we calculated the MM but we did not claim the cost of the last part of the contract stipulated in the 1st year of the project, for one specialized doctor involved in WP2 activity since it was not yet paid at the date of last Form C

UNIMIB

UNIMIB Costs (for the second year) 1/2/2007-1/2/2008

	EU contribution	UNIMIB contribution
Personnel	13.082,93	42.467,63
Equipment	582,16	20.000,00
Travelling	1787,72	
Indirect costs	3090,56	
TOTAL	**18.543,37**	**62.467,63**

WP's	**EU Contribution**	**UNIMIB Contribution**
WP0	0 planned 0,5	1
WP2	3 planned 3	2
WP6	3 planned 1	1
WP8	0 planned 2,5	1
TOTAL	**6 planned 7**	**5**

Explanatory note on major costs:
In this part of the project the costs have been related to traveling and intellectual contribution by researchers.
We have made use in this part of the project with own staff personnel and one contract research which started on 1st july 2007.

UNIMIB contribution
Personnel
AC own staff contribution
Prof. G. Parati c/m eur 68.649,32/11*5= eur 31.204,23
Dott. M. Bombelli c/m eur 46.857,31/11*2= eur 8.519,51
Dott.ssa Cherubini gross 36.364,81*83%(part time)/11 months * 1= eur 2.743,89

Total eur **42.467,63**

Equipment
Eur 20.000,00 for usage of computer systems developed for remote monitoring of heart failure patients and for testing the suitability of a number of biomedical signals for the project. This has included use of device for nocturnal polysomnography

EC contribution
Personnel
Contract dott. G. Bilo from 01/07/07 to 01/02/08 eur **13.082,93**

Equipment

Equipment Atcor medical invoice 00012418 dated 12/10/2007 eur 9.980,00/60*3,5= **582,16** cost period 12/10/07-01/02/08

Travelling

Meeting Heartfaid prof Parati Athens and Crete 08/07/07 eur 216,15
Bruxelles Meeting prof. G. Parati 26/3/07 eur 583,15
Zagreb Meeting 21/06/07 prof G. Prati eur 248,71
Cracow Meeting prof G. Parati 7/11/07 eur 739,71

Total **eur 1.787,72**

Indirect cost

20% to total direct cost 15.452,81*20/100= eur **3.090,56**

Deviations from the cost budget and from person-month budget.

The most significant deviation from expectations has been the increased number of engaged person-months. The reason for this deviation has been the amount of effort requested to start collecting clinical data in the outpatient congestive heart failure clinic far before the scheduled beginning of WP 7 "Testing and validation". A research grant fellow was hired to start collecting data on actual patients in the cardiology outpatient clinic during the second year of the project. This was aimed at enlarging the patient sample that will allow a more solid testing and validation of the HEARTFAID platform at the end of the third year of the project.

JUMC

	EU contribution	JUMC contribution
Personnel	**3 073,53 (3 MM)**	**3 600 (2 MM)**
Equipment	**11 731,31**	**7 000**
Travelling	**5 071, 20**	**-**
Consumables	**3 061,03**	**-**
Indirect costs	**4 587,41**	**-**
TOTAL	**27 524,48**	**10 600, 00**

JUMC personnel by work-package

WP's	EU Contribution	JUMC Contribution
WP6	1 planned 1	2
WP8	2 planned 2	
TOTAL	**3**	**2**

Explanatory note on major costs:

Major costs have been equipment, travel and personnel costs.

We have spent about 12.000 EUR for *equipment*. We have purchased one portable PC which are currently used for the project purposes. The remaining sum we have spend on the continuous blood pressure monitoring system which will be utilized for development of the HFP research level as it was mentioned in major cost justification for the first year.
JUMC contribution for equipment used for the project purposes was 7000,00 EUR according to monthly exploitation charge estimated for the first year of the project at 583,33 EUR per month.

We have spent about 5.000 EUR for *traveling*. We have traveled only to project-related meetings (Milan, Zagreb). The following staff members have participated: Prof. K. Kawecka-Jaszcz, K. Styczkiewicz MD, Andrzej Kononowcz Eng.

We have spent about 3.000 EUR for *personnel* working on the project. With this money we paid for 3 MM (technical personnel). Moreover as JUMC contribution we have spent 2.0 MM for 2 academic researchers.
It was completely in line with planned budget as stated in the DoW in Annex I for the second year.

Moreover we have spent about 3.000 EUR (*consumables*) for organization of HEARTFAID MB & STAB meeting in Krakow on 8-9th November 2007

Durable equipment costs – explanation

According to the Annex II Part B II.19 d of General Condition which is integral part of the contract the eligible costs of the project must be recorded in the

accounts of the contractor for in accordance to the accounting rules of the State in which the contractor is established. We are aware that normally the equipment used on the project should be accounted with the normal depreciation rules of the contracting organisation (*Financial Guide to 6FP)*, but when we talking about the scientific units in Poland (like our University) we should remember about unique State regulation in this area. According to those regulation, when we buy the durable equipment witch is use for scientific work, like Heartfaid is, we don't use the depreciation formula, but we put the total amount paid for specific item as a cost. Because this situation concerns all Universities in Poland we have consulted it with National Contact Point of Framework Programmes, which confirm our point of view. In sum up the amount presented in the financial statement for the second year of Heartfaid Project reflect the part of the total amount which has been paid from the EU as a payment for the durable equipment buy for the project.

Deviations from the cost budget and from person-month budget

We have no significant deviations with above.

VMWS

Personnel	**167200.00**
Travelling	**4732.21**
Other costs	**6499.39**
Indirect costs	**34386.44 + 1840,08 (adjustement)= 36226,52**
TOTAL	**214658,12**

VMWS personnel by work-package

WP's	
WP0	0.88 planned 0,5
WP2	21.55 planned 15
WP3	5.44 planned 1
WP8	0 planned 0.5
TOTAL	**27.87 planned 17**

Explanatory note on major costs

VMWS has spent 4732.21 EUR for traveling. This cost covered the travel expenses for the participation of 2 persons (Dr. Andrew Marsh and Dr. Christos Biniaris) in the STAB meeting in Milan and the 1st Annual review meeting in Brussels, as well as the expenses for the participation of Dr. Biniaris in the STAB meetings in Zagreb and Cracow.

Deviations from the cost budget and from person-month budget

Regarding WP0, there has been a slight deviation of person-month allocation (0.88 PMs instead of 0.5PMs planned), due to some unforeseen financial administration.

Regarding WP2 there has been a deviation of person-month allocation (21.55PMs instead of 15PMs planned). The reason for this deviation is unforeseen technical problems and burdens which needed extra effort to be overcome, during the procedure of integration of medical devices and sensors in the platform. These technical burdens are mainly related to the device specific implementation of the communication protocols, leading to time consuming interactions with the devices vendors in order to solve some problems in case of wrong or incomplete documentation, implementation details etc. Furthermore, due to some unforeseen software portability problems (e.g. same devices with different firmware), the developed software had to be tested on more mobile devices than it was initially planned.

Regarding WP3, there has been a deviation of person-month allocation (5.44PMs instead of 1PMs planned), but this deviation has no significant impact on the total PMs estimated for VMWS for the complete duration of WP3, since during the first year of the project VMWS has spent less than the estimated PM (8.21 instead of 11) effort in WP3 activities (which were mainly related the definition of

standards and functional requirements), reserving the PM effort for the development phase during the second year.
Finally, regarding WP8, the planned 0.5 PM for second year has been reserved, in order to be used during the third year of the project, since VMWS has already engaged a slot for the HEARTFAID project at the 5th ICMCC Event "Patient Empowerment - The Power of Information", which will be organised from June 9-11, 2008, at University of Westminster, London.

Explanatory note

Adjustment to P1: The adjustment amount of 1840.08 Euros is related to the previous cost statement where overheads were applied to direct costs but not to travel costs. The amount of € 1840.08 relates to the overheads applied to travel.

FORTHNET

CATEGORY	
PERSONNEL	90.577,97
TRAVEL	11.543,19
INDIRECT	72.462,37
TOTAL	**174.583,53**

WP's	
WP0	0 planned 1
WP2	1 planned 8
WP3	0 planned 2
WP6	15 planned 19
TOTAL	**16 planned 31**

Explanatory note on major costs

In period 2, Forthnet S.A spent 90.577,97 EUR for personnel cost and 11.543,19 EUR for travel cost.

The above staff cost covered the following works, performed in the framework of the project:

- ✓ WP2: -Development of Nurse@home application
  -Sensor data acquisition

- ✓ WP6: -Design of Front End Portal
  -Development of Front End Portal
  -Integration of HeartFaid services to the Front End
  -Implementation, finalisation and submission of D23
  -Contribution on D31

The above travel cost covered the expenses for the participation of two staff members (Manolis Stratakis and Stelios Louloudakis) in several project meetings organised during Period 2.

Deviations from the cost budget and from person-month budget

Taking into account the significant overspending of person-months declared in Period 1, Forthnet S.A. made the necessary adjustments in Period 2 for normalising that overspending. In order to achieve that, we have spent less than the originally planned person-months (16 out of 31) in Period 2.

SYNAPSIS

CATEGORY	
PERSONNEL	209.683,57
EQUIPMENT	90,33
TRAVEL	3.964,01
INDIRECT	42.747,58
TOTAL	**256.485,49**

SYNAPSIS personnel by work-package

WP's	
WP0	3 planned 1
WP2	10 planned 3
WP3	22 planned 11
WP4	4 planned 1
WP5	13 planned 5
WP6	22 planned 12
WP8	1 planned 2
TOTAL	**75 planned 35**

Explanatory note on major costs
The major costs afforded by SYNAPSIS are related to travels and labour activity. As far as the travels are concerned, they are related to the General Assembly meetings, held in:

- Brussel: March 26-29, 2007
- Zagreb: June 20-23, 2007
- Krakow: November 7-10, 2007;

And other internal technical meetings, held in:

- Milan: February 20-21, 2007
- Milan: April 18, 2007
- Pisa: April 12, September 20, September 25-26 and October 31, 2007
- Livorno: September 27, 2007
- Cosenza: October 22-24, 2007.

Concerning the personnel costs (total of 75 person/months with respect to the planned 35 person/months), SYNAPSIS has been strongly involved in the activities of WP2, WP3, WP5 and WP6, and has provided support to the activities of WP4 and WP8. Moreover, SYNAP has been responsible of the technical coordination of the overall activities for the development of the software demos for the second review meeting.

Deviations from the cost budget and from person-month budget
There are no main deviations from the cost budget. The slightly higher expenditure in personnel costs of about 20K €, out of 190K €, foreseen for the

second year of the project lifetime, partially covers the lower expenditure of about 30K € of the first year.
In fact, some of the activities that should have been carried out during months M1 to M12, have been carried out in the second year. This delay is mainly related to definition of the requirements and the design of the HF platform of services, able to interact with the existing cardiological EMR. Although at the beginning of the project we assumed that suitable EMRs were already in use by the clinical partners' premises, it was assessed that no consolidated ICT approach was actually in use. Consequently, the activities related with the definition of the functional specifications and the design of the HF platform, have been slightly delayed.

As far as the person-month budget is concerned, we report a significantly higher effort with respect to the effort expected. In fact, for the same reason explained above (i.e. the unexpected absence of Cardiovascular EMRs in use by the clinical partners), and with the goal to further improve the quality of the results that should to be achieved by the end of the second year, as well as to obtain more advanced prototypes which can be effectively used for early experimentation, we needed to invest a personnel effort significantly higher than the one foreseen for 2007. In order to cover this additional effort, we had to involve in the HEARTFAID project a higher number of researchers. These were mainly junior software engineers that from one side have been able to provide the capability to enthusiastically experiment innovative technologies whilst, on the other side, they had a lower productivity thus requiring a higher effort in terms of man-months with respect to our estimation.

CNR

CATEGORY	
PERSONNEL	93.919,60
TRAVEL	10.031,02
MANAGEMENT(AUDIT)	1200
INDIRECT	66.967,32
TOTAL	**172.117,94**

CNR personnel by work-package

WP's	MM
WP0	1 planned 1
WP3	2 planned 2
WP4	3 planned 3
WP5	12,32 planned 12
WP6	1 planned 1
WP8	0.5 planned 0,5
TOTAL	**19,82 planned 19,5**

Explanatory note on major costs
Total Person Month: 18,82 RTD + 1 MGM (19,82 TOT)
Personnel Costs: 160.886,92 (including Overhead)
Major Costs: Travel - 10.031,02 (Cosenza, Catanzaro and Milan February 2007, Brussels March 2007, Crete April 2007, Zagreb June 2007, Catanzaro July 2007, Krakow November 2007, Crete December 2007)

Deviations from the cost budget and from person-month budget
With respect to the planned 19,5 PM (18,5 RTD + 1 MGM), we increased of 0,32 our total effort in Year II. This slight deviation, only concentrated on WP5, was really limited with respect to the large amount of work done for the implementation of the CDSS.

FORTH

FORTH costs

CATEGORY	
PERSONNEL	58436.57
TRAVEL	10109.69
OTHER	401.00
INDIRECT	62569.80
TOTAL	131517.06

WP's	
WP2	4.61 planned 0
WP3	1 planned 0
WP4	1.5 planned 3
WP5	8.85 planned 16
WP6	1 planned 2
WP8	0.48 planned 0.50
TOTAL	**17.44 planned 21.50**

Explanatory note on major costs

Major costs have been travel and personnel costs.

FORTH has spent about 10000 EUR for traveling. We have traveled to project steering meetings (Milan, Zagreb and Krakow) and at all these meetings we participated with one staff member (Franco Chiarugi) except the meeting in Zagreb where also another FORTH's person participated (Giorgos Zacharioudakis). We have also traveled to international conferences for dissemination purposes (CinC 2007 and HEALTHINF 2008) where the FORTH's participant was Franco Chiarugi. We have also participated to the first annual review held in Brussels (Franco Chiarugi) and to WP5 & WP6 technical meetings held in Italy and hosted by CNR and Synapsis respectively (Franco Chiarugi and Ioannis Tsamardinos). Finally FORTH has participated also in a technical meeting hosted by UNICAL at the end of October 2007 (Franco Chiarugi).

FORTH has spent about 400 EUR for other costs (management). This cost is referred to the audit certificate of the first year that was paid in April 2007.

FORTH has spent about 58000 EUR for personnel. With this money we paid about 17.4 men/months mainly of high-profile people for the reasons explained in the "Deviations from the cost budget and from person-month budget".

Deviations from the cost budget and from person-month budget

The most significant deviation is a little lower number of engaged person-months (about 17.4 instead of planned 21.5) with a very little decrement in the cost budget. The main reasons are the delay in the outcomes of WP2 and the difficulties in receiving satisfactory information about the devices used in the

HEARTFAID environments. For this reason we finally decided to offer a strong contribution to WP2 and to use more high profile resources in order to try to overcome the existing difficulties (we also used post-graduate students that are not accounted). The work done on the integration of medical devices for the home environment can be seen as part of WP2 or part as WP6. In terms of personnel cost the total amount is absolutely comparable with the estimation made in the DoW.

Workpackage progress

The work performed for the WPs has been completely in line with DoW. The most significant deviation is the contribution offered to WP2 in order to integrate several home devices and the MagIC Vest for the research environment. Furthermore the work performed in CDSS for WP5 has been partially done also for WP4 considering that WP4 and WP5 have several overlapping points.

RBI

	EU contribution	RBI contribution
Personnel	**31,899.15 (26.5 MM)**	**33,659.00 (16 MM)**
Travelling	**10,668.42**	**0.00**
Other Costs	**2,593.18**	**0.00**
Management	**1586,08**	
Indirect costs	**9,032.15+ 317,22 MNG: 9349,37**	**0.00**
total	**56096,20**	**33659.00**

RBI personnel by work-package

WP's	**EU Contribution**	**RBI Contribution**
WP0	0.5 MM (planned 0.5 MM)	1 MM
WP4	17 MM (planned 17 MM)	9 MM
WP5	5 MM (planned 4 MM)	2 MM
WP6	3 MM (planned 4 MM)	2 MM
WP8	1 MM (planned 1 MM)	2 MM
TOTAL	26.5 MM (planned 26.5 MM)	**16 MM**

Explanatory note on major costs

In the second year the greatest cost has been personnel. It has been used for 3 PhD students (Prcela, Jovic, and Bosnjak) and for 2 technical persons (Horvat and Svagljic). In total for personnel has been used less than planned because engaged PhD students have been young people coming directly from the university with low salaries.

Traveling costs include journeys to official project meeting: Milan, Italy (Gamberger), Brussels, Belgium (Gamberger), and Krakow, Poland (Smuc, Prcela, Horvat, Gamberger). Additionally we had one work meeting in Milan, Italy (Jovic, Gamberger). We also participated on a few conferences: Opatija, Croatia (Prcela), Ljubljana, Slovenia (Prcela), Amsterdam, The Nederlands (Gamberger), Funchal, Portugal (Gamberger). Additionally, there has been one dissemination activity in Vienna, Austria (Smuc) and one summer school in Leuven, Belgium (Prcela).

Other costs include expenses for books, software licenses, and computer spare parts.

Rudjer Boskovic organized one project STAB meeting in Zagreb. The expenses have been presented as management costs.

Deviations from the cost budget and from person-month budget

There have been no deviations from the cost budget and no deviations from the person-month budget.

AUXOL

AUXOL costs (for the second year)

	EU Contribution	AUXOL Contribution
Personnel	12.216,33	44.000,00
Equipment	2.783,20	65.000,00
Travelling	1.425,95	
Other Specific Costs	974,78	
Mangement	0,00	
Indirect Costs	3.480,05	
TOTAL	**20.880,31**	**109.000,00**

AUXOL personnel by work-package

WP's	**EU Contribution**	**AUXOL Contribution**
WP2	6 planned 3	3
WP8	2 planned 1	1
TOTAL	**8 planned 4**	**4**

Explanatory note on major costs

Major costs have been personnel, equipment, and traveling.

1. 12.216,33 EUR for a research grant (a junior cardiologist), largely involved in the research activities listed above.
2. 2.783,20 EUR: correspondent to the second year percentage of the depreciation (40% of the asset value), usually applied by Istituto Auxologico Italiano. The equipments purchased are a System for Biomedical signal acquisition and a portable PC.
3. 1.425,95 EUR for traveling which served to participate to project meetings (Bruxelles, Zagabria and Cracovia)
4. 974,78 EUR: meeting room, coffee break and lunch for Milano meeting that ook place on 21st February 2007.

Deviations from the cost budget and from person-month budget.

The most significant deviation from expectations has been the increased number of engaged person-months (12 instead of 4 planned). The reason for this deviation has been the amount of effort requested to start collecting clinical data in the outpatient congestive heart failure clinic far before the scheduled beginning of WP 7 "Testing and validation". By starting collecting data on actual patients in the cardiology outpatient clinic during the second year we intended to enlarge the patient sample that will allow a more solid testing and validation of the HEARTFAID platform at the end of the third year of the project.

Table 3: Budget vs. Actual Costs

Updated Cost Budget Follow-up Table						
Contract N°:	**IST-2005-27107**	**Acronym: HEARTFAID**				
PARTICIPANTS	**TYPE of EXPENDITURE (as defined by Annex 1)**	**BUDGET**	**ACTUAL COSTS**		**Pct.spent**	**Remaining Budget (EUR)**
			Period 1	**Period 2**	**Total**	
		e	a1	b1	(a1+b1)/e	e-a1-b1
UNICAL	**Total Person-month**	**70**	26	29,80	80%	**14,20**
	Personnel costs	**165000**	36453,42	85129,00	74%	**43417,58**
	Other costs	**86484**	21322,24	15109,37	42%	**50052,39**
	Indirect Costs	**49096**	9896,15	19826,48	61%	**19373,37**
	Total Costs	**300580**	**67671,81**	**120064,85**	62%	**112843,34**
UNICZ	**Total Person-month**	**35**	19,5	6,50	74%	**9,00**
	Personnel costs	**54200**	14387	7690,92	41%	**32122,08**
	Other costs	**51167**	1462,01	3543,82	10%	**46161,17**
	Indirect Costs	**20073**	3169,8	2246,95	27%	**14656,25**
	Total Costs	**125440**	**19018,81**	**13481,69**	26%	**92939,50**
UNIMIB	**Total Person-month**	**24**	0	6,00	25%	**18,00**
	Personnel costs	**43064**	0	13082,93	30%	**29981,07**
	Other costs	**35461**	1664,51	2369,88	11%	**31426,61**
	Indirect Costs	**14505**	332,9	3090,56	24%	**11081,54**
	Total Costs	**93030**	**1997,41**	**18543,37**	22%	**72489,22**
JUMC	**Total Person-month**	**26**	15,5	3,00	71%	**7,50**
	Personnel costs	**50000**	22368,92	3073,53	51%	**24557,55**
	Other costs	**28337**	13086,97	19863,54	116%	**-4613,51**
	Indirect Costs	**15267**	7091,17	4587,41	76%	**3588,42**
	Total Costs	**93604**	**42547,06**	**27524,48**	75%	**23532,46**
VMWS	**Total Person-month**	**63**	27,36	27,87	88%	**7,77**
	Personnel costs	**360000**	158720	167200,00	91%	**34080,00**
	Other costs	**24518**	14640,41	11231,60	106%	**-1354,01**
	Indirect Costs	**75704**	32832	36226,52	91%	**6645,48**
	Total Costs	**460222**	**206192,41**	**214658,12**	91%	**39371,47**
FORTHNET	**Total Person-month**	**66**	36,1	16,00	79%	**13,90**

	Personnel costs	**288000**	143058,68	90577,97	81%	**54363,35**
	Other costs	**42714**	6519,58	11543,19	42%	**24651,23**
	Indirect Costs	**237600**	114446,94	72462,37	79%	**50690,69**
	Total Costs	**568314**	**264025,2**	**174583,53**	77%	**129705,27**
SYNAP	**Total Person-month**	**80**	24,2	75,00	124%	**-19,20**
	Personnel costs	**429000**	132556,69	209683,57	80%	**86759,74**
	Other costs	**47933,33**	6405,62	4054,34	22%	**37473,37**
	Indirect Costs	**94186,67**	27792,46	42747,58	75%	**23646,63**
	Total Costs	**571120**	**166754,77**	**256485,49**	74%	**147879,74**
CNR	**Total Person-month**	**48**	25,96	19,82	95%	**2,22**
	Personnel costs	**197800**	113.019,48	93919,60	105%	**-9139,08**
	Other costs	**28400**	6.421,55	11231,02	62%	**10747,43**
	Indirect Costs	**165120**	76428,92	66967,32	87%	**21723,76**
	Total Costs	**391320**	**195.869,95**	**172117,94**	94%	**23332,11**
FORTH	**Total Person-month**	**43**	10,98	17,44	66%	**14,58**
	Personnel costs	**141900**	45895,92	58436,57	74%	**37567,51**
	Other costs	**18236**	6486,63	10510,69	93%	**1238,68**
	Indirect Costs	**170280**	53239,27	62569,80	68%	**54470,93**
	Total Costs	**330416**	**105621,82**	**131517,06**	72%	**93277,12**
RBI	**Total Person-month**	**46**	21,5	26,50	104%	**-2,00**
	Personnel costs	**72800**	21717,06	31899,15	74%	**19183,79**
	Other costs	**88666**	35815,73	14847,68	57%	**38002,59**
	Indirect Costs	**31573**	11506,56	9349,37	66%	**10717,07**
	Total Costs	**193039**	**69039,35**	**56096,20**	65%	**67903,45**
AUXOL	**Total Person-month**	**24**	9	8,00	71%	**7,00**
	Personnel costs	**50000**	13500	12216,33	51%	**24283,67**
	Other costs	**28525**	5986	5183,93	39%	**17355,07**
	Indirect Costs	**14505**	3897,2	3480,05	51%	**7127,75**
	Total Costs	**93030**	**23383,2**	**20880,31**	48%	**48766,49**
TOTAL	**Total Person-month**	**525**	**216,1**	**235,93**	86%	**72,97**
	Personnel costs	**1851764**	**701677,17**	**772909,57**	80%	**377177,26**
	Other costs	**480441,33**	**119811,25**	**109489,06**	48%	**251141,02**
	Indirect Costs	**887909,67**	**340633,37**	**323554,41**	75%	**223721,89**
	Total Costs	**3220115**	**1162121,79**	**1205953,04**	74%	**852040,17**

Table 4: Person-Months Status Table

Person-Month Status Table

CONTRACT N°: 27107			Partner - Person-month per Workpackage												AC - own staff						
ACRONYM: HEARTFAID																					
PERIOD: 1/2/07 31/1/08			TOTALS	UNICAL	UNICZ	UNIMIB	JUMC	VMWS	FORTHNET	SYNAP	CNR	FORTH	RBI	AUXOL	AC TOTALS	UNICAL	UNICZ	UNIMIB	JUMC	RBI	AUXOL
Workpackage 2:	**Title**	**Actual WP total:**	**47,16**	0,00	1,00	3,00	0,00	21,55	1,00	10,00	0,00	4,61	0,00	6,00	**10**		5	2			3
		Planned WP total:	**33,00**	0,00	1,00	3,00	0,00	15,00	8,00	3,00	0,00	0,00	0,00	3,00	**0**						
Workpackage 3:	**Title**	**Actual WP total:**	**30,44**	0,00	0,00	0,00	0,00	5,44	0,00	22,00	2,00	1,00	0,00	0,00	**0**						
		Planned WP total:	**16,00**	0,00	0,00	0,00	0,00	1,00	2,00	11,00	2,00	0,00	0,00	0,00	**0**						
Workpackage 4:	**Title**	**Actual WP total:**	**40,70**	12,20	3,00	0,00	0,00	0,00	0,00	4,00	3,00	1,50	17,00	0,00	**13**	3	1			9	
		Planned WP total:	**35,00**	11,00	0,00	0,00	0,00	0,00	0,00	1,00	3,00	3,00	17,00	0,00	**0**						
Workpackage 5:	**Title**	**Actual WP total:**	**48,77**	9,60	0,00	0,00	0,00	0,00	0,00	13,00	12,32	8,85	5,00	0,00	**9**	3	4			2	
		Planned WP total:	**43,00**	6,00	0,00	0,00	0,00	0,00	0,00	5,00	12,00	16,00	4,00	0,00	**0**						
Workpackage 6:	**Title**	**Actual WP total:**	**47,00**	1,00	0,00	3,00	1,00	0,00	15,00	22,00	1,00	1,00	3,00	0,00	**5**			1	2	2	
		Planned WP total:	**41,00**	1,00	0,00	1,00	1,00	0,00	19,00	12,00	1,00	2,00	4,00	0,00	**0**						
Workpackage 8:	**Title**	**Actual WP total:**	**11,98**	3,00	2,00	0,00	2,00	0,00	0,00	1,00	0,50	0,48	1,00	2,00	**6**	1	1	1		2	1
		Planned WP total:	**15,00**	3,00	2,00	2,50	2,00	0,50	0,50	2,00	0,50	0,50	0,50	1,00	**0**						
Workpackage 0:	**Title**	**Actual WP total:**	**9,88**	4,00	0,50	0,00	0,00	0,88	0,00	3,00	1,00	0,00	0,50	0,00	**6**	3	1	1		1	
Management		**Planned WP total:**	**9,50**	4,00	0,50	0,50	0,00	0,50	1,00	1,00	1,00	0,00	1,00	0,00	**0**						
		Actual total:	**235,93**	**29,80**	**6,50**	**6,00**	**3,00**	**27,87**	**16,00**	**75,00**	**19,82**	**17,44**	**26,50**	**8,00**	**49**	**10**	**12**	**5**	**2**	**16**	**4**
Total Project Person-month		**Planned total:**	**192,5**	**25**	**3,5**	**7**	**3**	**17**	**30,5**	**35**	**19,5**	**21,5**	**26,5**	**4**							

HEARTFAID

D27 – 2nd Periodic Report on the Distribution of the Community Contribution among Contractors

Submission date: 18/03/08
Due date of document: 31/01/08

HEARTFAID

A KNOWLEDGE BASED PLATFORM OF SERVICES FOR SUPPORTING MEDICAL-CLINICAL MANAGEMENT OF THE HEART FAILURE WITHIN THE ELDERLY POPULATION

Project summary	
Project acronym:	HEARTFAID
Project identifier:	IST – 2005 – 027107
Duration of the Project:	01/02/2006 – 31/01/2009
Project Co-ordinator Name:	Domenico Conforti
Project Co-ordinator Organisation:	UNICAL University of Calabria (Italy)
Thematic Priority:	Information Society Technology-ICT for Health
Instrument:	Specific Targeted Research Project

Consortium

- UNICAL- Università della Calabria (Italy)
- UNICZ- Università degli studi Magna Graecia di Catanzaro (Italy)
- UNIMIB- Università degli studi di Milano Bicocca (Italy)
- JUMC- Jagiellonian University Medical College (Poland)
- VMWS- Virtual Medical World Solutions Ltd (United Kingdom)
- FORTHNET S. A.- Hellenic Telecommunications and Telematic Applications Company S. A. (Greece)
- SYNAP- Synapsis s.r.l. (Italy)
- CNR- Consiglio Nazionale delle Ricerche (Italy)
- FORTH-Foundation for Research and Technology Hellas (Greece)
- RBI- Rudjer Boskovic Institute (Croatia)
- AUXOL- Istituto Auxologico Italiano (Italy)

D 27– 2st Periodic Report on the Distribution of the Community contribution among contractors

Document summary	
Document Title:	2nd Periodic Report on the Distribution of the Community contribution among contractors
Document Classification:	Deliverable D 27
Dissemination level:	CO
Period covered:	From 1 February 2007 to 31 January 2008
Submission date:	18 March 2008
Due date:	31 January 2008
Authors:	Domenico Conforti (UNICAL) Debora Minardi (UNICAL)
Work package:	WP0 – Management
Report Version:	1.3

Short Description
This deliverable describes the distribution, made by the coordinator, of the Community 2nd contribution among all the contractors of Heartfaid project.

Change Record		
Version Number	Changes	Release date
1.0	First draft of the Document	14/01/2008
1.1	Contributions from partners	03/03/2008
1.2	Further Contributions	13/03/2008
1.3	Final Version	18/03/2008

Report on the Distribution of the Community's contribution

Type of Instrument	STREP	Project Title (or Acronym)	HEARTFAID

Contract N°	IST-2005-027107

Part I — Community's prefinancing sent to the coordinator *(1)*

	Reporting Period 1 *(2)*		Reporting Period 2 *(2)*		Total Amount (I) *(3)*
	From	To	From	To	
	1/02/2006	31/01/2007	1/02/2007	31/01/2008	

	Date	Amount (A)	Date	Amount (B)	
Total (X)	5/04/06	835.900,00	3/07/2007	732.644,90	1.568.544,90

Part II — Distribution of the Community's prefinancing

			Reporting Period 1		Reporting Period 2		
Contractor n°	Organisation Short Name	Country Code	Date(s) *(5)*	Amount(s) (A') *(5)*	Date(s) *(5)*	Amount(s) (B') *(5)*	Total Amount (I') *(6)*
1	UNICAL	IT	5/04/2006	120.232,00	3/07/2007	90.518,84	210.750,84
			Total	120.232,00	Total	90.518,84	210.750,84

2	UNICZ	IT	11/04/2006	50.176,00	16/07/2007	22.410,23		72.586,23
			Total	**50.176,00**	**Total**	**22.410,23**		**72.586,23**
3	UNIMIB	IT	11/04/2006	37.212,00	16/07/2007	6.990,26		44.202,26
			Total	**37.212,00**	**Total**	**6.990,26**		**44.202,26**
4	JUMC	PL	12/04/2006	37.441,00	17/07/2007	47.512,14		84.953,14
			Total	**37.441,00**	**Total**	**47.512,14**		**84.953,14**
5	VMWS	UK	3/7/007	94.923,00	17/07/2007	11.437,21		106.360,21
			Total	**94.923,00**	**Total**	**11.437,21**		**106.360,21**
6	FORTHNET	GR	12/04/2006	116.902,00	17/07/2007	127.162,09		244.064,09
			Total	**116.902,00**	**Total**	**127.162,09**		**244.064,09**
7	SYNAP	IT	11/04/2006	116.864,00	16/07/2007	80.935,26		197.799,26
			Total	**116.864,00**	**Total**	**80.935,26**		**197.799,26**
8	CNR	IT	11/04/2006	81.360,00	16/07/2007	101.220,64		182.580,64
			Total	**81.360,00**	**Total**	**101.220,64**		**182.580,64**
9	FORTH	GR	12/04/2006	66.363,00	17/07/2007	54.202,93		120.565,93
			Total	**66.363,00**	**Total**	**54.202,93**		**120.565,93**
10	RBI	CR	12/04/2006	77.215,00	17/07/2007	69.091,18		146.306,18
			Total	**77.215,00**	**Total**	**69.091,18**		**146.306,18**
11	AUXOL	IT	11/04/2006	37.212,00	16/07/2007	28.376,05		65.588,05
			Total	**37.212,00**	**Total**	**28.376,05**		**65.588,05**

Total (Y)	Total	835.900,00	Total	639.856,83	1.475.756,83

Part III	Difference between Community's prefinancing (or payment) sent to the coordinator and Total Distribution of the Community's prefinancing (or payment) between contractors according to the consortium decision(s) *(4)*

	Reporting Period 1	Reporting Period 2	Total Amount
Community's prefinancing (or payment) not yet distributed between contractors (Z) *(7)*	0,00	92788,07	92788,07

I certify that the information set out in this form is accurate and correct and agreed by all contractors.

Name *and Surname*	Date	
Domenico Conforti		

Explanatory note: The amount of 92788,07 will be kept by the Coordinator according to the clause 9.7 for the contractor VMWS until approval of the second reporting period