HEARTFAID

D18 – 5th   Quarterly Managerial Report

(MB and STAB meeting minutes)
Submission date:15/06/07
Due date of document: 30/04/07

Information Society
and Media

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)

D18 – 5ᵗʰ Quarterly Managerial Report
MB and STAB meeting minutes

Document summary	
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Short Description
This document describes the activities of the Consortium during the fifth quarterly of HEARTFAID project and its future activities.

Change Record		
Version Number	Changes	Release date
1.1	First draft of the Document	11/05/07
2.0	Further improvement and new add-on	11/06/07
3.0	Final Draft of the document	15/06/07

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Executive Summary

The fifth Quarterly Managerial Report describes the activities and the objectives achieved by HEARTFAID Consortium during the period February 1 2007- April 30, 2007.

The work has been carried out by each partner of the Consortium sharing the responsibilities and duties in order to effectively perform all the obligations and requirements for the first periodic report (reporting period P1) (March 28th) and to carefully take into account its outcome (April 18th).

The following WPs have been involved :
- WP0: Management
- WP2: Biomedical Data Identification and Collection
- WP3: Middleware, Interoperability and Integration
- WP4: Knowledge, Representation, Discovery and Management
- WP5: Data processing and Decision support devices
- WP6: End-User application and Services
- WP8: Dissemination and Exploitation

The following deliverables have been produced during this quarter:
- D12/ D13/D17: WP0
- D14: WP2
- D15: WP5
- D16:WP 8

The subsequent interim period will be particularly intense from a technical point of view as the deadlines of M18 will involve the following WPs:
- WP2:
  - MS 2.2: Technological Infrastructure for the acquisition and the transmission of the relevant BM data.
  - Deliverable D19.
- WP3:
  - MS 3.2: Early mock-up prototype implementation of the Data Management and Exchange System.
  - Deliverable D20.
- WP4:
  - MS 4.1: Ontology and knowledge representation.
  - Deliverables D21 and D22.
- WP5:
  - MS 5.1: Early mock-up prototype of data processing and decision support services.
- WP6:
  - Deliverable D23.

At the end of the description of each WP, the objectives and the future foreseen activities, in the light of review outcome, for the subsequent quarter have been set and can be summarised as follows:

- WP0: monitoring of the overall technical and management activities and coordination and support for the next steering meeting in Zagreb (hosted by RBI).
- WP2: further development and implementation of the prototype of the data acquisition and transmission infrastructure.
- WP3: development and implementation of the first prototypal version of the data management and exchange system.
- WP4: definition of the functional specifications of the data warehouse and data preparation; definition and implementation of ontologies and knowledge representation.
- WP5: early mock-up implementation of the data processing and decision support services.
- WP6: definition of the functional specifications of end-user applications and services.
- WP8: further dissemination activities according to the early plan.

Consortium Management: WP0

WORK PACKAGE: 0
TITLE: MANAGEMENT
START DATE: MONTH 1
WORK PACKAGE LEADER:UNICAL
PARTNERS INVOLVED:UNICZ, UNIMIB , VMWS ,FORTHNET, SYNAPSIS , CNR,RBI

STATUS OF DELIVERABLES DUE IN THIS PERIOD

		DATE DUE	COMMENTS
DELIVERABLE	N°		
5th Quarterly Managerial Report	D18	30/04/07	The Deliverable has been completed on time with the contribution of each WP leader

FORECAST STATUS OF DELIVERABLES DUE IN THE NEXT 3 MONTHS

		DATE DUE	COMMENTS
DELIVERABLE	N°		
6th Quarterly Managerial Report	D24	31/07/07	The Deliverable is foreseen to be completed on time following the structure in use

MEETINGS OF THE PERIOD AND FORECASTED WP0- MB & STAB MEETINGS

	COMMENT	DATE/PLACE
FORTH/FORTHNET/UNICAL	Combined with attendance to Personal Health Systems	Brussels 12/02/2007
MB & STAB Meeting	Hosting: UNIMIB/AUXOL Attendants: MB	Milan 20/21 February 2007
UNICAL/UNIMIB/AUXOL	Combined with MB meeting	Milan 21 February 2007
MB & STAB Meeting	Hosting: UNICAL Attendants: MB	Brussels, 27 March 2007
1st REVIEW	Attendants: MB Guest: MyHeart Project leader	Brussels, 28 March 2007
UNICAL as Liaison Officer	Attendance to MyHeart 3rd Review	Brussels, 29th March 2007
MB & STAB Meeting	Hosting: RBI Attendants MB &STAB	Zagreb 21-23 June 2007

Description of the activities

During this quarter the management of the Consortium has mainly focused on the first reporting period, first Milestone of the WP.
The deliverables produced in this quarter have been the following:
- D12: Distribution of the Community Funds (pre-financing) among the partners
- D13: First periodic report (activity and management)
- D17: 4th Quarterly report.

Together with the submission of D14 and D15 (respectively WP2 and WP5).

WP0 deliverables, in particular D13, have required the active involvement of each partner and more actively of each WP leader who have strongly contributed to all managerial tasks.

Strong communication has been established in order to avoid delays and, under this respect, whenever economical and feasible, personal interactions have helped to clarify practical issues and strengthen teamwork .

After handling the procedures related to the first periodic report, both administrative and practical, the handling of the 1st review outcome issues and of the financial clarifications requirements are among the tasks in progress.

The work plan does not currently foresee any deviation and still until next interim the overall management will focus on the following tasks:

T 0.1 Overall management of the Consortium
- Handling of Deliverables
- Strengthen the cooperation with the STAB
- Cooperation with RBI for next MB & STAB meeting
- Horizontal Activities with other FP6 projects (MyHeart, ACGT)

T 0.3: Management of contractual, legal, financial and administrative procedure of the consortium
- Handling of financial and administrative procedures of review outcome
- Handling of the clause 9.2 for the Contractor VMWS for whom the Prefinancing is currently still kept by the Coordinator until further notice from the Commission

T 0.2: Co-ordination of the Consortium technical activities

The coordination of the scientific and technical activities has been carried out on the basis of a quite effective collaboration among the several partners involved within each WP. Under this respect, each WP Leader has been responsible of the coordination activity within the relevant WP, according to the following steps:
- plan and organise the overall internal work;
- coordinate the contribution from the relevant partners;
- define the roadmap for the development of the deliverables;
- collect feedbacks from the WP group as far as Quarterly Reports are concerned.

Finally, each partner has been responsible for all other direct issues with the coordination unit within the deadlines.

T 0.4: Internal Communication infrastructure

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.

Forecasted activities

During next three months management activities will mainly focus on the coordination and the handling of financial and administrative issues that will require accurate and punctual communication with all partners involved and the Commission.

The focus of management will be on ensuring a good communication and interaction both with the Consortium, the Commission and the External Advisors, in particular close cooperation is foreseen with RBI and with Doctor Krstacic and Dr Lavrac, who are currently actively cooperating to the development of the project.

Attention will be paid to a closer interaction with WP8-Dissemination and in particular to develop horizontal activities with other related FP6 projects, currently under evaluation the possibility, that will be discussed with the Consortium during next MB and STAB meeting, of joint activities with MyHeart and ACGT.

Ongoing workpackages progress: WP2

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

STATUS OF TASKS DUE IN THIS PERIOD

TASK	TITLE	COMMENTS
T 2.2	Design and Development of the Data Acquisition and Transmission Infrastructure	Based on the Specifications of the Data Acquisition and Transmission Infrastructure, the partners have continued with the development of mockups and software modules in order to intergate the sensors and medical devices to the HEARTFAID platform. The final set of sensors characterised as connectable to the platform has been defined, including sensors to be used both for clinical and personal (home and on-the-move) environments. 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. The progress of the development is in line with the timeline of the task and no deviations are expected.

STATUS OF DELIVERABLES DUE IN THE NEXT 3 MONTHS

		DATE	COMMENTS
DELIVERABLE	N°		
Prototype of Data acquisition and transmission infrastructure	D 19	31/07/07	The prototype is in its initial phase following the development of the mockups and software modules for the integration of sensors to the HEARTFAID platform. The complete version of D19 is expected to be achieved at the end of the next quarter.

FORECAST STATUS OF TASKS DUE IN THE NEXT 3 MONTHS

TASK	N°		COMMENTS
Design and Development of the Data Acquisition and Transmission Infrastructure	T 2.2		During the next 3 months, all the parts and modules comprising the Data Acquisition and Transmission Infrastructure are expected to have been developed, tested and integrated and the prototype of the infrastructure will have been implemented and will be described in D19.

Description of the activities

In the current reporting period, the activities of WP2 are related to Task 2.2, Design and Development of the Data Acquisition and Transmission infrastructure.

These activities were carried out by VMWS, FORTHNET and SYNAP. In the following paragraphs, a more detailed description of these activities is given:

a) **Definition of the set of sensors to be integrated into HEARTFAID (VMWS, FORTHNET)**

This activity was completed at the beginning of this reporting period by VMWS and FORTHNET. 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.

Regarding the sensors provided by the clinical partners (UNIMIB/AUXOL, UNICZ and JUMC), the list contains:

A&D UA-767PC for Oscilloscopic Blood Pressure measurements, Spacelabs 90217 and 90207 ans A&D TM-2130 for 24h ambulatory blood pressure measurements, Siemens Sequoia and Vivid 7 echocardiographs, CardioFScan 2 Premier and Delmar-Reynolds 24-h Holter ECG monitoring devices and ESAOTE-ARCHIMED EGC devices.

Pulse Oximeter Nonin 4100 (Bluetooth), Ambulatory Blood Pressure monitor A&D UA-767PBT (Bluetooth), Electronic Scale A&D UC-321PBT (Bluetooth)), BF-906 and BioScan 916 bioimpedance analysers, Finometer PRO.

Regarding the on-the-move scenario, Pulse Oximeter Nonin 4100 (Bluetooth) and FRWD heartstrap will be used.

Finally, the partners have identified a number of other sensors and devices characterised as not directly integratable 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.

b) **Development of modules for data acquisition (VMWS, FORTHNET)**

Software modules for data acquisition from sensors and devices provided by the clinical partners were developed during this period. Due to the fact that most of these devices communicated with a PC using vendor provided software, construction of messages through parsing the data stored at the PC using the export functionality of the vendor's software was considered as the best approach. For this reason, Java software modules were implemented in order to parse the information from the files and generate valid XML messages to be inserted in the HEARTFAID platform. At this point in time software modules for parsing information from A&D UA-767PC, and A&D TM-2130 and Spacelabs 90217 and 90207 have been developed by VMWS. 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. The parsing of information generated by the rest of the devices is in progress. Finally, regarding the DICOM compliant echocardiography devices (Siemens Sequoia and Vivid 7), their integration to the platform has already started as a collaboration between the technological and the clinical partners, which will provide the data for the integration tests.

The acquisition of data from the sensors that will be used in the Home environment is in progress. By processing the variety of data outcomes from the sensors, using java-based software, XML messages will be generated, in order to be forwarded to the main middleware of the platform. The data outcomes of the following sensors are being analyzed by FORTHNET:

1) PulseOximeter Nonin 4100 (Bluetooth),
2) Ambulatory Blood Pressure monitor A&D UA-767PBT (Bluetooth)
3) Electronic Scale A&D UC-321PBT (Bluetooth).

According to the devices mentioned above, most sensors will be connected to a PC using Bluetooth technology (wireless connectivity).

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

- A&D UA-767PBT (blood pressure and cardiac pulse)

- A&D UC-321PBT (scales)

- Nonin Oximeter

- FRWD Heartstrap

c) Data transmission (VMWS)
The connectivity between the mobile phones (Nokia 6630 and Nokia N80) and the XML gateway which creates the XML messages to be transferred to the platform has been tested via transferring real measurements over a GPRS network. Actual measurements reach the gateway as expected and the XML gateway properly creates the messages and sends them to the platform.

d) Development of EPR (SYNAP)
As already reported in the previous quarterly, preliminary studies have been started aimed at extending an existing general purpose EPR developed by Synapsis towards the following two objectives:
– Adapt the existing EPR to the needs of the cardiovascular experts in order to become the reference HEARTFAID Electronic Patient Record;
– Integrate the new HF-EPR with the platform of services; this way it will possible for the medical experts to select from the data acquired by the remote sensor networks, the relevant information that will be automatically stored into the EPR itself.
In this reporting period, Synapsis continued the development of the 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.

Ongoing workpackages progress: WP3

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

STATUS OF TASKS DUE IN THIS PERIOD

TASK	TITLE	COMMENTS
T 3.3.1	Early mock up prototype implementation	The activities of subtask T3.3.1, started at month M6, are still going on. During the reporting period we have evaluated some open source software framework implementation of SOA and ESB architectures to develop the prototype.
T 3.4	Interoperability Middleware	The activities of Task T3.4, started at month M8, have been carried out during the reporting period as expected from the Gantt of the Project. 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.

STATUS OF DELIVERABLES DUE IN THE NEXT 3 MONTHS

		DATE	COMMENTS
DELIVERABLE	N°		
Clinical standards and first middleware prototype	D 20	31/07/07	In the next 3 months it is expected that the partners will have achieved the definition of a first middleware prototype. The advances towards this achievement will be evaluated during the general meeting of the Consortium that will be held in Zagreb on June. During this occasion the partners will evaluate if the prototype will be achieved in time, according with the Gantt of the project, or with a slight delay.

FORECAST STATUS OF TASKS DUE IN THE NEXT 3 MONTHS

TASK	N°		COMMENTS
Early Mock-up prototype Implementation	T 3.3.1		This task is expected to be concluded at the end of the next reporting period. The task will successfully achieve its scope to implement an early mock-up of the integration middleware. The study of the available technologies have last more than what was expected, therefore it will be possible a slight delay in the conclusion of the task.
Interoperability Middleware	T 3.4		This task will continue during the next reporting period. The results obtained from Task 3.3.1 will strongly influence the activities of this task that we expect to get into it more intense phase.

Description of the activities

During the reporting period, the activities of tasks T3.3.1 and T3.4, started at month M6 and M8 respectively, have been continued. The progress of the work carried out is described in the following paragraphs.

T3.3: Integration Middleware

T3.3.1: Early mock up prototype implementation
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).

A first instance of the architecture has been deployed in this period, in order to evaluate the feasibility of the solutions identified. As reported in the previous period we adopted Service Oriented Architectures (SOA), Enterprise Service Bus (ESB) architecture, and Open Geospatial Consortium specifications as reference information model, for the implementation of the Integration Middleware.
In this period we accurately evaluated and tested the most common open source frameworks implementation for web services, and more in detail we evaluated: 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, are being experimented: OpenJMS and JBoss Messaging.

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, have been 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. To this goal, we studied and experimented ebXMLRR technologies that is the open source registry reference implementation of ebXML OASIS standard. The experiments have been carried out using also the functionalities offered by an existing commercial EPR developed by Synapsis, trying to combine the available features.

also experimenting with composition of preliminary functional services in generic EPR available. The results obtained by these studies will support the implementation of the HF platform of services.

Ongoing workpackages progress: WP4

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

STATUS OF TASKS DUE IN THIS PERIOD

TASK	TITLE	COMMENTS
T 4.1	Design and development of a suitable data warehouse for knowledge discovery	Functional specification of the data transformation from patient data defined by the 'Case report form' into the complete set of attributes prepared for knowledge discovery has been done. Open source DW software package Pentaho has been extensively studied and its application tested for some multi-patient managerial tasks and single patients decision support purposes.
T 4.2	Data understanding and preparation	Retrospective data from UNICZ have been transformed to the standard Weka (arff) form. Data have been cleaned manually by elimination of obvious outliers and sparsely populated attributes. For the purpose of testing automatic noise detection procedures, the data have been converted also to the ILLM (Inductive Learning by logic Minimization) form.
T 4.3	Implementation of Knowledge Discovery in Database Processes	Experiments with contrast set mining and Kernel based Support Vector Machine algorithms have started in parallel on available retrospective data.
T 4.4	Ontologies and medical knowledge representation in the domain	Actionable knowledge related to HF has been prepared in the form of 10 sets of rules. For experimental purposes, some rules have been converted to the OWL form and a novel OWL closed world interpreter has been developed to test possibilities of integration with the decision support system. Additionally, for some common HF related decision problems medical plans have been developed.

STATUS OF DELIVERABLES DUE IN THE NEXT 3 MONTHS

DELIVERABLE	N°	DATE	COMMENTS
Functional Specifications of data warehouse implementation and data preparation	D 21	31/07/07	The technical partners started to prepare the deliverable which will describe specific properties of data warehousing for expected knowledge discovery processes inside the platform. Included will be description of the data cleansing process, potentially with construction of some complex features based on expert knowledge. The report is expected to be on time.
Ontologies and knowledge representation	D 22	31/07/07	The report will include detailed description of the constructed ontology representing HF descriptive knowledge and the description of the sets of rules representing HF actionable knowledge. Special attention will be devoted to the problem of integrating these knowledge representation forms with the decision

		support system. The report is expected to be on time.

FORECAST STATUS OF TASKS DUE IN THE NEXT 3 MONTHS

TASK	N°	COMMENTS
Data understanding and preparation	T 4.2	Evaluation of data cleansing methodology on retrospective UNICZ data. Investigation and testing of the process of semi-automatic construction of complex features that can increase the quality of knowledge discovery.
Implementation of knowledge discovery in database process	T 4.3	Application of subgroup discovery and Kernel based Support Vector Machine algorithms on retrospective data. Comparison of the results obtained by different methodologies. Development and tuning of the SVM and the Random Forest methodology.
Ontologies and medical knowledge representation in the domain	T 4.4	Development of the complete set of medical plans for HF decision-making situations. Evaluation of the OWL based decision making process and the closed world interpreter. Integration of descriptive and actionable knowledge.

Description of the activities

The work on WP4 included all tasks T4.1 - T4.4 in parallel.

On March 08.-10. 2007 a WP4 meeting took place in Milano, Italy devoted to the definition of procedural HF related knowledge. Participating partners were AUXOL, UNIMIB, and RBI. Additionally, there have been continuous communication and discussion between JUMC and RBI on procedural knowledge improvements.

The period correspond to the end of T4.1 and in the next 3 months we should prepare two deliverables. D21 will present results of tasks T4.1 and T4.2 while D22 will contain detailed information about systemized HF domain knowledge collected in T4.4.

T4.1 – Design and development of a suitable data warehouse for knowledge discovery

The work concentrated around two main tasks: a) functional specification of attributes that will enter the knowledge discovery process and b) study of the open source software for the data warehousing tasks inside HF platform.

In respect to the first part of the task we have used the 'Case report form' and D5 as the definitions of the data that can be expected inside the platform. Two major data types have been identified: the first are patient data collected by medical personal during their visits and described in the 'Case report form'. The other type is data automatically collected during continuous monitoring. Both data types are temporal sequences but the difference in the way they should be handled is significant. Patient data described in the 'Case report form' represent short temporal sequences of unknown length. In a simple case we can have only the baseline evaluation while in cases with many complications we can have many unplanned data collection points (additional visits) with irregular time distance. The effective data warehousing system should be able to handle the whole spectrum of possible situation and for all of them enable effective knowledge discovery. The other type is automatically collected data that should be handled as long temporal sequences of unknown collection rate. Finally, attributes for both

data types are integrated into a single table in the standard form prepared for different knowledge discovery procedures.

In respect to the second part of the task we have tested the open source data warehousing software Pentaho with ETL, DW and OLAP functionalities. The unique potentially very relevant fact is that Pentaho will in the future integrate with Weka open source knowledge discovery platform. Based on the requirements specifications we have performed conceptual design of the data warehouse, encompassing its architecture and crucial functional capabilities. We have investigated two possibilities for using the open source software. The first is evaluation of the HF platform in respect to the quality and overall effectiveness in handling HF patients. The second is application of data visualization tools for presenting single patient characteristics in order to support decisions by medical personnel.

T4.2 – Data understanding and preparation

Retrospective data available from UNICZ about connection of genetic properties with ecocardiographic measurement results has been transformed to the form appropriate for knowledge discovery. In total there are four different, relative small sets of data with various performed genetic tests. During the transformation, which included also selection of the set of potentially relevant attributes, we have manually cleaned the data. Intentionally we have eliminated the attributes with many unknown values. Also, obvious outliers have been substituted by unknown values. On the so prepared data we have tested automatic noise detection procedures. Although these procedures are unable to detect many obvious outliers, they are effective for preserving data consistency.

First knowledge discovery results with the prepared data demonstrate that there are no strong and obvious connections between genomic and ecocardiographic attributes. In this situation introduction of some novel complex attributes is potentially relevant and completely justified. This will be our main task in the next period.

T4.3 – Implementation of knowledge discovery in database process

The work concentrated around two main tasks: a) development and tuning of novel knowledge discovery approaches and b) application standard knowledge discovery algorithms and comparative analysis of their performance.

In respect to the first part of the task we have concentrated on the Random Forest approach, especially in order to enable evaluation and ordering of attributes in respect to their significance. Also we started the work on the development of novel kernels for Support Vector Machines.

In respect to the second part we successfully tested decision tree and subgroup discovery algorithms on retrospective data. According to the obtained classification accuracy the results are not optimistic. In the next iteration we will try to improve the quality of the obtained results by adding complex features in the data pre-processing phase. Also, unsupervised approaches based on association rule learning will be tested.

T4.4 – Ontologies and medical knowledge representation in the domain

The work on the development of the actionable HF related domain knowledge has ended in the form of 10 sets of rules for tasks like diagnosis, severity estimation, and medication. After thorough evaluation by medical experts and experimental verification, the rules will be prepared for the implementation. The problem of soft computing has been solved by introduction of different reliability levels in conclusion parts of the constructed rules. Special care has been devoted to the problem of integration of the descriptive medical knowledge, presented in the form of HF ontology, with the procedural knowledge represented in the form of rules. Experimentally a part of the procedural knowledge has been presented as an OWL ontology. For the integration with the decision support system an experimental interpreter able to act in accordance with the closed world assumption has been developed. Testing of this approach will be our main future task. Additionally, we have identified some common HF related decision situations and we have developed medical plans describing possible patient handling. Still completely open issue is if and how these plans could be used for automatic decision support.

Ongoing workpackages progress: WP5

WORK PACKAGE: 5
TITLE: DATA PROCESSING AND DECISION SUPPORT DEVICES
START DATE: MONTH 5
WORK PACKAGE LEADER: CNR
PARTNERS INVOLVED: UNICAL,UNICZ, SYNAPSIS,FORTH, RBI
MEETINGS: CNR/SYNAPSIS Pisa, April 2007   CNR/SYNAPSIS/UNICAL

STATUS OF TASKS DUE IN THIS PERIOD

TASK	TITLE	COMMENTS
T 5.2	Design and development of models and methods for signals and images processing	ECG waveform modeling. ECG pre-filtering and QRS detection algorithm. Algorithms for X-Ray image processing and parameters measurements. Echocardiographic sequence image analysis. Image segmentation, geometrical parameter extraction.
T 5.4	Implementation of the Decision Support System	Selection of tools for CDSS implementation (ranging from strategy controller to inference engine) Mapping of data formats. CDSS internal data models (ontological, Java Data Mining specifications), external Data Manager (data about patients). Missing data and actions handling. Work distribution among the involved partners.

STATUS OF DELIVERABLES AND MILESTONES DUE IN THE NEXT 3 MONTHS

MS	TITLE	COMMENTS
MS 5.1	Early mock-up prototype of data processing and decision support services	Identification and first tests of the basic tools of the DSS.

FORECAST STATUS OF TASKS DUE IN THE NEXT 3 MONTHS

TASK	N°		COMMENTS
Design and Development of models and methods for signals and images processing	T 5.2	31/07/07	Refinement of the algorithms under test for QRS detection and echocardiographic images segmentation.
Implementation of the Decision Support System	T 5.4	31/07/07	Early mock-up prototype implementing all the basic functions internal to DSS and the communication protocol between DSS and middleware.

Description of the activities
On the base of the methodological and technical requirements and specifications of the Decision Support System presented in the Deliverable D15, the implementation characteristics of both the DSS and the signal/image processing algorithms were deeply investigated to start the realization of a first prototype.

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

The algorithms for ECG waveform modeling, ECG pre-filtering and QRS detection already investigated and partially developed were further refined. In particular, a general ECG processing and a well-performing QRS-detection algorithm was prototypized. The algorithm was based on QRS enhancement, derivative filters, adaptive thresholding and threshold increment after QRS for avoiding detection of T-waves as QRS. First round results were obtained on MIT-BIH Arrhythmia Annotated Database (48 half hour 2-lead ECGs).

Regarding images, an algorithm for geometrical parameters measurements from digital X-Rays was studied and partially implemented. Tests were also performed of advanced methods for LV delineation in echocardiography.

Task 5.4 - Implementation of the Decision Support System

In order to start the implementation of the DSS firstly an accurate analysis of the most adequate tools and actions was carried out.
As a result of this activity the following operational strategy was defined.

- To implement CDSS-HL7 adapters in Java for messaging in XML format between *modules* and the *middleware*
- To develop a Java Mapper in order to transform data obtained from patient data into ontological format and vice-versa
- To implement and test a procedure for managing actions and retrieving missing data based on both meta-level rules (workflows management systems WFMS such as Jboss and ActiveBPEL could be needed) and object-level rules (Bossam procedural features)
- To write a KB using OWL (a subset of the one developed in WP4) plus SWRL when rules are needed.
- To implement a tool for managing the ontology using with Jena+Bossam (Jess discarded cause of costs for licenses and royalties).
- To implement a procedure able to synchronize *service-data,* i.e. some data should be always allowable both to the meta and to the object levels, such as information like drugs, illness, pathways).
- To evaluate the use of PMML (Predictive Model Mark-up Language) in order to implement the model-base.
- To use a standard API (e.g. Java Data Mining API) to implement the model query. (Separation between computational reasoning and signal and image processing).
- To realize a mock-up based on both diagnosis and prognosis scenarios. It will be composed of:
  - a prototypical CDSS module (KB, selected computational reasoning, selected algorithms for signal processing)
  - a clinical database module (Data Patient Repository)
  - a tiny user interface module (consisting of a Java Servlet and some JSP pages containing html forms)
  - adapters to facilitate information exchange between modules and the middleware HL7 format
  - a mapper to convert data between the relational and ontological data models.
- In order to realize this mock-up the following actions have to be performed:

- to bridge the gap between the ontology and the terms of HL7 RIM (adapters and mapper involved)
- to complete the ontology for the selected scenarios
- to consider the extension of the Data Patient Repository by adding a number of parameters coming from the considered scenarios.

According to the above necessities preliminary segments of software have been developed in Bossam, Pellet and Jena for testing little basic functionalities of the DSS.

Ongoing workpackages progress: WP6

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

STATUS OF TASKS DUE IN THIS PERIOD

TASK	TITLE	COMMENTS
T 6.1	Design end-User Services Interaction Functionalities	The activities of Task 6.1 started at M10 and will be completed at M16 of the project. The design of the high level services necessary for the users to interact with the HEARTFAID platform and its functionalities is in progress, inline with the Gantt Chart of the project. Emphasis has been given on the Graphical User Interface (GUI), in order to provide a user-oriented and user-friendly outcome. Furthermore, the requirements for the integration of the developed services are being considered, throughout the development of this Task.
T 6.3	Knowledge discovery system for web-based data extraction and analysis	Specification of patient data has been prepared, in the appropriate form for knowledge discovery process. Evaluation of the contrast set approach on retrospective data for mining descriptive rules has been done.

STATUS OF DELIVERABLES DUE IN THE NEXT REPORTING PERIOD

		DATE	COMMENTS
DELIVERABLE	N°		
User needs analysis and functional specifications of the Heartfaid platform services	D 23	31/07/07	Most of the content that will be included in this Deliverable has already been defined and the distribution of work among the participating partners will start by the end of Month 16.

FORECAST STATUS OF TASKS DUE IN THE NEXT 3 MONTHS

TASK	N°	COMMENTS
Design end-User Services Interaction Functionalities	T 6.1	Task 6.1 will end on Month 16, where the Front-End of the HEARTFAID platform shall be available for the end-users. Most of the functionalities and services that will be provided through the Front-End have been identified and their design is already in progress. Security is a very important factor for the development of the End-users services and various access levels have been considered, according to users' attributes, in order to access the various proposed functionalities.
Development of end user applications and services	T 6.2	The development of the Alert & Notification system has started and various interoperability tests with the Synapsis platform will take place in the following month.
Knowledge discovery system for web-based data extraction and analysis	T 6.3	Random forest approach will be tested for the detection of relevant attributes. The requirements for the user guided attribute selection process will be analysed.

Description of the activities

T 6.1: Design End-User Services Interaction Functionalities

The "end-user" level constitutes the front-end layer of the HEARTFAID platform and provides the means for every interaction between external users and the system. The selected approach for this module is a Graphical User Interface that conforms to the common conventions of most popular web applications. Based on the template drafts that were designed in the previous quarter, a prototype of static pages has been developed to act as a guide for the dynamic application. The prototype includes the parts of the final interface's functionality that are indicative and descriptive enough to deliver an accurate representation. The front-end is divided into modules and sub-modules, but cross-references between sections have also been included, where they enhance usability. On the whole, the front-end follows an intuitive hierarchical structure, in order to allow the user to reach the desired functionality with the minimum Number of Clicks.

The Decision Support System (DSS) is an issue of special consideration in the design of the user interface. The DSS is a complex feature on its own and it requires intensive and collaborative effort to design a user interface that does not reflect this inherent complexity. The developed prototype includes some initial suggestions on user interaction with the DSS, but further suggestions and feedback will certainly be incorporated in the final interface.

The HEARTFAID middleware platform supports a multitude of functions to assist data entry and retrieval, and intelligent deduction. It is evident that for these functions to be adequately exploited, an intuitive, inclusive and stable UI should be developed. Up to M15, most of the important functionalities of the middleware, as well as the respective Front-End interfaces, have been identified. Furthermore, the static prototype that was developed to demonstrate the concepts and approach of the User Interface is a helpful point of reference. In the meeting in Zagreb, we expect to get valuable feedback from our partners and we expect to finalize the specifications for the end-services module.

T6.3: Knowledge discovery system for web-based data extraction and analysis

We have identified different types of available patient data inside the platform and we have specified the form and the generation procedures for the construction of attributes that can enter the web based knowledge discovery process. The list is exhaustive and the open issue is selection of the most appropriate subset that actually will enter into the data mining process. Interesting possibility is to enable some sort of user guided approach. This will be the research task in the following period. Additionally, we have tested contrast set approach on available retrospective data. Although, the obtained results are very interesting, especially for the brain stroke domain, it has been detected that the approach is not convenient for web based application. The problem is the necessity of intensive interaction with the user. In the following period we will test less complex approaches like those aimed at detection of most relevant attributes.

Ongoing workpackages progress: WP8

WORK PACKAGE: 8
TITLE: DISSEMINATION AND EXPLOITATION
START DATE: MONTH 1
WORK PACKAGE LEADER: UNICAL
PARTNERS INVOLVED: ALL

STATUS OF TASKS DUE IN THIS PERIOD

TASK	TITLE	COMMENTS
T 8.1	Dissemination activities	Contributions to the dissemination have been given by the clinical partners, in detail below

FORECAST STATUS OF TASKS DUE IN THE NEXT 3 MONTHS

TASK	N°		COMMENTS
Dissemination activities	T 8.1		Specific initiatives have been planned, specifically related to the dissemination of the Heartfaid activities to health care professional associations and to the possibility of joint dissemination activities with MyHeart and ACGT Contribution for future activities from • VMWS • RBI & STAB (Dr Krstacic/Dr Lavrac) • CNR

Description of the activities

During the first quarter of the second year of project activities, the dissemination activities have been carried out according to the general plans defined in the Deliverable D6.

In particular, each partner has carried out its own internal dissemination activities, by increasing the awareness of Heartfaid activities and current results within its own institution.

Moreover, the clinical partners have consolidated the interactions 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)
- ◆ Polish Cardiac Society
- ◆ Polish Hypertension Society

In particular, UNICZ has presented Heartfaid project and current results within the following events:
- ◆ Sicily and Calabria Congress of the SIMI (Vibo Valentia, April 19-21, 2007)
- ◆ Advanced School in Nursing Science (organized by SIC, Amantea, April 15, 2007)

As far as clustering activities are concerned, evaluation of possible co-operation with other projects and programmes has been carried out during Personal Health Systems (12 and 13 February 2007) event in Brussels and it is currently under evaluation and discussion will be open over next MB and STAB meeting about the feasibility of joint dissemination activities with the projects MyHeart and ACGT.

USE AND DISSEMINATION
Future activities until next quarterly report month 18

Date	Channel	Event	Place/ Country	Partner responsible	Nature and size of audience
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
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	