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Project Co-ordinator

Company name : Ericsson Enterprise AB
Name of representative : Jennie Weingartner
Address : Ericsson GmbH
Fritz Vomfelde Str. 26,
D-40547 Düsseldorf ; Germany
Phone number : +49 211 534 2234
Fax number : +49 211 534 3744
E-mail : Jennie.Weingartner@ericsson.com
Project WEB site address : www.healthservice24.com

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HealthService24

eTEN-C517352

Continuous Mobile Services for Healthcare



HS24 – Final Project Report

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1. Executive Summary

The goal of HealthService24 was to launch an innovative mobile health care service that supports patients' and health professionals' mobility, increases patients' quality of life, and at the same time lowers health care costs. In February 2005, the HealthService24 Consortium started out with a technically fully validated prototype of the mobile health services platform from the forerunner project MobiHealth (IST-2001-36006). Now the challenge was to test the feasibility of the existing prototype via pilot runs, to fine-tune this solution and validate the precise conditions that needed to be fulfilled in order to enable a sustainable market deployment.

The economic and social burden is pressing heavily on governments, health care providers and citizens. Only the number of patients with chronic diseases in Europe for the next decade is estimated to more than 100 million. Even if only one of these patients out of ten is using a mobile health service, the economic benefits are substantial. Thus, two important pre-requisites for market deployment are already fulfilled: the technology is available and the healthcare market seems to bear huge potential for mobile patient management applications. However, in order to create a sustainable concept, there are a number of other vital parts that need to fall into place. In the end, it all boils down to one overall aspect: all participants of the value chain – from the patient to the health insurance company – must be able to recognize substantial benefits in order make this concept sustainable. Within HealthService24 we have assessed the market and the value chain players, their needs and requirements. In our three different pilots featuring real-life scenarios, we gained important knowledge about the end-user experience and about the feasibility for integration into the clinical process, which led to adaptations of the prototype. Overall, our pilots showed that HealthService24 is not disruptive to current work practices. End-user acceptance is very high and cost savings up to 38% on direct costs could be achieved when comparing to conventional treatment. The savings were mainly achieved through less emergency room admissions, lower number of admissions in general and a shorter length of stay. However, we also learned the important lesson that technology is not enough. Implementing a mobile healthcare service is more of a socio-economic challenge. Healthcare players need to be willing to embrace new technologies and work methods. The health-political support, data security and legal challenges are other hurdles to implement a mobile monitoring system on a broader scale.

The overall positive project results have not only strengthened the commitment of the partners for the deployment of the project results, but have also triggered discussions towards agreements for the commercialization of the forthcoming services and products: The **industrial partner** of the consortium has already got a certified solution available on the market¹. The **hospitals** recognise the importance and usefulness of the proposed mHealth services and have started actions towards the definition of the strategies for incorporating HS24 mHealth services in their organizations. The **SME's** will continue developing new applications and devices for telemedicine services. Also the **universities** are in the process of expanding their research directions to include areas that will allow the development of new concepts for m-health.

¹ Ericsson Mobile Health

2. HealthService24 – Introduction

The HealthService24 project (HS24), addressing eHealth and eInclusion, aims at launching an innovative mobile health care service supporting patients' and health professionals' mobility, increasing patients' quality of life and lowering health care costs.

The HS24 service is a viable mobile health care service permitting healthcare professionals to remotely assess, diagnose and treat patients whilst the patients are free to continue with daily life activities. HS24 allows patients and non-patients to monitor their physical condition and obtain advice and info.

HS24 was based on a technically validated and fully functioning mobile health services platform prototype. The solution was developed within the MobiHealth project, co-financed by the European Union under the IST program (IST-2001-36006). The existing service prototype has been validated and fine-tuned to enable a sustainable market deployment.

Why HealthService24?

Today the health care sector faces serious and increasing problems concerning limited resources for effective disease prevention management. In most of our Western societies, the “acute care” paradigm has led to the design of “find-it, fix-it” health systems, but they are not meeting the changes in demand of care services prompted by the aging population. The economic and social burden is pressing heavily on governments, health care providers and citizens. Emerging proposals are stressing the imperative need to redesign the provision of services in ways that are more flexible. Technology, especially mobile applications, seems to be the cornerstone that will make this transformation possible.

The economic potential of mobile health services is very high. The number of chronic patients in Europe for the next decade is estimated to more than 100 million. Even if only one of these patients out of ten is using a mobile health service, the economic benefits are substantial. Furthermore, the use of mobile health services will boost the use of wireless communications, pushing for a reduction of wireless telephony communication costs and improving the coverage of wireless networks. In the long term, we expect that mobile health services will be a fundamental part in the transformation of today's health model, allowing access to high quality treatment and follow-up, anytime and from anywhere.

The objective of the project was to test the feasibility of the deployment of the existing prototype on the European market via pilot runs, and demonstrate and validate the precise conditions to be fulfilled for subsequent deployment. The result should be a fully marketable solution.

While the general idea behind this service was not new, a successful implementation yet remained to be delivered. In contrast to past approaches, the consortium decided to collaborate with health insurers, medical service providers, mobile operators, hospitals and law firms. Due to the uninterrupted inclusion of all members of the value chain, the consortium was in the unique position to assess market needs accurately and act accordingly, thus laying the basis for a successful deployment.

The HealthService24 can potentially be used in many areas, ranging from patient management to sports and rehabilitation and from illness prevention to patients' treatment. The most relevant application areas are post hospitalisation, public health care and home care; the targeted users include post-hospitalisation patients, patients with chronic diseases/ problems or high-risk

patients. These patients today are often hospitalised for long periods, resulting in high hospital costs and moral degradation. The HealthService24 will enable them not to stay at the hospital, increasing their feeling of comfort and safety and at the same time reducing the health care costs.

Not only the patient mobility but also the medical personnel mobility can be targeted - the idea is to replace the traditional medical bag with an advanced medical Body Area Network (BAN) system assisting the practitioner in diagnosis and treatment. The service can be implemented by hospitals and public healthcare organizations.

3. The HealthService24 Consortium

Trans-European market validation of the HealthService24 requires concerted efforts from partners with different areas of expertise (namely specialists in wireless communication interfaces, health service brokers, manufacturers of mobile devices, medical sensors etc.) Such a coalition of partners with complementary work experience can only be found on European level.

The following partners together form the HealthService24 consortium:

- **Ericsson Enterprise AB (SE)** – Project Coordinator & Industrial Partner
- **University of Twente (NL)** – Project Scientific & Technical Management
- **University of Cyprus (CY)** – Hospital Information System Support
- **Hospital Clínic Provincial de Barcelona (E)** – Healthcare Provider
- **Medisch Spectrum Twente (NL)** – Healthcare Provider
- **LITO Polyclinic Paralimni Ltd (CY)** – Healthcare Provider
- **TMS International B.V. (NL)** – Medical Systems Manufacturer
- **Yucat B.V. (NL)** – Mobile Business Solution Development



All these partners, with exception of the UCY and the LITO Polyclinic, were the core technology and service development partners in the MobiHealth project (IST-2001-36006), which developed the existing prototype service being the starting point of the HealthService24 project.

Below follows a short introduction to the HS24 consortium partners.

3.1.1 Ericsson Enterprise AB – Project Coordinator / Sweden

Ericsson Enterprise AB provides industries with segment-specific mobile solutions. They utilize an integrative project approach that extends from the conception of a strategy, to the building of relevant competence networks and project structures and further on to the development of Mobile Internet solutions and system integration. Developing Mobile Internet applications and solutions for the healthcare sector is a major interest to Ericsson Enterprise Solutions.

Ericsson was in a very favourable position to lead mobile healthcare endeavours, as the company unites expertise in the pharmaceutical and healthcare sector with substantial know-how in mobile communication technology and project management.

Ericsson GmbH/Germany (a subsidiary of Ericsson Enterprise AB, SE) was responsible for overall project coordination for the MobiHealth Project (IST-2001-36006) that was successfully concluded in February 2004.

3.1.2 University of Twente (UT) / Netherlands

The University of Twente has a long record in health application research and development of telematics systems and services. The major area the UT has identified for the application of telematics services is the medical and health care environment (Tele-medicine). The University of Twente has also an established history in the commercialization of research results via the creation of new spin-off companies, licensing of rights etc. A holding company that is owned and controlled by the university provides for example funding, legal advice and “shelter” to spin-off companies commercializing research results.

Within this context, the Architecture and Services of Networked Applications (ASNA) group (previously Application Protocol Systems (APS)) works in collaboration with major operators and hospitals in the design of new value-added health services and applications. The APS group’s work concentrates on the area of telematics applications and services with special emphasis on multimedia protocols for mobile wireless health care systems. The main targets are the development of applications for the support of e-health and m-health. The group’s activities are supported by the CTIT and are done in collaboration with local hospitals, network operators and small companies, specialized in design and manufacturing of portable health sensors.

The University of Twente was the main technology developer, Scientific Coordinator and Technical Coordinator of the MobiHealth system in the IST-2001-36006 project.

3.1.3 University of Cyprus (UCY) / Cyprus

The University of Cyprus is a university with its first departments set in operation in 1992. The Department of Computer Science is one out of three departments in the Faculty of Pure and Applied Sciences, the other two being Mathematics and Statistics, and Natural Sciences. The Department of Computer Science is a research-oriented department active in several areas of information technologies such as Internet Technologies, Mobile Computing, Electronic and Mobile Commerce, Medical Informatics and Telemedicine, and Multimedia Systems. Strong emphasis is put on competitive research and education that can benefit the local industry. Currently, the Department runs a number of research programs related to Health Telematics, Mobile Computing, eEducation, and Information Gathering through the Web. This work is financed by Government organizations and the Cypriot and local industry.

3.1.4 Hospital Clínic Provincial de Barcelona (HCPB)

The Hospital Clínic Provincial de Barcelona (HCPB) is a university tertiary hospital located in Barcelona. It is a public institution with a sound reputation for excellence in care provision, training and research at national and international level.

Excellence in Care: HCPB is the main specialized provider covering an area of approximately 500.000 inhabitants, aiming at maximising cooperation among professionals, levels of care and institutions. As a result, research lines have been created to explore, develop, validate and implement information technologies to support new models of care provision.

Excellence in research: The research work carried out at HCPB covers most of the leading-edge research lines in Medicine, with a special emphasis on the applicability of the results into mainstream health services. This aspect is further reinforced by the basic research done in close collaboration with the School of Medicine and other top institutions at regional, national and international levels. This configures a constant policy of truly translational research “from bench to bedside”.

Excellence in training: The Hospital Clínic is a renowned centre for pre-graduate, post-graduate and specialization courses with students coming from all over the world. Integrated in the principle networks of continuous medical education, the institution has proven to be highly successful in transferring research results and innovation into a corporative body of knowledge.

HCPB participated in the MobiHealth IST-2001-36006 project as a trial site for the COPD trials.

3.1.5 Medical Spectrum Twente (MST) / Netherlands

Medical Spectrum Twente (MST) is one of the largest public general hospitals in the Netherlands with 1100 beds, 4000 employees and 200 medical specialists. The MST offers all kinds of specialised medical services and is a top-clinical hospital, which means that it is legally allowed to offer specific medical services such as heart surgery, in vitro fertilization, kidney dialysis, PTCA's etc. The MST is very active in the field of patient-related medical research (no fundamental research) regarding the effect of medical treatments and medication. Responding to the growing patients' need, an increasing number of medical specialists is engaged in projects concerning hospital care at home. An important focus patient group in this regard are pregnant women. One of the dermatologists of the MST has recently won the second prize in a European contest for a project enabling to see wounds of patients on a distance and give advice to a general practitioner.

MST participated in the MobiHealth IST-2001-36006 project as a trial site for the high-risk pregnant women trials.

3.1.6 LITO Polyclinic / Cyprus

The LITO Polyclinic, a private hospital founded in 1990, is managed by a dedicated group of specialists covering a wide spectrum of medical fields such as general pathology, cardiology, gastroenterology, general surgery, urology, dermatology, gynaecology, paediatrics, orthopaedics, ENT, neurology, plastic surgery and diagnostic radiology.

The polyclinic is fully equipped, including also an intensive unit with central supply, oxygen monitoring, modern chemical laboratory and diagnostic centre of radiology including CAT Scan and multi-probed ultrasound machinery. There are over 35 employees, including special nursing and secretarial staff. LITO has 2 ambulances for emergency cases, 65 beds in rooms for 1 or 2

and it is open on a 24 hour basis, covering all the patient's needs. At present LITO is planning to expand in the home health care sector.

3.1.7 Twente Medical Systems International B.V. (TMSI) / Netherlands

TMS International B.V. is an SME specializing in physiological measurement systems. TMSI is specialised in developing and producing hardware solutions for ambulatory and stationary measurement systems. These systems are used for sleep studies, neurological research, movement sciences etc. Used techniques include DSP's, Bluetooth, low-power electronics, specialised amplifiers etc.

The technology developed by TMSI has been on the market for more than 15 years now. The specialized know-how has been built up during many years of co-operation and research with the University of Groningen and Twente University at Enschede. Since 1982 TMSI has been developing amplifiers; in 1994 works on a true DC reference amplifier, being especially targeted to the market for ambulatory measurements, have been launched. The ambulatory system developed by TMSI has been on the market since 1996, ranging from 8 up to 32 channels. The stationary model is equipped with 24 up to 128 channels, measuring all types of (electro-) physiological signals. More than 300 systems are in use today, in all kinds of applications, ranging from EEG, sleep, cardiology or movement disorders. For research purposes, TMSI has developed a special software program, allowing all types of flexible measurement configurations. Setting up any type of measurement can be performed within a few minutes ambulatory or stationary.

TMSI developed the hardware controlling the sensors used in the MobiHealth IST-2001-36006 project (front-end system).

3.1.8 Yucat mobile business solutions ltd. / Netherlands

Yucat is a B2B supplier of mobile solutions, primarily focused on PDA solutions. The solutions are aimed at increased efficiency, realisation of cost reduction and improving the (internal) service level of the client organisation.

Yucat aims at innovative and high-tech solutions and has extensive knowledge of mobile communication and a large experience in ICT in general and in mobile solutions in specific. Yucat is able to use this knowledge in such a way as to create an optimal solution for problems within an organisation. Thanks to a firm knowledge of the current and future mobile market and technologies, Yucat is able to realise a broad range of mobile applications.

Yucat has a strong university and research background and attempts to make use of this in developing solutions that go beyond implementing at application levels solely. By combining research and commercial skills, Yucat is able to conduct and contribute to academic research and assist in converting theoretical issues into implementations of systems and applications.

Yucat participated in the IST-2001-36006 MobiHealth project in the development of back-end server components, PDA software components and end-user manual and is currently involved in the Freeband project called AWARENESS. Other related (commercial) projects are: mobile solutions for home-healthcare, multiple mobile field force / inspection projects, PDA-data logger (medical).

4. Project objectives

The HealthService24 project, addressing eHealth and eInclusion, aimed at launching an innovative mobile health care service supporting patients' and health professionals' mobility, increasing patients' quality of life and lowering health care costs.

The starting point of the project was an existing prototype - a technically validated and fully functioning mobile platform and solution for ambulant patient monitoring over public wireless networks developed within the MobiHealth project, co-financed by the European Union under the IST programme (IST-2001-36006).

The Goal of HealthService24 was the launch of an innovative mobile health care service

- supporting patients' and health professionals' mobility
- increasing patients' quality of life
- lowering health care costs

The Objectives were:

- To *test the feasibility* of the deployment of the existing prototype on the European market via pilot runs
- To *demonstrate and validate* the precise conditions to be fulfilled for subsequent deployment
- The result should be a fully *marketable solution*

Today there is no concise mobile monitoring service available in Europe. There are various systems, services and applications available, which allow users to monitor their health status and transmit some type of vital signal information to remotely, located medical personnel. For example, pregnant women can be monitored from home instead of being admitted to the hospital, Rheumatoid Arthritis patients can be monitored remotely during rehabilitation exercises at home, the glucose level can be registered and the patient can download the data once a day/week to a PC and send it to the hospital. However, the currently available services allow patients to monitor and transmit their state over a wired phone (home services), meaning that the mobility of users is very limited, as they need a telephone line and electricity connection. On the other hand wireless systems available in the market they are based on store and forward model. Data are locally stored on the mobile device and transmitted off-line to the health server, or provide support only for "spot" measurements (that is, not continuous measurement of the signals, but rather few minutes of measurements and transmission to the medical centre for storage and analysis).

HealthService24 aims to bridge this gap offering a viable mobile health care service permitting healthcare professionals to remotely assess, diagnose and treat patients whilst the patients are free to continue with daily life activities. The HealthService24 concept allows patients and non-patients to monitor their physical condition and obtain advice and information at any place and moment. In this way, the service enables patients to be fully mobile.

The mobile technology as such is of course an important element in HealthService24, but the crucial factors are of socio-economic nature. Former technological innovations in the field of mobile health applications were not successful in the long run due to neglecting issues such as

social and economic aspects, changes in medical work practices and even standardization of technologies and integration with existing medical information systems. The HealthService24 project deals with the adaptation, customization and localization of the existing service prototype, the related social aspects and working conditions, and the related economic issues stemming from the deployment of the system on a larger scale, including the changes that will be brought to the processes and practices of the healthcare organizations and medical personnel. HealthService24 has defined the needs, expectations and requirements of all members of the value chain and creates added value and benefits for all value chain members, as only such an approach can make a sustainable market deployment possible.

The HealthService24 project aims at launching an innovative, integrated mobile health care service, supporting patient and health professional mobility and thus realizing the mobile health dream.

5. Service description and users

5.1 Description of the service

A user is equipped with sensors interconnected under a Body Area Network managed by a PDA or a mobile telephone. The collected data is constantly wirelessly transmitted via UMTS or GPRS to a data centre, from where it is forwarded to responsible healthcare professionals, who can remotely assess, diagnose and treat patients whilst the patients stay mobile. In case of rapidly deteriorating medical conditions, the data centre can also send an SMS-alarm or provide the patient with a 1-level medical support. The figure below provides a high-level simplified diagram of the information flow.

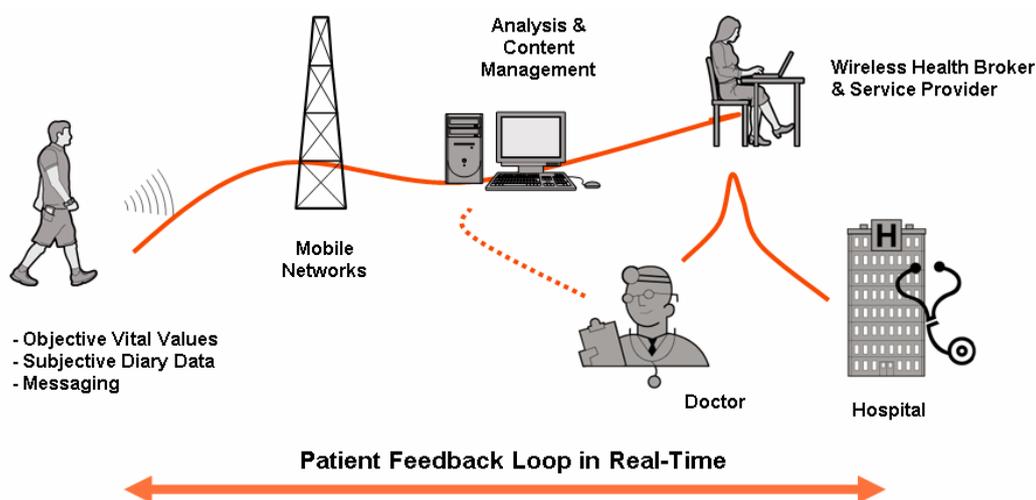


Figure 5.1: Overview of the HealthService24 Mobile Monitoring System²

Additionally the patient is equipped with diverse vital constant sensors, like blood pressure, pulse rate and ECG interconnected under a wireless Body Area Network managed by a PDA or mobile

² Source: Ericsson

telephone and worn on the body, and thus moving around with the person. This way, patients can stay mobile but monitored continuously and receive advice when needed.

The measurements are transmitted wirelessly using UMTS or GPRS to a data centre acting as an intermediary between patients/users and health care providers. It provides three services: data repository (collecting and storage of the received data), streaming service (forwarding data to a doctor or medical centre) and alarming service (analysis of the received data and sending of an warning (event) signal to a predefined destination (using SMS or other means)). The data centre may also provide technical support and, if needed, act as the first-level medical support for the HealthService24 users.

From the data centre, the data is transferred to the health care providers. Data sent to a health care provider can be visualized (e.g. on a laptop or a PDA). Healthcare professionals, to whom the patients' data is transferred, can remotely assess, diagnose and treat patients whilst the patients stay fully mobile and continue with their daily life activities.

As the data (patient's measurements) are transmitted wirelessly, mobile network operators play an important role in the HealthService24 value chain.

The picture below shows the 2nd generation of the research version (HS24v2.0R) of the HealthService24 BAN used in the project trials. In particular, it shows the TMSi Mobi sensor system (blue-box at the left) together with the attached respiration and ExG sensors and the BAN Mobile Base Unit (i.e general purpose PDA) with the Grafical User Interface."



Figure 5.2: Overview of the HealthService24 mobile monitoring system

5.2 Users and customers

The main drivers of the healthcare sectors have been identified as follows:

- Patient-Empowerment & Quality-of-life
- Cost Pressure & Budget deficits of healthcare payers
- Cost Pressure & Fixed budget in hospitals
- Development of new drugs

Hence the different target groups can be pictured as follows:

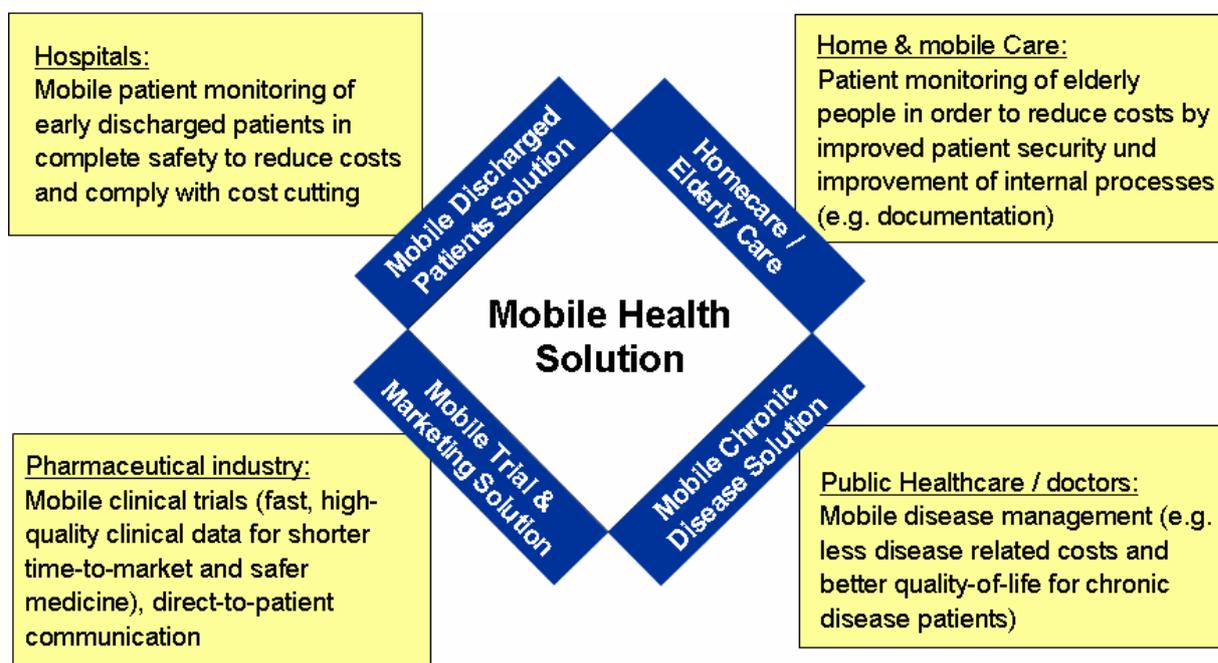


Figure 5.3: Target group and value proposition

The HealthService24 can potentially be used in many areas, ranging from patient management to sports and rehabilitation, from illness prevention to patients' treatment. The most relevant application areas are post hospitalization, public health care and home care. Within these application areas three different identified user areas have been defined:

- Mobile Chronic Disease Management,
- Mobile Clinical Trial Support, and
- Home monitoring of patients under different programs (i.e. early discharged patients, home hospitalization, prevention of risk patients to name a few).

The targeted end-users, i.e. the patients, include post-hospitalization patients, patients with chronic diseases/problems or high-risk patients. These patients today are often hospitalised for long periods, resulting in high hospital costs and moral degradation. The HealthService24 enables

them not to stay at the hospital, increasing their feeling of comfort and safety and at the same time reducing the health care costs.

A first approach on the market to reach the patients is to consider those patients that undergo secondary prevention health programs. This means that the patient has already been diagnosed (ex: chronic respiratory disease, congestive heart failure, hypertension...) and he/she has joined a program where he/she is instructed to change behavior (ex: perform regular exercise) or monitor some vital signs (ex: weight, blood pressure, oxygen saturation...). This is part of patient's treatment and HS24 is one of the possible tools that patients will be asked to use to facilitate the control of the disease (market position).

Customers of these user areas are typically hospitals, insurance companies and governmental health bodies. Their role is to be the user of the system and also the payer of the system. Not only the patient mobility but also the medical personnel mobility will be targeted - the idea is to replace the traditional medical bag with an advanced Med-BAN system assisting the practitioner in diagnosis and treatment. The service will be implemented by hospitals and public healthcare organizations.

5.3 Overall benefits

Deploying the HealthService24 services benefits several healthcare stakeholders:

Healthcare payers benefit through:

- Reduction in patient treatment costs
- Better management of resources
- Significant health-economic improvements

Patients benefit from:

- Increased freedom and improved quality of life
- Flexible, individual and effective treatment and therapy
- Peace of mind

Healthcare providers benefit from:

- Better management and monitoring of patient's therapy
- Prevention, as well as fast and professional handling of worsening conditions
- High service differentiation with low investment in technology and time
- Better allocation of scarce resources such as sophisticated premises and specialists' time

Commercial services providers benefit from:

- An open and standardized mobile service platform
- Proven functionality and usability
- Convincing business models

Pharmaceutical industry benefits from:

- Faster time-to-market and
- Lower R&D costs by using mobile clinical trials

The suggested cost savings are to be seen in the light of sustainability. There will always be a cost implied, also when applying a mobile healthcare solution. Nevertheless, under the bottom line our pilots have shown that HS24 means a reduced cost to healthcare suppliers. The key is to incorporate HS24 to a redesigned care practice and ensure that the global results conforms a service that is sustainable.

6. Market validation: Main results and conclusion

The HealthService24 project ran patient trials from September 2005 – September 2006 at 3 sites in parallel. Each trial site targeted patients with different health conditions, so that a wider spectrum of conditions and cases could be validated in the timeframe of the project. The target was to test the HealthService24 system in real-life scenarios, assessing the feasibility for integration in the clinical process and market viability. Another target was the validation of the system and its services from the medical and health-economic point of view. To fulfil these goals, each participating trial site developed specific clinical scenarios in which the use of the HealthService24 system supports the respective clinical process as a whole.

The trial sites of HealthService24 validated two different systems: the research version of University of Twente and the commercial version of Ericsson Mobile Health (EMH). The reasons for the parallel testing of the two systems was the need for a more flexible platform in order

- to test different set-ups,
- to easily add on new type of sensors
- to adopt the system fast to the requirements of the different trial sites
- and to easily exchange handsets

6.1 Methodology

Within the project plan, significant amount of effort were allocated to the pilot runs (WP4) since they were to provide the information needed to define a viable deployment strategy. The stress of the different tasks within this WP was set in performing the assessment in close to real life situations.

To this end, firstly a methodology for pilots' evaluation was drawn up and applied for the three pilot sites. The option was taken for a step-wise approach encompassing the different phases from first contact with the solution as released by the developers' team till, if achievable, clinical testing with real patients. Clinical outcomes, however, were not the goal of the project, but the validation and acceptance of the approach by patients and hospital staff.

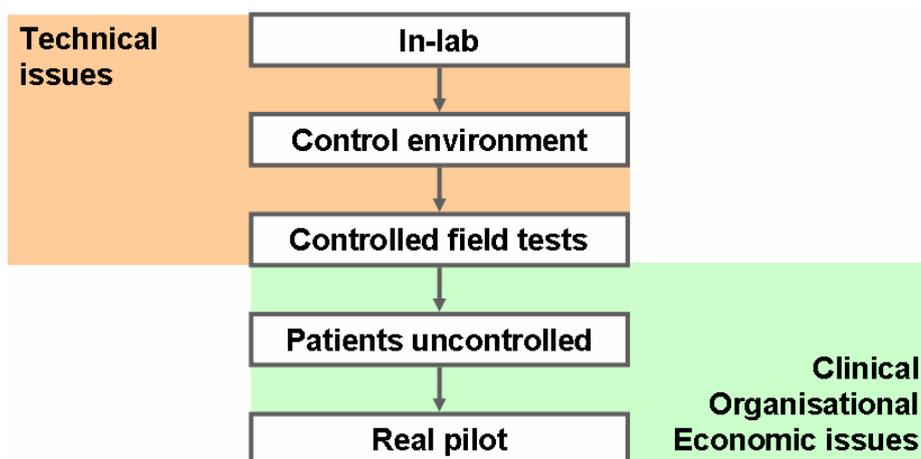


Figure 6.1: Pilot evaluation methodology

The evaluation methodology designed for the HS24 project focuses mainly on those domains related to the feasibility of the envisioned range of services in the medical domain and their market viability from a health economics perspective.

Therefore, the design corresponds to the combination of formative and summative evaluation. Formative evaluation is directly linked to the lifecycle of the system developed and aims at facilitating the organizational learning that ensures successful system design and implementation. Gathering knowledge in this area is fundamental for the continuous improvement of the system.

However, in the real health market, the technology should be seamless coupled to the services it is designed to support. This requires a summative evaluation strategy with the objective of establishing the expected benefits of the system in a number of domains, mainly clinical benefits and cost-saving advantages.

Both approaches translate into four basic evaluation domains, as follows.

- **Evaluation of end-user needs:** This domain focusses on to what extent end-user needs have been properly satisfied by the HS24 system. It is key to understand the degree of acceptance and derive what changes should be introduced into the system in order to ensure a better organizational fit.
- **Technical evaluation:** The technical performance of the system was measured and validated, regarding the ability of the system to measure, process, and transfer biosignals and also whether the medical personnel receives the required information for the reading and interpreting of the measurements. Availability of 2.5/3G wireless communication infrastructures for daily use and the security of the system is also addressed.
- **Health economics evaluation:** The use of HS24 in real environment allows the collection of indicators that could be translated into economic figures: 1) hospital length of stay (days of initial hospitalization plus days during hospital re-admissions); 2) emergency room visits not requiring admission to the hospital; 3) hospital outpatient visits to specialists; 4) primary care physician visits; 5) visits for social support; 6) nurse visits at home; 7) treatment prescriptions; 8) phone calls; and, 9) transportation services. Data on use of categories were obtained for each patient during the follow-up period.

- **Clinical evaluation:** Clinical evaluation was covered through a stepwise approach going from very controlled, artificial settings with healthy volunteers, via controlled settings with patients, to real-life settings, and continuing, if possible, towards medical trial designs.

6.2 Experiences and results

The following section describes the general outcomes per evaluation criteria whereas the subsections describe the situation per pilot site.

End-user social evaluation

- High satisfaction
Professionals satisfaction related to access to patient condition from anywhere, anytime, any location. In addition, the low training effort was appreciated.

Patients felt more reassured that they were given a higher level of care and felt more empowered. E.g. patient could pin point the time that he felt any symptoms using the system, lead to the comprehension that the patient could play a more vital role in his health care supervision

- Convenience of use
- No disruption with current work practices
- Easy to apply / extend to other areas

Technical evaluation of the HS24 research system: ³

As a result of the pilots' feedback, the prototype of the HS24 research system was continuously improved over time. University of Twente even released a second version of their system. The overall technical evaluation included the following comments, valid for all trial sites.

- HS24v2.0R good successor of v1.0R
- Helpful warning and error messages guided users
- The user interface was improved, now much better to use; MBU interface very user-friendly and users were easily trained to use it
- Connection screen has indicators for critical resources (e.g. GPRS signal strength, battery level of BAN components)
- HS24 2.0.1R stability depends on native PDA OS (e.g. MS WM2003)
- In poor signal's GPRS strength conditions the HS24 BAN may stop transmitting data to the BackEnd server (e.g. residing at the mHealth call centre) due to MBU resource starvation.

³ The technical evaluation refers to the HS24 Research system from University of Twente. The other scenarios are more of socio-economic nature where it is system independent.

- Battery capacity of MBU (i.e. PDA) limits BAN operational time to 3-6hrs (cont. monitoring)
- Bulky BAN system components (i.e. sensor system and PDA) and long sensor wires limit wearability.
- MST trial revealed GPRS (i.e. GSM) interference when MBU or other transmitting GSM device operates in close proximity of TMSi Mobi4 sensor system.
- The Portilab⁴ program displayed the measurements correctly and accurately but in some cases, when it was not closed properly, it became unusable and we had to restore it from our backup server

Health economics evaluation:

- Reduction in unnecessary admissions, associated savings in scarce resources
- Reduction in the use of emergency room care
- Savings in total examination time by doctor (by remotely assessing the patient)
- Reduction in travelling costs for patient and relatives
- Reduction in costs for in-clinic treatment of patient is offset by cost of HS24 based home care service
- Overall, up to 38% cost savings with regards to the direct costs could be achieved

Clinical evaluation:

The mobile health monitoring services tested (combining the technological solution for vital signs monitoring and the clinical and educational intervention) have proved to have a positive clinical impact.

- Patients had a better knowledge of the disease
- Lower rate in unexpected patient admissions observed
- Higher rate of early discharge observed because patients using the system felt more reassured that they were ok

⁴ Used for visualisation and analysis of physiological data

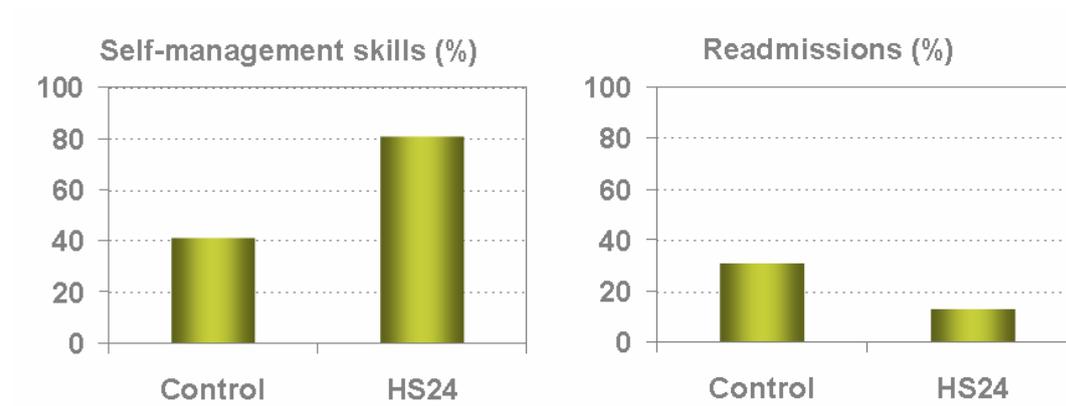


Figure 6.2: Results self-management skills and re-admissions rate vs. control group

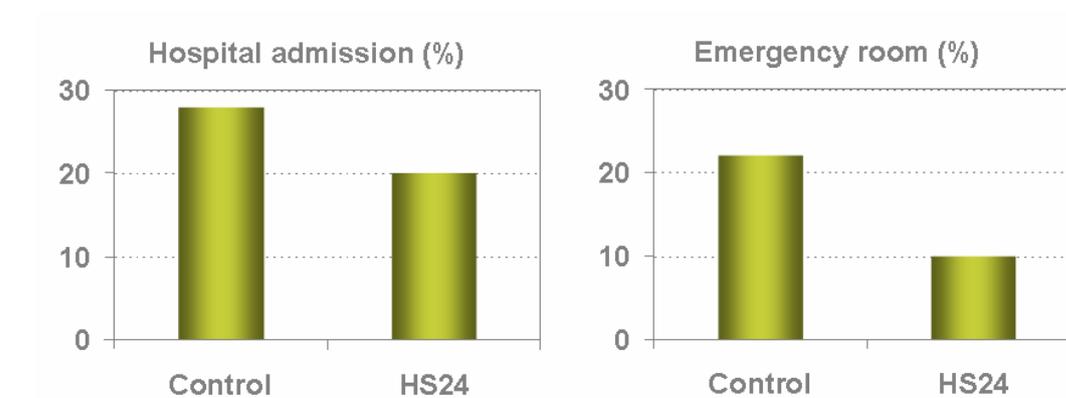


Figure 6.3: Results hospital admission rate and emergency room admission rate vs. control group

The graphs correspond to the HCPB pilot, but similar results can be assumed for the others. The following sections highlight each specific case in more detail.

6.2.1 COPD patients pilot (Hospital Clínic Provincial de Barcelona, Spain)

This pilot used the HealthService24 to support remote assistance for elderly and chronically ill patients suffering from COPD (Chronic Obstructive Pulmonary Disease) with or without other concurrent diseases. The HealthService24 BAN was used to perform patient measurements during nurse home visits. The significance of the selected group of patients derives from the fact that they are usually high consumers of resources and especially in wintertime cause the problem of “bed-blockers”. Hence there is a high need to facilitate patients' access to healthcare professionals without saturating the available resources.

25 patients participated in the trial. The users acknowledged the advantages offered by the system as well as the dramatic improvement of the usability and interfaces (compared with its forerunner MobiHealth). The mobile health monitoring services tested proved to have a positive clinical impact. COPD patients claimed to have a better understanding of the disease and better adherence

to the treatment was achieved after 6-8 weeks follow-up. Thus, a higher percentage of patients had a better knowledge of the disease (58% versus 27%) which led to a better self-management of their condition (81% versus 48%). Comments regard the short life of the BAN batteries and the sensitivity to poor GPRS network connectivity.

From a socio-economic point of view, professionals highlighted the fact that the solution could be easily applied to their current work practices. In the COPD pilot a reduced use of resources (emergency room, admissions, shorter length of stay) has been observed leading to a reduction of 38% in direct costs when compared to the conventional treatment. Although some treatment and follow-up pathways were introduced to ensure an appropriate use and frequency of the services being piloted, the related costs as well the benefits are clear for the hospital and the patients.

6.2.2 Cardiac patients pilot (LITO Polyclinic, Cyprus)

Two distinct groups of cardiac patients were tested in this pilot:

Group1 – Patients with an acute episode. They were admitted and stabilised, but still there was a need for continuous monitoring of their condition and drug regime for a few days. Using the HealthService24 system these patients were earlier discharge, with an appropriate follow-up (by using the system) in the place of their choice.

Group 2 – Patients in a suspected acute episode. In this group of patients, and following a medical examination, a decision must be taken on whether to keep the patients at the hospital for observation, or to discharge them home. In the pilot, the patients were discharged and equipped with the HealthService24 system enabling constant monitoring of the patient's health state.

The pilot included 20 patients. Although the users were happy with the overall concept, feedback for the first phase was given regarding the usability of the mobile part of the system (i.e. BAN). For example, too long ECG cables reduced wearability, BAN usability depends on the battery capacity (4-6 hours), limited usability due to poor connectivity of the local GPRS network. Many of these problems were fixed for the second phase of the trials. The performance of the system was excellent when using the clinic's WiFi wireless network and satisfactory when having good GPRS coverage. Most cardiac patients (90%) found that the solution was convenient to them with a rate of satisfaction similar or higher to the classical treatment. They felt more reassured because they were provided constant care. From the economic and social validation point of view, the LITO clinic has already identified savings and possibilities for the HealthService24 services to different types of patients. A lower rate in unexpected patient admissions was observed (60%). In addition, a high rate of early discharge was observed because patients using the system felt more reassured. Furthermore, the HealthService24 system was integrated into the DITIS Hospital Information System used at the LITO clinic and this increased efficiency further.

6.2.3 High risk pregnancies pilot (Medisch Spectrum Twente, The Netherlands)

Women with a high-risk pregnancy are admitted to the hospital frequently for medical examination and intensive monitoring of maternal and foetal vital signs. Based on monitoring data, a gynaecologist is able to act pro-actively in case of emerging complications. In many cases, an examination reveals no immediate health-risk for both mother and foetus. Hence, a high-risk pregnant woman is unnecessary bound to a hospital bed for a substantial amount of time. HS24

mobile monitoring system allows these women to continue their normal daily lives, visiting the clinic only in case of emerging complications.

18 women with term pregnancies participated in the pilot. They were asked to apply the HealthService24 Body Area Network (BAN) and register their uterine activity (EMG signals) during an hour each day until labour ensued, or whenever they thought contractions occurred. The observation time was therefore different from case to case - ranging from a couple of days to a couple of weeks. Overall the system was convenient to wear, but the sensor cable length needed to be reduced to increase convenience. It was also reported that the registration process of the uterine activity was disrupted because of GSM interference. It turned out that the pregnant women were using their mobile phones during the registration process in close distance to the registration device. Lab tests proved that these technical problems are solved in the next generation of EMG registration devices. However, the identification of the source of the problem was not simple and we spend quite a long time trying to recreate the problem. As a result the trial had to be stopped since the obtained measurements were damaged. In this sense the trial was declared as failure, since we were not able to extract sufficient valid results. On the other hand, from the research point of view, the trail was a success since it allowed us to identify a very important problem in the technology used and the habits of the patients using the system. Finally we must mention that despite the interference problems during the trial, both patients and doctors are very enthusiastic about the potential of the system.

From the economic and hospital process validation point of view, the pilot results showed that the potential financial benefits can be very high and that the integration to the MST hospital process is feasible at low cost.

6.3 Conclusions

Our validation pilots showed that the introduction of a mobile health monitoring service is not disruptive with current work practices. It can easily co-exist with other formats of service delivery, in some cases supplementing them or, in other cases, replacing previous practices. This facilitated the integration, putting the end-users in command to decide on the most adequate pace.

Furthermore, economic benefits were observed in all pilots. This means that from a financial perspective, hospitals and other care organizations can save money with this approach, mainly due to early discharges and less emergency room admissions.

However, the willingness to review the way care is being delivered must be clearly present, as well as the acceptance of re-allocating some professional roles. This reflects one important lesson of the pilots: the process of incorporating the mobile monitoring solution is more of socio-technical nature. Technology alone is not enough – it requires the right perception and use by the users to drive a change. New approaches to treatment and follow-up of patients were adopted. This undoubtedly maximised the benefits that mobile monitoring systems brought about. This meant: (a) Normalisation of care pathways (appropriate use and frequency of the monitoring services), (b) Reallocation of professional roles, (c) Specific patient education on the disease.

This has to have a clinical sense (based on established guidelines) but also should not add extra costs that could make the whole design unfeasible.

A note on insurance companies

Our pilots showed a financial interest from the hospitals' point of view in terms of cost savings. But there is also another side of it, namely reimbursement from the insurance companies. Insurance companies in general see the value in the approach, but...:

- Long term results are needed in order to build a case
- Payers/Health insurers should be properly included in validation scenarios to secure health economic outcomes
- Statistics available to the insurance companies only show “Diabetic patients” or “Cardiac Patients”, but do not provide the detail to identify the patients that would benefit from such an approach.
- The identification has to be done in collaboration with the doctors
- There is no practice for telemedicine evaluation today. This makes it difficult to introduce telemedicine solutions in a routine setting

A note on legislation

Up to today, there is a lack of a European Union wide framework:

- Teleconsultation is still not reimbursed in a number of countries
 - in some countries, e.g. the Netherlands, legislation is changing in favour of telemedicine
- No legislation available on liability
- Privacy and security of patient data
- Reimbursement is dependent on the healthcare system in respective countries (some have a joint National Health System (e.g. UK), others are very diverse (e.g. Germany))

As long as this is the situation ruling, we see low opportunities for implementing the HealthService24 concept on a nation-wide or even European-wide scale. Still, hospitals in charge of their own profit and loss will see economic benefits.

Concluding remark

The HealthService24 concept improves the quality of life of the patient and provides a higher rate of empowerment. At the same time, it was possible for the professionals to provide better care and lower care costs (up to 38% savings on direct costs were achieved). Using the HealthService24 concept is not disruptive – rather, integration into existing systems and processes is possible and adds value. However, technology itself is not enough – a successful implementation is much more subject to organizational matters such as re-design of conventional care delivery, both concerning the hospitals as well as to the insurance policy and the legislative situation.

7. Business development aspects

The business development plans of each of the HealthService24 members are confidential. Each member has identified its wanted position for both a short, mid and long-term perspective. Ericsson for example, already has a commercially certified product available world-wide, based on the HealthService24/MobiHealth concept (Ericsson Mobile Health). Although the plans are confidential and commercial roll-out already has started, some general facts and project findings can be shared.

The prime target sector of HS24, the healthcare market, bears huge potential for mobile patient management applications. The most relevant application areas are post hospitalization, public health care and home care; the targeted users. Between 25 and 30% of the population in western European countries suffer from chronic diseases. Efficient patient management can save up to 30% of yearly treatment and disease related costs. It is estimated that between 5 and 10% of the total potential patient number would initially use mobile management systems.

The most important potential buyers / users of the HS24 services are: governmental health bodies, health insurers, health service providers, hospitals, pharmaceutical or diagnostics companies, mobile network operators, application service providers and network infrastructure suppliers.

Possible barriers of market entrance are: reluctance of healthcare players to embrace new technologies and work methods, lack of health-political support, potential health hazards from wireless communication technology, data security and legal hurdles and the need to manage the very complex health care value chain.

7.1 The value chain

A well-functioning value chain is one of the key success factors for HealthService24. A prerequisite for a successful market implementation of HealthService24 is that all involved members of the value chain recognize their benefits of being part of this approach.

The actors in question include health care service providers, insurance companies, national governments, patient groups, network operators, call centers and of course technology developers. This shows that the value chain can be seen from several perspectives. The success of the service will depend on actors' readiness to support and recognize the service as valuable to their operations.

Depending on what mobile health care application scenario is offered, the value chain and its players will vary. Thus, there is no single defined role for each step for the participants – it depends on to what degree the hospital thinks of outsourcing the technology. Possible scenarios range from a simple form (buying the sensor technology including the software, i.e. a single business transaction) to mixed forms (buying the sensor technology and have it integrated into the specific hospital environment) up to full versions, where the complete system runs on at an External Service Provider via so-called hosting.

Seen from a data flow perspective, however, a basic value chain can be depicted which can be applied for all application cases and countries:

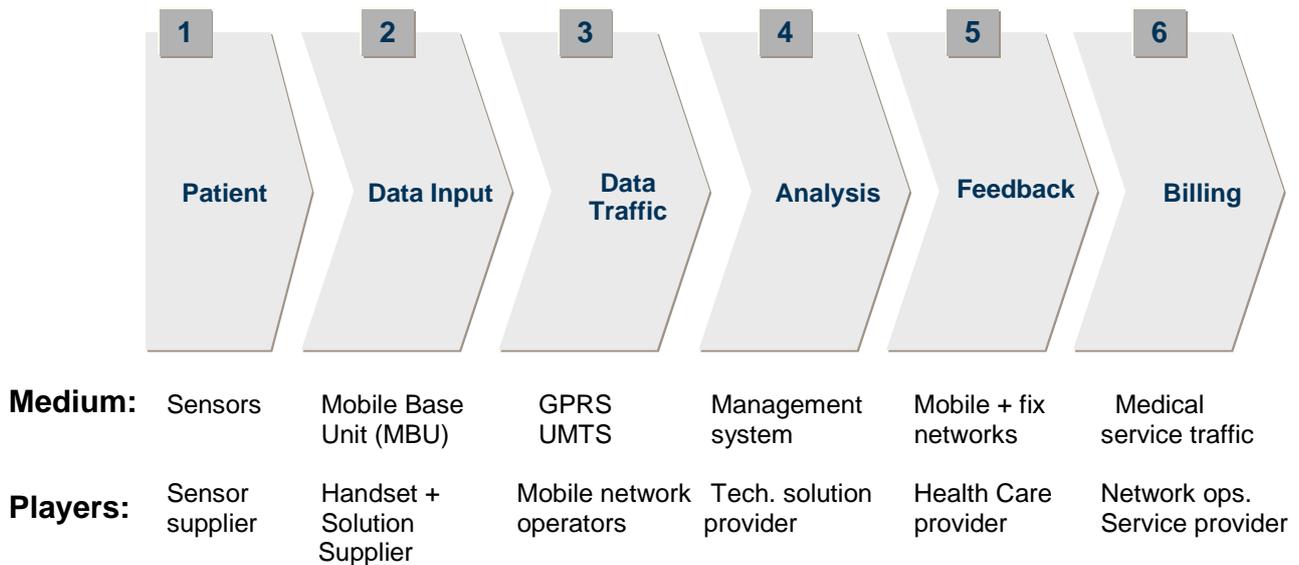


Figure 7.1: Technical value chain

Below follows a brief description of the different stages with examples of potential players.

1) Patient

The patient has registered for the mobile monitoring application (HealthService24) and has been equipped with sensors that together with the Mobile Base Unit form the Body Area Network.

Players involved at this stage are the sensor supplier. Because of the platform character of the mobile solution all kinds of Bluetooth-enabled sensors can be adapted to the solution.

2) Data Input

The desired data is measured via the body sensors and registered in the BAN's Mobile Base Unit (MBU). The communication between the sensors and MBU is handled within the BAN via Bluetooth technology. In the future, new low-energy techniques are foreseen to be used.

The MBU can be for example a mobile 'smartphone' or a PDA. In addition, it is possible for the patient to use the MBU for the input of manual data, for which no sensor exists or for information concerning quality-of-life of pain level. Hence, the MBU supplier is either a smartphone or PDA manufacturer that delivers the hardware platform and also has access to the adequate integrated software (e.g. Bluetooth stack, Java Virtual Machine). This can be realized by the same supplier or by using developed software by somebody else. Examples of PDA and smartphone suppliers are HP, Nokia, Motorola, Siemens, and Sony Ericsson.

3) Data Traffic

The MBU transports the measured data from the sensors via wireless communication technology (e.g. WiFi, GPRS, UMTS) to a host in a fixed network environment, i.e. to the place where the BackEnd server/services is/are located.

Players here are Mobile Network Operators that provide the technology bearers and that have sufficient network coverage are needed for the data transport. International mobile network operators are for example Vodafone and T-Mobile.

4) Analysis

The BackEnd server is the central service entity where the logic for the analysis resides. It is a Management System that is responsible for communication between the involved parties and Content Management of the data, i.e. a big databank with several different ways of data utilization possibilities. The Health Care Provider chooses the features appropriate for his purpose and interacts on the information provided by the analysis. This can for example be feedback to the patient from a clinical study questionnaire, or include medical advice based on the measures achieved for a chronicle disease or early-dismissed patient.

Depending on what purpose shall be fulfilled and who the receiver of the information is, the system will be able to create different formats of the data output.

Players for the Analysis phase are twofold: the technical solution provider, for example Ericsson, and the Health Care Providers. This can be hospitals, doctors, or the outsourced medical customer care centers.

Crucial for the success of the mobile monitoring system will be integration into the existing hospital information system of the hospital. Already today medical staff is obliged to use more than 105 information and communications system per day. Not integration the system of e.g. the patient records or surveillance systems would jeopardize the acceptance of the system of the medical staff. For this reason the monitoring system will be built with an open architecture that allows for integration with healthcare and pharmaceutical specific state of the art software for either medical or administrative purposes. Due to the broad range of different solutions in the area of hospital information system specific integration points and protocols will, in the first projects releases, be delivered by customer specific integration projects. Nevertheless the solution will support the existing standards like HL7.

5) Feedback and support

After the gathering and analysis of all relevant information in the content management system there are different communication streams:

- a) Content Message Center (CMC) to patient
Based on the collected information the patient receives feedback, describing his status, personal development and personalized information and tips
- b) CMC to physician
Physicians must be able to monitor the status of their patient and get the latest information about them. This has to be possible in different ways. First of all the physician must be able to check the history and development of patient data including related data from other areas e.g. with help of a web access to the content data management. Second the physician has to be informed automatically, when special parameters exceed some pre-defined boundaries in order to react immediately. For this reason it's possible for the physician to define the boundaries for each patient separately.

In addition physicians will have the availability to shape the communication with the patient in order to react in the best way to the special needs of the patient and in case of a clinical trial to refine the trial set-up to the current requirements.

⁵ Information from one leading hospital in Sweden

c) **CMC to Medical Contact Center**

Should some kind of problem occur for the patient while using the HealthService24, he or she contacts the Medical Contact Center. This is a helpdesk for technical failures (for example problem with mobile base unit or with the sensors, battery failure) as well as for medical problems. The patient communicates either over the mobile or fixed network to reach the Medical Contact Center.

Player next to the mobile network providers is the Medical Contact Center, in-house or outsourced. Examples for outsourced medical call centers for health insurances are “Anycare” and “Gesundheitsscout”.

6) Billing

The last stage is billing for the services used. The billing addressee depends on the business model and application chosen. In some scenarios the hospital will pay for the costs, other cases the patient, and others the Health Care Provider. For the initial services planned, it is more likely that the health care administration will pay for having patients followed up under a special program. This would likely include everything - medical costs, communication and equipment costs.

In order to provide the customers an end-to-end solution, so different costs have to be summarized. Following areas must be taken into account:

Service costs for communication and traffic:

This includes costs for the connection between the MBU and the back-end system. There are different price models in different countries. Especially in the countries with a high competition in the operator sector, there is an enormous decrease in communication costs. In some countries there are already flat fees available, independently from the amount of traffic. If there are no constraints from the perspective of the coverage all operators could be used as a service provider. Depending from the numbers of sold systems, there will be a specific agreement for this type of offering. For instance Ericsson has chosen Vodafone a supplier for the communication services within the trials and demo kits due to the high availability nearly all over the world.

Additionally the hospital must be connected to the internet. Nearly most hospitals have already a service provider for accessing the internet, so there are no additional costs.

Service costs for hosting and providing the backend (data storage etc.) are offered by the solution provider and will be included into the license fee.

Medical support:

Beside of the more “technical” services from network operators and internet provider and important part of the billing will be medical oriented. The billing structure is heavily depending on the type and size of customers.

If not provided by hospitals, doctors have to monitor the status of patient, e.g. in a case of a patient management program for chronic diseases and they have to be refunded for this task. E.g. in Germany and general practitioner will get 35 € per patient and quarter. Additionally if not provided by a hospital owned call / contact center, this has to be sourced externally and paid. There are already different players in the market which provide already medical advice to patients on behalf of insurance companies. Today they charge about 25 € per patient and month for a service, which is described above.

7.2 Player's business perspectives

As mentioned above, a well-functioning value chain is one of the key success factors for HealthService24. All actors in question need to recognize the service as valuable to their operations. This can be either improvement of life quality for the end-users or economic and social benefits for the health care providers and industrial actors. The following section defines the roles, requirements and benefits (i.e. value proposition) of all members of the value chain. Only such an approach can make a sustainable market deployment possible.

The idea of HS24 is to offer an end-to-end solution for all the participants of the value chain where all interfaces have been considered. This is a prerequisite in order to meet the requirements of the patients.

Depending on what business model is chosen, however, the value chain can look differently for the participants. Thus, there is no single defined role for each step for the participants – it depends on to what degree the hospital thinks of outsourcing the technology. Possible scenarios range from a simple form (buying the sensor technology including the software, i.e. a single business transaction) to mixed forms (buying the sensor technology and have it integrated into the specific hospital environment) up to full versions, where the complete system runs on at an External Service Provider via so-called hosting.

The figure below depicts a generic model for possible roles and their relationship to each other:

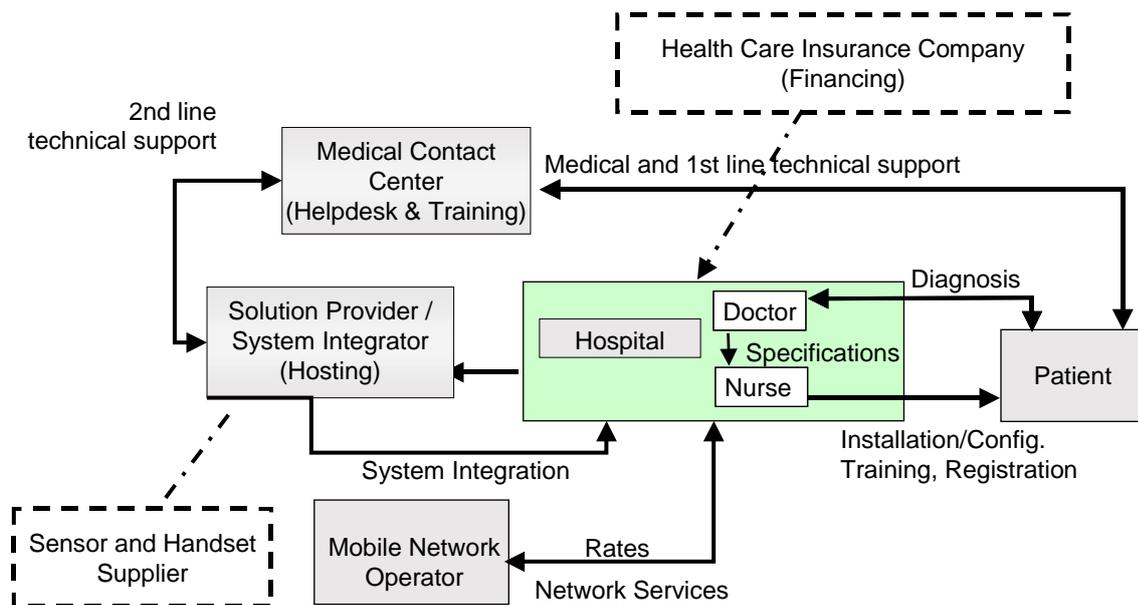


Figure 7.2: Model for roles and relationships between the business players

7.2.1 Sensor system supplier

There are more than 15000 sensor system suppliers, but none of them is playing a role in the medical market today. HealthService24 paves the way for further sales and other business opportunities. Thus the value proposition for sensor suppliers is the larger revenue opportunity and the vertical enhancement of their product portfolio.

On the other hand, the sensors will be integrated front-end or in the complete measurement system. Very often, the signal of the sensor is not used at all as the medical variable, but one or more derivatives are used for the medical profession. An example to illustrate this point: If for instance an ECG is measured, the sensor is just measuring the electrical signal that is caused by ion concentration differences. Using the ECG the medical professional can calculate the heart rate, the mean heart rate, the heart rate variability, the period of bradycardia and tachycardia and a lot more. In the medical field it is often the derivative that is used for the direct medical application. This means that the intelligence and the value as such lie within the complete measurement system and not in the sensors.

The first requirement is that the sensor interfaces must be able to connect to the platform.

Secondly, there are several values, variables and derivatives that can be measured by sensors and several sensors can take the same measure, but by using different means (for example internal or external measurements). By the selection of the sensor supplier(s) for the HealthService24 solution it is therefore important to concentrate on the mobile medical application as such and what has to be measured there in order to find the suitable supplier(s) that fulfills the requirements of the variables and derivatives.

For HS24 the most important application fields concern the chronic illnesses:

- COPD
- Diabetics
- Congestive heart failure
- Pacemaker monitoring
- Cardiac event recording
- Cardio vascular
- Movement disorders
- Anti trombolitic monitoring

And

- Pregnancy
- Sports
- Screening work, environment
- Screening ergometry
- Screening job
- Physiotherapy
- Pain
- Neonatology

In those fields, a lot of variables need to be measured, and even more parameters are calculated as derivatives. The variables that need to be measured can be divided into three different categories. This division helps to track down what kind of sensors will be required:

- Electrophysiological (for example ECG cardiography)
- Physiological (for example flow, pressure, O₂, glucose etc.)
- Imaging (roentgen, MRI, or simple pictures of dermatology)

When knowing the variables, the parameters and the types of sensors that are needed for doing these measures, it is possible to identify suppliers in the telemedicine field including the type of sensors they are using.

7.2.2 Mobile smartphone supplier

The mobile smartphone must be based upon open interfaces that are able to connect to the sensors and to the platform. Furthermore they must support Bluetooth and GPRS/UMTS technology (also other future technologies might be applicable as well such as Zigbee) and have a large screen and sufficient memory. Both Bluetooth and GPRS/UMTS technology are already in use and not subject to a propriety technology. Mobile handset suppliers should therefore have no problems to comply with this.

The value proposition for mobile smartphone suppliers is the opportunity to increase numbers of sold devices.

7.2.3 Mobile network operators

The role of the mobile network operators is to provide a safe and stable connectivity for the data transport. This means that there is sufficient regional coverage and availability of the network. Another role that mobile network operators could hold is to act as an additional sales partner.

Next to the basic requirement of guaranteeing secure communication, mobile network operators must also show willingness in offering special tariff models for this service. This involves special billing agreements where the Health Insurance receives the phone bill instead of the patient, but also the willingness to offer mass tariffs or flat rates. Additionally, the subsidy of mobile handsets might be an issue as large parts of the target group might not have a mobile phone today. International roaming enabling patients the mobility across national boards is furthermore an important requirement that needs to be fulfilled.

Entering the HealthService24 model with special tariffs for this service offers a horizontal enhancement to mobile network operators, which also includes the opportunity of revenue growth. In addition, operators can hereby improve their image: first, the fact that they contribute to a concept that improves quality-of-life in the health care arena can be used for PR reasons. Secondly, this works as a proof-of-concept for data communication solutions in general.

- With the HS24 Platform the network operators can differentiate themselves from competitors by offering high value content
- By offering the HS24 Platform and applications the network operator can approach new customer target groups, which have till now not been interested in consumer mobile data applications
- The m-Health Portal will produce additional traffic for the network operator

7.2.4 Medical Contact Center

The role of the Medical Contact Center can be held by different players and can be different in case to case. It can be outsourced to an external Health Care Service Provider, it could be a mobile network operator, and the hospital could organize this center in-house. The tasks include analyses and evaluation of the data as well as delivery of the data. Furthermore the medical contact center is responsible for the first line support as well as alarming the doctors in case of emergency or critical situations.

The requirements on the Medical Contact Centers are comparably high: They have to be highly integrated into the hospital environment. External companies need to be certified according to the requirements of the hospitals and insurance companies. This includes legal requirements as well. Furthermore the Medical Contact Center needs to hold a sufficient crew of medically educated resources, available on 24 hours 7 days per week basis. It is vital that the Centers are accepted by the hospitals and the health insurance companies.

The HealthService24 concept opens up a completely new role in this business field. Hospitals can elaborate on their core competence and thereby enhance vertically. The HS24 concept will allow the pharmaceutical industry as a whole to communicate with their end-customers in a more direct and individualized way. For example, a new form of communication that combines promotion, related content and context to a trusted and personalized device can be offered. In addition, HS24 opens up for newcomers such as external service providers to enter the market.

7.2.5 Technical Solution Provider

The role of the technical solution provider is to have a solution in place that works towards all interfaces and complies with the different customer requirements on the solution.

The technical solution provider is responsible to select appropriate hardware suppliers for the sensors and handsets that comply with the overall technical solution and the backend. Furthermore, it must comply to open interfaces and fulfill the customer and legal requirements in terms of reaching identified Key Performance Indicators.

As for software the technical solution provider is responsible for developing the software solution under the legal and technical customer requirements. They have to undertake release improvements and cater for an adequate user interface. Backend functionality must be initialized, i.e. the connection to the existing customer interfaces must be catered for.

Furthermore, the technical solution provider can take on the role of 2nd line support. 1st line support would in general provided by the hospital.

In an enhanced role, the technical solution provider can be responsible for the system integration. This requires advanced knowledge of the customer systems but also the trust of the customers. This role can also be fulfilled by hospital/insurance company's internal resources or also be outsourced to an external company.

The final and most extensive role that a technical solution provider could take on upon customer request is the hosting role of the complete system. The hosting center needs to be fail-safe on a 24/7 base and must comply with the strong security and quality requirements of the customers.

7.2.6 Customers

The customers of the HealthService24 are typically hospitals, insurance companies and national governments. Their role is to be the user of the system and also the payer of the system. They personate the direct interface towards the end-users, i.e. the patients. This requires developing and maintaining patient management programs.

Hospitals and Insurance companies need to identify patients' requirements and needs for using this new service. They must show willingness to integrate the new service into their existing processes. This includes creating an attractive offering towards the patients.

7.3 Payment flow

Details around the payment flow of the value chain will be highly dependent on the different roles and on the character of the application offered. This might differ from country to country as well. A possible business scenario for the service value chain can look like this:

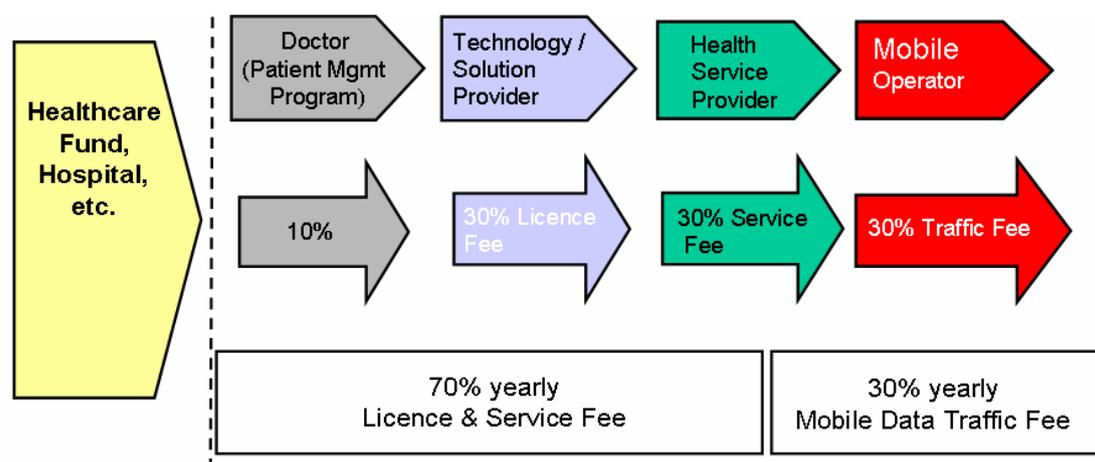


Figure 7.3: Possible business scenario

These figures have been found feasible during discussion with several healthcare players. However, it is a model only and has to be negotiated between the different players individually and this can of course differ from country to country, from application to application.

The question of financing the service for the hospitals has not been clarified yet. Either the hospitals will provide this type of services to their patients financed by the savings or they will discuss with insurance companies or public health organizations about funding and reimbursement of the costs. MST is looking into a possibility to offer the “delivery predictor” directly to the women in The Netherlands, which means that they have to purchase it privately.

7.4 Market size and trends

As the project scope did not allow a detailed market analysis for each of the European Union countries, two approaches were combined: Major trends within the healthcare sector provided guiding principals and a detailed market study was conducted by a professional research company (Frost & Sullivan) to deliver specific facts for one country. The United Kingdom was selected due to the fact that the UK is one of the leading European markets and it is supported by the government with different grants to deploy new technologies.

Major trends within the healthcare sector:

Fact is that the total expenditure on health has increased dramatically over the last 30 years within the EU. Reasons for this can be seen in both the constant improvement of the quality of life in the EU countries with the growing demand for health care as well as in the growing proportion of the aging society. Europe is projected to be the region in the world the oldest population. Currently, elderly people represent around 20% of the total population and will represent 25% by 2020. Furthermore, the number of patients with chronic conditions is increasing rapidly and these disorders are considered to be amongst the top three causes of mortality by 2020. This state configures a huge market for the introduction of the HS24 services. In addition, Health Care administrations in the Western countries in Europe are seeking new strategies to cope with the burden that these patients represent and will become in the future.

In the European Union, Frost&Sullivan has estimated that there are just fewer than 400 million individual healthcare consumers and 150 million household units of consumption. The healthcare market is expected to witness a boom with almost 80 million European citizens aged 60 years or older, more than 2 million above 90 years of age, and almost 25 percent of the households having a person aged 65 years and above. Thus, at any given point in time, there are enough patients needing specific healthcare support.

Another important trend is the societal change. Patients become pro-active, feel responsible for their own health and seek individualized and interactive treatment and care. Also human beings today are used to be rather active and want to continue with their lifestyle:

- Health related content is one of the major information searched in the Internet
- Since 1999, the number of people interested in Health (Online) is steadily rising
- In the meantime 27 Mio. people use the Internet searching for health topics (Germany)
- Increasing demand for personal mobility worldwide and individualized information with health and fitness related data
- Personal spending on healthcare prevention (including consumption of relevant publications) will increase from 118 EURO/ citizen/ year in 2003 to 237 EURO in 2007
- Pharmaceutical industry is looking for comprehensive channels to communicate with their (potential) customers
- Disease management programs are provided by insurance companies in order to steer customers/patients

These topics lead to a new concept of a more personalized healthcare as a new product of its own.

⁶ Durlacher Report

Specific facts:

For the study Frost&Sullivan interviewed 2 healthcare regulators, 4 pharmaceutical companies and 9 healthcare service providers in addition to the usage of secondary research material.

Currently the UK healthcare system is facing following challenges:

- Bed shortage and inefficient bed management system
- Staff shortage
- Long waiting times
- High spending on treating chronically ill patients
- Ageing population
- Struggle to provide better care to the community

A patient monitoring system could significantly contribute to solve the above mentioned challenges. Analysis indicates that wireless patient monitoring solutions could significantly help to address several challenges facing the NHS. The Preventative Technology Grant indicates the starting acceptance of the need to monitor patients' conditions in order to implement preventative measures as early as possible. Wireless patient monitoring solutions are able to identify early warnings of health issues, and therefore the uptake would be accelerated by this grant.

The following picture describes the different patient groups and priorities with regards to the relevant group with can be considered appropriate for monitoring:

The UK Healthcare Service Sector - Patient Groups and Priorities

Disease area	Total Number of chronically sick people	% can be considered appropriate for monitoring	Frost & Sullivan Analysis
Cardiac Problems	9.2 million people in the UK suffer from CHD or stroke. 1.4 million people suffer from angina (Source: DoH and British Heart Foundation)	80% to 95%	<ul style="list-style-type: none"> • DoH has claimed that 80% of Diabetes, Asthma and cardiac patients are at level 1 who are suitable for self management. 15% to 18% are at level 2 who are at high risk and need help from caregivers. Only level 3 patients with compound conditions are not suitable for wireless patient monitoring as they have to be under case management. (Source: Department of Health) • There is a large potential for wireless patient monitoring solutions due to the high number of chronically ill patients and old people in the UK. • However, the actual uptake rate will depend on a large pool of factors such as: <ul style="list-style-type: none"> • Government priorities • NHS budget allocations • Clinical and commercial evidence • How wireless patient monitoring solutions can be integrated into the existing healthcare IT infrastructure • There are some technologies for monitoring premature babies and pregnant women, but the solutions are not as advanced as those for monitoring other disease groups.
Diabetes	There are 2.4 million (2003) people have Diabetes in the UK (Source: Department of Health)	80% to 95%	
Asthma	10 million people in the UK suffer from Asthma conditions (Source: Global Initiative for Asthma (GINA))	80% to 95%	
Elderly People	There are 10 million individuals are 65 years and older in the UK, 2 million of them over 85. 700,000 are dementia patients. Source: UK ONS and UK Alzheimer's society)	80% to 95%	
Obstetrics	1 in 14 new born babies (49,000 out of 700,000 a year) are underweight or premature in the UK (Source: Institute of Child Health and the London School of Hygiene and Tropical Medicine)	Our research has shown this area is not an immediate opportunity	

Figure 7.4: Market potential UK⁷

⁷ Source: Frost&Sullivan Market study: Market Assessment for Mobile Technologies 2006

7.5 Deployment potential

As mentioned before, the HealthService24 concept can potentially be used in many areas, ranging from patient management to sports and rehabilitation and from illness prevention to patients' treatment. The deployment potential depends on many different factors and is therefore very difficult to assess.

In general, the selection of disease areas which will be targeted first depends on the prevalence of the disease, the related treatment cost (short and long-term) as well as on the usability and need of the system for the special disease. The following chart describes the shares of different disease areas of the total disease related costs⁸

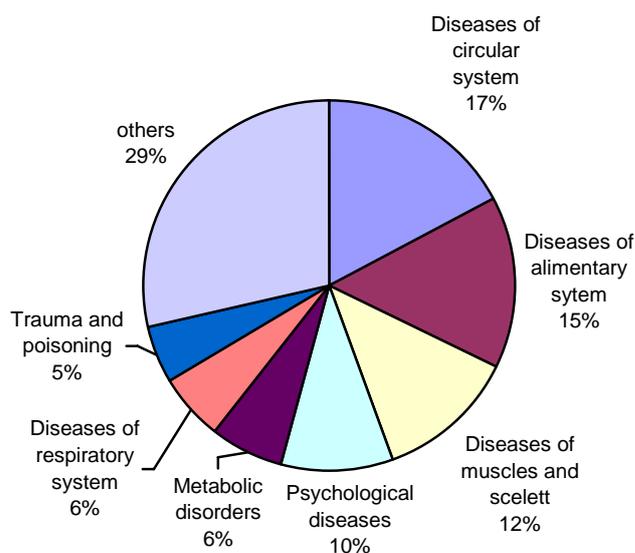


Figure 7.5: Treatment costs for different disease areas

Based on the nature of the system especially the diseases of circular (arrhythmia, heart failure, post infarction surveillance, high blood pressure) and respiratory system (Asthma or COPD) are due to the need of long term monitoring and patient management very attractive disease areas for this type of solution. It is already proven, that a disease management program, which combines the monitoring of patients with a management and education of patient is cost effective and improves quality of life of the patients.

- Disease management in Sweden reduced re-entry to the hospital for patients with heart failure from 106 to 141 days and the reduction of treatment costs front 3.594 \$ to 1.300 \$9
- Study with 162 patients (first diagnosis Asthma) within a disease management program shows a significant improvement of the lunge function¹⁰
- A study which compares treatment cost with and without disease management programs including patient management, compliance management monitoring for heart

⁸ Disease related costs 2002; Germany; Statistisches Bundesamt

⁹ Cline 1998

¹⁰ Kaupinnen 1999

insufficiency. The outcome was: 44% reduced re-admitting to the hospital: improvement of quality of life 80 to 90%; Reduction of treatment cost in the hospital 1.000 \$ (increase of costs for home treatment a patient management 500\$), which implies a net reduction of costs of 500 \$ within 90 days.

There is currently no medical and health-economic data available, which describes the influence of a patient monitoring system in detail, but it is a necessary component to provide the patients with a complete disease management program. The mobile monitoring system could be used in different disease areas / diseases depending from the usage of different diseases.

Disease area	Pulse Oximeter	Respiration frequency	Diary	Pk-Measuring	Glucometer	Thermometer	Body Weight	ECG	EMG	Capnography	Blood Pressure
Metabolic diseases											
Obesity			X				X				
Diabetes			X		X		X				
Cardiovascular diseases											
Arrhythmia	X		X					X			
Heart failure	X		X				X	X			
Post Infarction	X		X					X			
Respiratory diseases											
COPD	X		X							X	
Asthma	X		X							X	
Emphysema	X		X							X	
Sleep apnoea	X		X								
Movement disorders											
Parkinson			X								
RA			X					X			
Obstetrics											
Risk pregnancies	X		X				X	X	X		
Foetal heart rate monitor			X					X	X		
Neurological disorders											
Stroke			X								
Bipolar disorder			X								
Trauma care											
Field trauma	X							X			
Homecare											
Patient surveillance	X		X				X				
Geriatrics	X		X				X				

Figure 7.6: Overview sensors per disease area

Depending on the strategy of the different players and the situation in different markets, there are different go-to-market-models possible. For the solution provider, the following are possible scenarios:

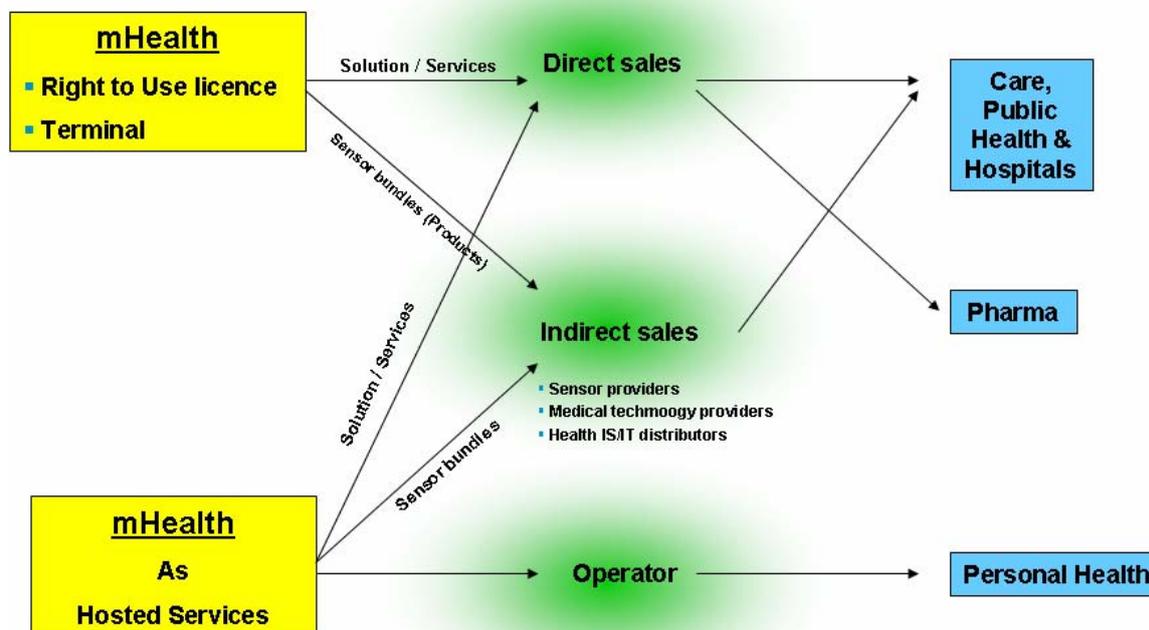


Figure 7.7: Go-to-market model for m-health

7.6 Market enablers and barriers

The healthcare market is difficult to access. It is highly regulated, conservative and not very dynamic in embracing new technology, work methods or business models. In most countries medical services are only paid for if there is a face to face contact between doctor/nurse and patient. Per definition, this is not the case for telemedicine. Experience has shown that most projects in hospitals are stopped if they are not regularly imbursed. This is not solved today. However, the market starts considering this barrier. For example, first moves can be seen in The Netherlands, where they try to constitute financial rules for internet consults of general practitioners.

The market barriers and enablers vary in the different countries. General based upon available knowledge today the following factors need to be assessed:

Barriers of entry:

- Reluctance of the healthcare players to embrace new technologies, work methods and business processes

- Healthcare is a highly regulated area and difficult to access
- Lack of health-political support
- Potential health hazards from wireless communication technology
- Medical data security hurdles, ethical and legal requirements
- Technology is not enough – management of complex value chains and processes is necessary

The barriers of entry are characterized by changing rather traditional views and ways of working. The factors of success deal predominantly with adaptation ability issues in different regards such as patient usability, technical integration, and process adaptation:

Factors of success:

- Adequate market entry-strategy, taking into account all value chain players and providing respective business models and benefits
- Integration of e- and m-health¹¹
- Complete system offer, providing end-to-end services and solutions
- Miniaturization of medical equipment for mobile monitoring
- Straight-forward, easy to handle and robust solutions to show quick benefits and return-on-investment
- Availability of good medical and health-economic validation data

An important point is that it is not the technology alone that will be responsible for success/failure. Rather it is the organizational set-up that configures the service that is the ultimate responsible.

¹¹ e-health refers to health services and information delivered or enhanced through the Internet and related technologies. m-Health refers to the healthcare process improvements that can result when mobile and traditional applications converge. This enables automated data collection with real-time feed-back, allowing patients to be easily monitored from a distance wherever they are.

8. Next steps

All HealthService24 partners confirm the relevance, importance and need for mHealth services.

Ericsson as the industrial partner has modified its internal organization and has created an eHealth department that will be responsible for the deployment of Ericsson Mobile Health, which is the commercial version based on the HS24/MobiHealth concept. Ericsson will follow its decided plans for go-to-market in different regions and target areas. Ericsson Mobile Health (EMH) is now available in its second release and has been CE-certified according to the Medical Device Directives. Commercial discussions are currently ongoing in different countries, both inside and outside the European Union, both with hospitals, national insurance organizations as well as pharmaceutical companies. Currently, EMH has three application areas: a) Patient Monitoring (different kits are available), b) Mobile diary (a mobile questionnaire), c) Mobile Messenger (SMS with answering-function). Amongst others, Ericsson Mobile Health is currently being implemented in Singapore. Ericsson will continue developing additional needed functionalities and functions for a hassle free usage of EMH.

The **SMEs** TMS-I and Yucat will continue the collaboration with University of Twente on the research version.

Twente Medical Systems International (TMSI) has developed a telemedicine device for monitoring pace-maker patients for the biggest pace-maker company world wide. TMS-I will continue defining products or half products based on the BAN components, together with the end user software, and bring those products to the market. They also plan to define a platform or integrated service as a telemedicine end user product, and to develop, produce and bring that product to the market together with partners.

Yucat will offer an MBU software platform that can be used in different mobile measurements settings. They will sell software (components) through partners and directly to end-users (as part of the research platform). They also plan involvement (business) and contribution (knowledge, expertise, components) in a commercial system.

The **hospitals** recognise the importance and usefulness of the proposed mHealth services and have started actions towards the definition of the strategies for incorporating HS24 mHealth services in their organizations.

Hospital Clínic Provincial de Barcelona plans to integrate the HS24 mobile monitoring solution as the regular equipment for monitoring patients in different severity clusters within the institutional integrated care program, targeting chronic conditions. Furthermore, they plan to combine the mobile monitoring service with an already existing patient management system in the area of lung diseases, especially COPD. The HS24 system will also be applied to other pathologies that could potentially benefit from the functionalities available (e.g. day-case-surgery, AIDS treatment and follow-up, etc.). HCPB will also serve as an expert for future expansion plans of the usage of the complete solution to other health care providers in the region and over Spain when the HS24 solution is better established.

Medisch Spectrum Twente has chosen a two phase approach: The first focus will be on research. MST will continue studying conditions that can predict labour and will solve the technical problems faced in the HS24 pilot. In addition, they will develop algorithms that can be

embedded and for this they will obtain a patent. The next step is commercial development and deployment.

LITO Polyclinic are currently reorganizing their current clinical practices related to the cardiac patients' service provision in order to integrate the HS24 mobile solution into the clinic processes as the regular equipment for home care (main target until 2008). If successful, expansion to other conditions likely. The HS24 training will take place for an increased number of staff and patients. Once the deployment of the service has reached a stable state a comprehensive financial analysis will also be sought. A spin off company is planned for commercialization of the integrated DITIS/HS24 system. Investigations have started how to promote DITIS¹² into the Ericsson worldwide portfolio as additional functionality for EMH

Finally the **universities** are in the process of expanding their research directions to include areas that will allow the development of new concepts for m-health.

University of Twente (UT) has created an eHealth laboratory for knowledge valorization purposes. It facilitates continuous development of the UT's mHealth services platform and also promotion of research results particularly for the healthcare domain. The main target is to provide a mHealth services platform for niche markets that does not compete with full commercial services for healthcare research in Europe and (basic) healthcare in developing countries. UT also has plans to proof the generic mHealth services platform in hospital and research institutes for medical research and to try to formalize further collaboration with industrial partners for developed applications to enter the commercial version. After the project Ericsson and University of Twente will discuss further collaboration opportunities with regards to new applications. When new applications prove successful in pilots on the research system, those could be integrated into future releases of the commercial system.

University of Cyprus will collaborate close with LITO in reaching by 2008 a successful proof of concept and will provide continuous support in applying the new service of managing cardiac patients in LITO. It is also their task to continuously develop DITIS system to include new healthcare concepts and new mobile technologies

Thus the project results not only have strengthen the commitment of the partners for the deployment of the project results, but have also triggered discussions towards agreements for the commercialization of the forthcoming services and products.

¹² DITIS is the patient management system used at LITO.

9. Appendices

9.1 HS24 management

9.1.1 HS24 management setup

The overall management of the project is based on the Project Management Board (PMB) composed of one authorised representative of each partner. The PMB is the highest project authority supervising the executive body - the Project Executive Committee (PEC) composed of the Project Manager, the Technical Officer and the Scientific Officer. There is also a subsidiary body – the WP-Management composed of Work Package Leaders. One of the main objectives of this body is to foster the communication, coordination and cooperation between the work package leaders and the work packages itself.

All issues are reported and consulted with the Project Manager. The technical issues and decisions in the project are additionally reported and consulted with the Technical Officer. Issues relating to future evolution, the use/integration of new ideas and technologies, interface with the research community as well as general strategic directions are additionally reported to the Scientific Officer.

The project management structure is shown in the following chart.

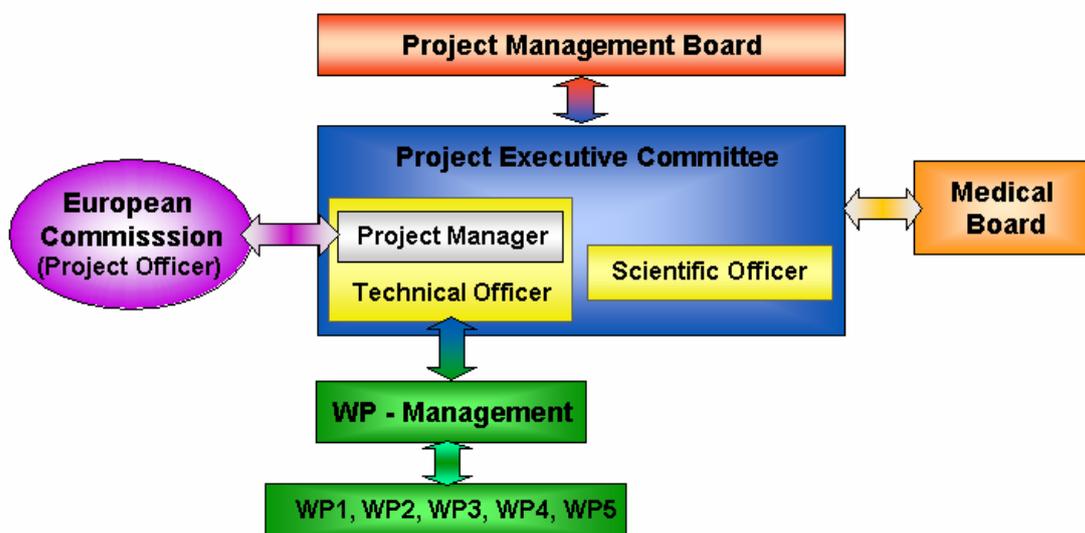


Figure 9.1: Structure of the HealthService24 project management

Project Management Board (PMB)

The PMB contains only one representative of each beneficiary and each member in the Consortium (called a Representative), who is the only person empowered to transact legal and administrative agreements on behalf of the respective partner. The Representatives will be the primary points of contact between the partners and the Co-ordinating Partner (Ericsson). Having informed the others, each partner shall have the right to replace his Representative.

The PMB approves or rejects proposals coming from the PEC regarding new partners, replacement of partners, budget reallocations, as well as a change of the PM, TO, and SO. During the meetings of the PMB the PEC shall present the results of the project of the last period and the plans for the next period. In total, 5 PMBs were held.

Project Executive Committee (PEC)

The Project Executive Committee, composed of the Project Manager, the Technical Officer and the Scientific Officer, is responsible for the overall control of the project and the implementation of the decisions. It is an autonomous management body, which takes all decisions regarding the project work.

The PEC provides the external interface of the project, representing the project interests in the European Commission and all contacts with companies and institutions.

Project Manager (PM)

The Project Manager (PM) is responsible for the overall co-ordination of the project and is the contact person for the European Commission. She takes care of the project planning and monitoring, progress reports, milestones reports, cost statements, budgetary overview and review organization. The PM handles all day-to-day administrative and management functions with the help of the other management bodies. In co-operation with the Technical Officer, she has the authority to adjust the project work plan to avoid short-term difficulties.

Scientific Officer (SO)

The Scientific Officer (SO) is responsible for the overall scientific supervision of the project and the definition (with the PM) of the strategic directions of the project. His role is to advice and guide the project work towards the defined scientific goals (medical and technological). He provides the interface for the incorporation of new technologies coming from research, and provides advice on major strategic decisions that arise in the project.

Technical Officer (TO)

The Technical Officer (TO) is responsible for the day-to-day monitoring, co-ordination and validation of the project technical work. He is responsible for the coordination of the technical decisions of the WP-leaders in order to avoid incompatibilities in the integration of the project results. The responsibility also covers the technical quality assurance and for the quality control of developed tools. He is entitled to request additional reports and remedial actions, should any doubt concerning progress and adherence to timescales be evident.

Medical Board (MD)

The medical board is composed by the medical partners of the project (one representative per partner), and has the task to monitor the medical part of the project. The MD provides input to the executive board regarding the medical needs of the project, the issues and problems related to the medical applications (like, ethical committee considerations, medical restrictions etc). The medical board is also responsible for the medical evaluation of the services and the interpretation of the medical evaluation results.

WP-Management

The WP-Management is composed of Work Package Leaders. One of the main objectives of this body is to increase the communication, coordination and cooperation between the Work Package Leaders and the work packages itself.

The WP-Management reports, discusses and consults the technical issues and decisions taken during the project with the TO. The organisational issues as well as the control over the decisions concerning the exploitation and deployment were reported and consulted with the PM.

Work Package Leaders (WPL)

Each WP is lead by a Work Package Leader (WPL), responsible for the work carried out within the WP. He has to provide periodic reports to the WP-Management detailing manpower allocations and other costs. Details of technical progress within the work package will be passed to the Technical Officer for evaluation. Each WPL shall be responsible for the timely completion of deliverables due from the work package and their submission to the Technical Officer, Scientific Officer and Project Manager for validation. Each WPL is also responsible for identification of risks and for proposing solutions in respect of his work package.

9.1.2 Who owns which position within the HS24 project?

Project Manager	Barbara Streimelweger / Ericsson (part 1) Jennie Weingartner / Ericsson (part 2)
Scientific Officer	Dimitri Konstantas / University of Twente
Technical Officer	Richard Bults / University of Twente
WPL of WP1	Barbara Streimelweger / Jennie Weingartner / Ericsson
WPL of WP2	Philip Herrmann / Ericsson
WPL of WP3	Richard Bults / University of Twente
WPL of WP4	Dr. AlbertAlonso / Hospital Clínic Provincial de Barcelona
WPL of WP5	Rainer Herzog / Ericsson
Leader of Medical Board	Dr. Josep Roca / Hospital Clínic Provincial de Barcelona

The PEC consists of the PM, SO and TO.

The PMB (Project Management Board) consists of all partners. Each partner has one vote.

9.2 Work package overview

The overall project workplan is divided into five work packages.

Workpackage 1 (Project management, WP Leader Ericsson) will ensure the overall coordination of the work performed in the HealthService24 project as well as the monitoring of the project progress and results and reporting to the Project Officer.

Effective management is critical to the project's success and therefore the project has to provide mechanisms to ensure that both technical and non-technical tracks are independently and continuously monitored and controlled. There will be a clear separation between the project coordination and the administrative project management on one hand, and the technical project management activities on the other hand. Hence, it is the goal of this workpackage to set-up and implement effective management structures and processes. Respective tools and procedures for quality control of project work will be developed, as well as effective internal and external communication.

Results of the Workpackage 1 will be presented in periodic reports to the Commission and, prior to that, will have to get accepted by the reviewers and the Project Officer. The project reports will demonstrate the project progress to the European Commission and, depending on the dissemination level, to the public. Expected results are project processing without turbulence, fast reacting to any problems arising, evaluating of the deliverables, and agreements on objectives for the following reporting period by the reviewers and the Project Officer.

The initial aim of the **Workpackage 2 (Draft business plan and Final business plan, WP Leader Ericsson)** is to generate a business plan that forms the basis for all further sustainable market deployment and implementation strategies, activities and associated resources.

In order to accomplish this, a detailed market analysis will have to be carried through in close cooperation with health insurers, hospital organizations, medical service providers and mobile network operators, also incorporating legal aspects.

The result of the WP 2 will be on the one hand a business plan, which will be the basis for market deployment and will pave the way to commercializing the project outcomes and applications. On the other hand, it will provide the Commission with a status report and analysis of deployment activities having been undertaken by the project and its partners.

The objectives of the **Workpackage 3 (System integration/ adaptation and support of the prototype, WP leader University of Twente)** are twofold:

1. provide an operational HealthService24 system that delivers a service according to specified end-user (i.e. healthcare practitioner) requirements, and
2. perform a feasibility study on the HealthService24 technical integration and adaptation in the healthcare providers infrastructure.

The approach towards the fulfilment of the objectives is divided into six activities, which are matched to WP tasks. The initial activity contains the definition of end-user requirements for the services delivered by the HealthService24 during the pilot phase. The requirements will be prioritized and correlated to the existing prototype system functionality to avoid a major development effort (deliverable 1). The conclusion of the initial activity triggers the start of other WP activities. The existing prototype system will be adjusted and/or refined according to the defined end user requirements (milestone 1 and 2). In parallel, operators of UMTS/GPRS mobile telecommunications infrastructures will be approached to guarantee the availability of these

infrastructures on the locations where the pilots will run (milestone 3). The fifth activity is a feasibility study on integration/adaptation of the HealthService24, including aspects like: technical integration into the healthcare organization's infrastructure, manageability aspects of the existing system and adaptation/localization of the BAN. The results of the study (deliverable 2) and feedback from WP4 are evaluated and used to refine (within the scope of the eTEN framework) the existing system. The last activity is setting up a helpdesk to support the pilots with technical operational aspects of the HealthService24.

The results of WP3 are a pilot-ready HealthService24 platform and two reports describing the end user requirements on the HealthService24 and the results on the HealthService24 integration/adaptation feasibility study.

The goal of the **Workpackage 4 (Pilot runs, WP leader Hospital Clínic Provincial de Barcelona)** is to test the HealthService24 system in real-life scenarios, assess its level of feasibility and market viability, and validate the system and service from the medical and health-economic point of view.

To fulfil this goal, each participating pilot site will develop specific clinical scenarios in which the use of the HealthService24 system supports the process of care or its significant parts. The evaluation of the performance of the system will be carried out in accordance to the intended market validation goal but it will also consider the impact of the system in other domains (technical, professional, organizational, ethical and legal).

The main outcome of this work package is of fundamental importance for the elaboration of the business plan and deployment report of the HealthService24 system. Since the evaluation phase will take place in real clinical scenarios and will apply to specific care services, it will be possible to derive sound data regarding the actual impact of the introduction of the system and its implications, as well as considerations that facilitate or hinder large-scale deployment.

The objective of the **Workpackage 5 (Dissemination of project results, WP leader Ericsson)** consists of the communication and dissemination of the results of the validation trials and other project outcomes to the medical, scientific and industry communities so that target users of the mobile applications and services are familiarized with the advantages, possibilities and opportunities offered by HealthService24.

To realize the above objective, it is envisaged to use a variety of market communication vehicles. The respective approaches, activities and targets will be defined in detail in the Dissemination Plan.

The overall result of the WP 5 will be the spread of HealthService24's validation results and business opportunities throughout the Community and throughout all relevant medical, scientific and industry sectors and beyond, as well as the collection of feedback from outside the project consortium regarding usage opportunities. The direct result will be the management report on dissemination activities at the end of the project.

9.3 Deliverables produced

Deliverables				
Del. no.	Type (a)	Distribution (b)	WP ref. (c)	Title and short description
D1.1	RE	C	1	Consortium Agreement
D1.2	RE	C	1	Project handbook and quality plan
D1.3	RE	C	1	Quarterly management reports (6)
D1.4	RE	C	1	Periodic project reports (2)
D1.5	RE	P	1	Final project report
D2.1	RE	C	2	Ranked list of target areas
D2.2	RE	C	2	Draft business plan
D2.3	RE	C	2	Final deployment report
D2.4	RE	C	2	Final business plan
D2.5	RE	C	2	TransEuropean Dimension
D2.6	RE	C	2	Harmonisation, Interoperability & Standardization
D3.1	RE	C	3	Report on HealthService24 end user requirements
D3.2	RE	C	3	Report on HealthService24 integration/ adaptation feasibility study
M3.1	Milestone		3	Trials ready and supported HSP at UT
M3.2	Milestone		3	Trials ready mobile telecommunications infrastructure at pilot locations
M3.3	Milestone		3	Trials ready BANs and PL2 at pilot locations
M3.4	Milestone		3	Trials ready helpdesk
M4.1	Milestone		4	Pilots up and running at all sites
D4.1	RE	C	4	Methodology for the pilots' evaluation
D4.2	RE	C	4	Pilots evaluation report
D5.1	OT	P	5	Project presentation brochure and a WWW site
D5.2	RE	C	5	Dissemination plan
D5.3	RE	C	5	Management report of the dissemination activities
D5.4	RE	P	5	Dissemination Workshop 1
D5.5	RE	C	5	Dissemination Workshop 2

Table 9.1: HS24 deliverables (based on Grant Agreement)

RE = Report, OT =Other

P = Public, available for wide dissemination: www.healthservice24.com

C = Confidential, limited to project participants and responsible EC services. Available via restricted area at: www.healthservice24.com.

9.4 Time table and schedules

General facts

HS24 project duration:	February 2005 – September 2006
Project type:	Market validation, eTEN
Grant Agreement Number	N° C517352
Project objectives:	Validation of existing prototype Acceptance by hospital staff and patients Integration into existing systems & processes Health economics potential
Focus of the pilots:	COPD patients (Hospital Clínic, Barcelona) Cardiac Patients (LITO Polyclinic, Cyprus) High risk pregnancies (MST, Enschede)
Total project costs:	2.24 mil €(EC contribution: 1.2 mil €)
More info:	www.healthservice24.com

Project Milestones

M3.1	30.04.2005	Trials ready and supported HSP at UT
M3.2	30.04.2005	Trials ready mobile telecommunications infrastructure at pilot locations
M3.3	30.04.2005	Trials ready BANs and PL2 at pilot locations
M3.4	30.04.2005	Trials ready helpdesk
M4.1	30.04.2005	Pilots up and running at all sites

Detailed Schedule – Gantt chart

The following Gantt-chart provides an overview of the different Work Packages (WP) and the corresponding tasks for the duration of the project.

The colours in the legend refer to the following:

	original planned schedule
	additional required time -> expanded time-frame
	original planned schedule but start has been postponed

HealthService24																				
based on TA V08	2005											2006								
	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	August	Sept
Workpackage	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
WP 1: Project management																				
Task 1.1 Project co-ordination and management																				
Task 1.2 Quality assurance																				
Task 1.3 Monitoring and reporting																				
WP 2: Draft business plan + Final business plan																				
Task 2.1 Definition of applications and services																				
Task 2.2 Analysis and definition of the respective value chain																				
Task 2.3 Market analysis																				
Task 2.4 Costs for market deployment and expected business impact																				
Task 2.5 Draft business plan																				
Task 2.6 Legal requirements																				
Task 2.7 Final business plan																				
WP 3: System integration/adaptation and support of the prototype																				
Task 3.1 Service requirements definition																				
Task 3.2 HSP operational (adjustment and engineering support during trials)																				
Task 3.3 Mobile telecommunications infrastructure (UT)																				
Task 3.4 HSP integration/adaptation feasibility study																				
Task 3.5 Medical data generation & visualization																				
Task 3.6 Support (UT)																				
WP 4: Pilot runs																				
Task 4.1 Design of the evaluation phase																				
Task 4.2 Field evaluation in Netherlands																				
Task 4.3 Field evaluation in Cyprus																				
Task 4.4 Field evaluation in Spain																				
Task 4.5 Evaluation of the trials																				
WP 5: Dissemination of project results																				
Task 5.1 Development of a project presentation																				
Task 5.2 Development of dissemination plan																				
Task 5.3 Dissemination activities																				
Task 5.4 Internal use of gained knowledge																				
Task 5.5 Contribution to standardization																				

Table 9.2: HS24 Gantt Chart (based on Grant Agreement, Amendment N°3)

9.5 Dissemination activities

9.5.1 Introduction

The HealthService24 (HS24) has taken a very active role with regards to dissemination work. Some activities were conducted as bigger, joint activities such as presentations at different exhibitions and congresses, others were part of the project partner's daily work such as customer meetings or university lectures and ordinary meetings with doctors and patients.

As the project aimed at delivering and launching a fully marketable solution, dissemination of the major project goals, activities and results was of utmost importance. The prime target audiences for the HS24 dissemination activities are within the healthcare sector: health insurers, hospitals, pharmaceutical companies, care organizations, medical service providers, patient organizations. Secondary targets were: mobile network operators, health IT and hardware suppliers or vendors. Dissemination aimed at preparing the acquisition of potential customers, preparing and involving the different market and value chain partners, as well as acquiring development and technology partners and raising potential investors. Especially the potential target users and customers were familiarized with the advantages, possibilities and opportunities of the HS24 mobile services.

For dissemination, suitable elements from the communication mix had been used: promotion, public relations and personal selling/communication activities. The main activity and focus of HS24 were the market validation trials. Hence, these were always in the center of all dissemination activities.

One of the big challenges of the HS24 dissemination activities was to show and prove more than the technical functioning of the mobile healthcare applications and services and to properly address issues like: lucrative business cases and health-economical outcomes, user benefits to ensure user acceptance, data security issues as well as liability issues.

Furthermore, communication-effectiveness and cost-effectiveness issues had to be taken into account when the HS24 project partners looked at implementing or proposing means for ensuring and fostering dissemination, exploitation and use.

9.5.2 Dissemination approach

For the HS24 consortium, the task to communicate and exploit the knowledge and results from the project was essential, particularly as the project aimed at delivering marketable solutions and services at the end of the project.

The communication elements that had been applied to accomplish this task were the following:

- **Promotion:**
 - Brochures
 - Publications
 - Symbols and logos
 - Website
 - Direct initiatives (e.g. mailings)

- **Personal activities:**
 - Presentations and speeches

- Conferences, seminars and similar events
- Exhibitions and demonstrations
- **Public Relations:**
 - Press kits
 - Press releases
 - Press conferences
 - Community relations
 - Opinion leaders and lobbying

- **Identification of the target audience**

It is essential to start with clear target audiences in mind, which for HS24 included potential future users or user groups, political decision makers and industry

For HS24, the prime target audience was the healthcare sector. Hence, we focused on the relevant players in this sector when we targeted our dissemination activities. A secondary area of interest was health IT / telecommunication.

The following table shows a summary of the relevant addressed targets in healthcare and health IT / telecommunications.

Healthcare	Health IT / Telecommunications
<ul style="list-style-type: none"> • Government (health ministry or similar) (e.g. Canada, Portugal, Russia, UK, Singapore, China) 	<ul style="list-style-type: none"> • Mobile network operators (e.g. Vodafone, Telefonica Moviles, TIM, Swisscom, O2)
<ul style="list-style-type: none"> • Health insurers (e.g. Helsana) 	<ul style="list-style-type: none"> • Application service providers (e.g. Pharmtech, Medgate, Sanvartis)
<ul style="list-style-type: none"> • Pharmaceutical and diagnostics companies (e.g. AstraZeneca, Pfizer, Menarini, Boehringer Ingelheim) 	<ul style="list-style-type: none"> • Hardware suppliers (e.g. Nonin, MedAir, CTech, Menarini, Roche Diagnostics)
<ul style="list-style-type: none"> • Health service providers / Care associations (e.g Stockholm Stad, SLL) 	<ul style="list-style-type: none"> • Network infrastructure suppliers
<ul style="list-style-type: none"> • Doctors / Doctors associations 	<ul style="list-style-type: none"> • Scientific and research institutions (e.g. Karolinska, IIT)
<ul style="list-style-type: none"> • Hospitals / Hospital groups (e.g. Capio, Hirslanden, Changchi, Parkway, St. Vincent, Karolinska) 	<ul style="list-style-type: none"> • Technology consultants (e.g. TietoEnator)

Table 9.3: Targets in healthcare and health IT

- **Determining the dissemination objectives**

As already mentioned above, the ultimate goal of HS24 was to validate mobile healthcare services, prepare their market deployment and familiarize target users with the mobile services offered by HS24. In order to arrive there, the objectives of our dissemination activities were to raise awareness of the project, its activities and goals amongst our targets, generate interest in the services and solutions that had been validated and supply highly relevant data and information in the most suitable and adapted way in order to generate a strong conviction to use the project results.

- **Designing the message content**

The challenge was to create messages that gets the attention of the specific individual target groups which we defined above and trigger their conviction to use the HS24 solutions and services. Hence, we will had to identify the respective value propositions, which clearly state the reasons why it is beneficial for the individual target groups to make use of the project outcomes.

The magnitude of the communication and conviction challenge we were facing here can be quite neatly illustrated with the following picture:

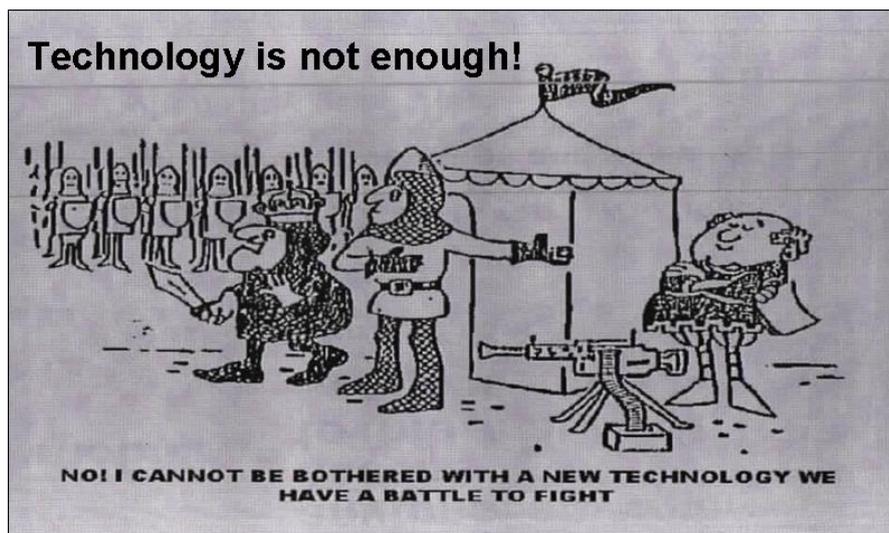


Figure 9.2: Technology is not enough!

It was by far not enough to demonstrate and communicate that mobile healthcare applications work well from a technical service quality and mobile telecommunication point of view, but quite decisive that we were able to generate data and properly communicate on the following elements:

- Lucrative business cases for mobile healthcare applications
- Significant positive health economic effects
- Strong user benefits (convenience, safety, reliability, quality-of-life) to ensure user acceptance
- Solutions or arguments to overcome social, or ethical issues (e.g. health risks related to mobile phone usage, data security and privacy)

- (Medical) responsibility and liability
- Accreditation of devices and applications

As pointed out above, for each of our target groups, the respective resulting value propositions (VP's) had to be considered when addressing or communicating to them:

Healthcare	Health IT / Telecommunications
<ul style="list-style-type: none"> • Government (health ministry or similar) Proposed VP's: significant positive health-economic effects, data security, accreditation, liability 	<ul style="list-style-type: none"> • Mobile network operators Proposed VP's: lucrative business case, strong user benefits, social issues (health risks)
<ul style="list-style-type: none"> • Health insurers Proposed VP's: significant positive health-economic effects, service quality (reliability), user acceptance, data security, accreditation 	<ul style="list-style-type: none"> • Application service providers Proposed VP's: lucrative business case, strong user benefits, quality of service (reliability), data security
<ul style="list-style-type: none"> • Health service providers / Care associations Proposed VP's: lucrative business case, service quality (reliability), user acceptance, data security 	<ul style="list-style-type: none"> • Hardware suppliers Proposed VP's: lucrative business case, social issues (health risks), user benefits, accreditation
<ul style="list-style-type: none"> • Doctors / Doctors associations Proposed VP's: lucrative business case, data security, liability, service quality (reliability) 	<ul style="list-style-type: none"> • Network infrastructure suppliers Proposed VP's: lucrative business case, quality of service (reliability)
<ul style="list-style-type: none"> • Patients / Patients associations Proposed VP's: strong user benefits, service quality (reliability), data security, social issues 	<ul style="list-style-type: none"> • Scientific and research institutions Proposed VP's: quality of service, data security solutions, accreditation
<ul style="list-style-type: none"> • Hospitals / Hospital groups Proposed VP's: lucrative business case, service quality (reliability), data security, liability 	<ul style="list-style-type: none"> • Technology consultants Proposed VP's: lucrative business cases, quality of service, data security solutions, accreditation
<ul style="list-style-type: none"> • Academia Proposed VP's: potentially all of the above elements, according to individual focus 	
<ul style="list-style-type: none"> • Pharmaceutical and diagnostics companies 	

Healthcare	Health IT / Telecommunications
Proposed VP's: lucrative business case, strong user benefits, quality of service (reliability), data security, accreditation	

Table 9.4: Value propositions of target groups

In order to accumulate the best possible information on the value propositions mentioned above, HS24 also related to other projects and try to utilize and build upon those results and findings.

- **Message structure and format**

Apart from the content, the effectiveness of our dissemination activities also depended on the structure and format of the messages we used. As the different project target groups had a quite different background and knowledge and different objectives and interests, communication structure and format had to be adapted to these different wants and needs in order to be convincing.

Consequently, and according to what has been defined above, suitable structures or formats therefore included:

- highly technical and detailed presentations of components and processes
- comprehensive, simple and straight forward presentations of functionalities and benefits
- business driven market analyses
- medical or health-economic findings
- legal dossiers summarizing accreditation or liability issues

- **Deciding on the communication mix**

Each element in the communication mix has its own unique characteristics (and associated costs). As described at the beginning of this chapter, we considered the 3 following elements of the communication mix to be applicable in the HS24 context:

- **Promotion:**
Highly public and pervasive medium. Allows the targeted individuals to evaluate and reflect on the HS24 results and outcomes and on related benefits. Provides the opportunity to tune the content to individual wants and needs. Useful as an instrument to raise awareness and provide first information.
- **Public relations:**
Highly credible, as news stories are more authentic and credible to a large number of people, especially if they come from opinion leaders or highly valued publications.
- **Personal activities:**
Probably the most cost-effective tool, especially at later stages of the communication / dissemination process and particularly when it comes to create conviction to really make

use of the projects outcomes. Moreover, with HS24, we are operating in an area where it is important to build solid relationships based on mutual trust – which can be effectively established with personal communication activities.

In order to accomplish the project’s dissemination and exploitation objectives and get the most out of related communication and marketing activities, a mix of the above mentioned elements had been applied, always bearing in mind each element’s strength and potential impact with regard to the project objectives.

This will be reflected in the chapter 3, where we will describe in detail the individual dissemination and exploitation activities that we carried through.

9.5.3 Dissemination activities

Conferences, seminars, workshops

The following conferences, seminars and workshops count to the major events with regards to the HS24 dissemination work.

Event title	Place & Date	Participation	Impact
MOCOMED Seminar (mobile computing in medicine)	Freiburg, Sept. 15, 2005	Presentation of project goals and activities	Communicate to academia
MEDICA	Düsseldorf, Nov. 16-19, 2005	Booth, presentations, press, dissemination workshop, press release	Raise awareness, communicate project objectives and activities, show mobile solution, acquire commercial projects
Phealth	Luzern, Jan. 31, 2006	Presentation	Present project goals and activities to academia and industry
3GSM World Congress	Barcelona, Feb. 13-16, 2006	Booth, presentations, press	Raise awareness, communicate project objectives and activities, show mobile solution, acquire commercial projects (focus: health IT and telecom)
IT Association of Canada - Symposium	Toronto, March 15, 2006	Presentation	Presentation of project towards industry to support commercialization
eHealth 2006	Malaga, May 10-12, 2006	Presentation, live-demo	Presentation towards health political world; lobbying towards health politics
National Disease Conference	Singapore, May 19-20, 2006	Presentation	Present project goals and activities; support commercial and trial projects with government

ITEG 2006	Frankfurt, May 30 – June 01	Exhibition, presentation, demo	Presentation of services, activities to industry and potential partners
ICT for an inclusive society	Riga, June 11-13, 2006	Exhibition, presentation, live demo	Present project goals and activities; raise awareness and make use of political stage; lobbying towards health political world
IMIA HIS Working Conference	Oeiras, July 2-4, 2006	Presentation	Present project towards academia and health political world
Dissemination and Press Workshop HS24	Düsseldorf, Sept. 5, 2006	Dissemination workshop, presentation, demo, press conference and release	Communicate project results towards industry and press; use for supporting go-to-market and commercialization
World of Health IT	Geneva, Oct. 10-13, 2006	Presentation	Present project and communicate project results towards academia and industry
ECEH	Fribourg, Oct. 12-13, 2006	Presentation	Present project and communicate project results towards academia and industry
eChallenges	Barcelona, Oct. 25–27, 2006	Conference, booth, live-demo	Present project and communicate results towards academia and industry

Table 9.5: HS24 conferences, seminars and workshops

Publications

Scientific papers had been written and submitted to different conferences around the world. Nevertheless with the evolution of the further go-to-market activities, more papers will be written and published to conferences, journals and book chapters. The papers not only presented the project results but also discussed issues and problems on the methodologies, technology and process integration as well as on health-economic issues.

Web presence

A specific project website was set up and is available to the public since April 2005.

The URL of the project site is: <http://www.healthservice24.com>

The site aims at providing access to all project-related activities and information which might be of relevance to the target groups mentioned in the previous chapter. Such information includes: project summary and presentation, relevant contacts, information on the different work packages and their status, information on the project deliverables and on the project consortium.

The site has also an internal part which is only accessible with personal ID and password; this section holds internal consortium information like certain parts of the periodic project reporting or other internal reports and documents.

Standardization

Part of the work on dissemination went into standardization issues. The project was based on existing standards and contributed to ongoing standardization activities.

A lot of standards are used on GPRS and UMTS that are not worth repeating here, since they are implemented, or to be implemented by operators and manufacturers. Furthermore, in the area of health devices, there are also a few standards that some products on the market do follow. However, there are specific issues in which standardization work is still needed, more in the profiling side than in the base standard development one. Examples can be found on security issues, where the signature management has still many ongoing standardization and profiling activities, both in ETSI and CEN.

Also in CEN, there is some ongoing work on health standards that would be needed to consider when integrating BANs in a wireless environment. This includes several items dealt with in different WGs of CEN/TC 251 (Health Informatics), such as technology for interoperability and security, safety and quality. In particular, concerning this last point, there is work on e-health security – protection profiles in WG III (security, safety and quality) of CEN/TC 251 (see <http://www.cenitc251.org/WGIII/WGIII.htm>).

More specific on wireless issues, around BANs, the work on IEEE 802.15 WPAN/Bluetooth (Wireless Personal Area Networks), see: <http://standards.ieee.org/wireless/overview.html#802.15>).

Finally, still on security, but on the UMTS side, there is work on mobile communications security in 3 GPP (3rd generation partnership projects) – TSG SA (Technical Specification Group on Service and System Aspects) – WG 3 (Security), see: <http://www.3gpp.org/TB/SA/SA3/SA3.htm>).

Public Relations

Press releases were launched whenever major project results were obtained or important events were carried through. As already mentioned, the target publications were journals from the areas of healthcare / medicine and telecommunication, either directly or using the partner organizations as multipliers.

Whenever possible, press events and releases were prepared for large exhibitions or other events where HS24 was presented (e.g. Medica).

Promotion

A product brochure was prepared and made available from end of June 2005 onwards, giving full information on all aspects of the project and taking into account the different wants and needs of the individual target audiences. The brochure was designed in a way to give information on one side, but also to raise awareness on the other side and to generate interest and to market the product to potential users. The design of a project logo was done in parallel to the brochure conception.

9.6 The HS24 trial scenarios

9.6.1 General description of the trial scenarios

The trial scenarios for the three chosen cases are more or less similar. In the following we describe the generic trial scenario from the point of view of the patient, the physician, the nurse, and the first line help desk, and later on we describe the differences and special requirements for each trial case.

Patient: A patient arriving at the hospital will be diagnosed to be potential user of the HealthService24 system. In an interview, the treating physician will explain the HealthService24 services and all related issues. If the patient agrees then she/he will be selected as user of the system. After signing the required (if any) documents, a training session with a nurse will be organized where the patient will be provided with a system, a user's manual and a set of consumables (like sensor stickers). Following the training session, the patient will leave the hospital with the system and instructions when to use it. Depending on the case, the patient might be instructed to use the system only a few times per day or continuously. In case of problems, the patient will be given a number to call for first line help (both technical and medical). On regular intervals or on demand, the patient will be contacted by the medical personnel (nurse or physician) and will be asked clarifications on his/her status. He might even be called to return to the hospital. If the patient is not able to move, an ambulance will be sent to his present location. In case of emergency, the patient will contact the treating personnel and receive instructions.

In case of system failure (like for example the device falls down and breaks) the patient will be have to come back to the hospital to receive a replacement device. At the end of the treatment, the device(s) will be returned to the hospital.

Physician: The physician will first receive a training course for the use and capabilities of the HealthService24 system. Once a patient has been diagnosed and identified as potential user of the system, the physician participating in the project will explain in an interview the HealthService24 services and evaluate whether the patient can be a test subject in the trials. The patient having accepted the physician will provide to the nurse the required system specifications and instructions of what to monitor. During the monitoring phase the physician will be contacted by the nurse when needed, and will be informed on the evolution of the patient's status. The physician will have to decide whether the patient should be called to the hospital for treatment, modification of the monitoring parameters etc. In regular intervals (depending on the patient) the physician will examine the patient and evaluate the registered collected data and possibly re-evaluate the patient's prescribed treatment. In case of changes to the HealthService24 configuration, he will inform the nurse for required updates. We expect that in each trial we will have at least 2 physicians that will be seeing the data and taking the decisions accordingly.

It should be noted that during the trials the "normal" handling of the patients will not change. The HealthService24 services will run in parallel to the existing model and will provide additional information to the medical personnel, needed for the evaluation of the results and their comparison with the present situation. A small group of patients will participate in the trials and will be handled differently from the other patients. As a result, in case of system malfunction the physicians will be able to continue the monitoring of the patients based on the traditional model of work.

Nurse: The nurse will first receive a training course for the use and capabilities of the HealthService24 system. Once a patient has been identified to use the system the nurse will first

receive instructions from the physician regarding the required configuration for the patient. He will assemble the system, configure it according to the patient profile, and organize a training session with the patient. After the training session the nurse will provide the mobile device to the patient along with a set of sensors stickers, a user's manual and information for first line assistance. At this point the collection of the data and monitoring of the patient will start. Depending on the patient's profile, the data will be monitored either on-line or off-line. In the on-line monitoring the patient data will be continuously projected on the monitoring nurse's screen (hopefully!) 24 per day. If a problem is detected, then the nurse will contact the treating physician and provide him with the measurements in question. Depending on the instructions of the physician the nurse will either contact the patient asking clarifications on the patient's current state, or simply ask the patient to come to the hospital. If the patient is not able to come alone to the hospital, a nurse will send an ambulance to fetch him/her. The nurse will also receive instructions from the physician regarding updates in the patient's HealthService24 system configuration, which she will perform either by providing new sensors to the patient, or by changing software controlled system parameters.

First line help desk: The help desk will provide the users (patients and medical personnel) with technical information and assistance in the use of the system during the trials. In addition, will direct medical questions from the users to the medical personnel. The nurse when configuring the system for the patient she will be able to contact the help desk for questions regarding "non-standard" configuration. The patient will be able to call the first-line support at any moment, describe the problem (like for example, "the system does not boot", or "how do I connect the X sensor", or even "some part fell in the water is no longer functioning!"). The help-centre will try to resolve the problem or if it a important malfunction or failure of the system will take the necessary steps to replace the system of the user. In case of medical questions, the help desk will contact directly the medical person in charge or provide the contact details to the user. The reply from the help-desk will be immediate for simple problems, a delay of 1 hour for more complex issues that require reference to the second line support and in case a replacement of a device is needed, the service delay will less than 3 hours (during the day- in fact this will be the time to configure and deliver the new device to the user – if the user is in an unreachable area, the delay of course be grater). In case of an important problem, the first line support will contact the second line support, who will take over the handling of the situation. Problems referred to the second line support will be resolved with 48 hours.

9.6.2 Service and supply chain

The complete product and service supply chain is shown in Figure 9.3. The patient will visit the healthcare centre or specialist who will prescribe the required HealthService24 system. The treating specialist will prescribe the specifications of the required BAN to the nurse who will configure the BAN for the patient, provide first level training and take all required actions for the registration of the patient's BAN and medical conditions to follow in the hospital system. If required the nurse will refer the patient to the medical service provider for further training. The patient will obtain first line medical and technical support from the helpdesk (which can be part of the hospital or be an external service provider).

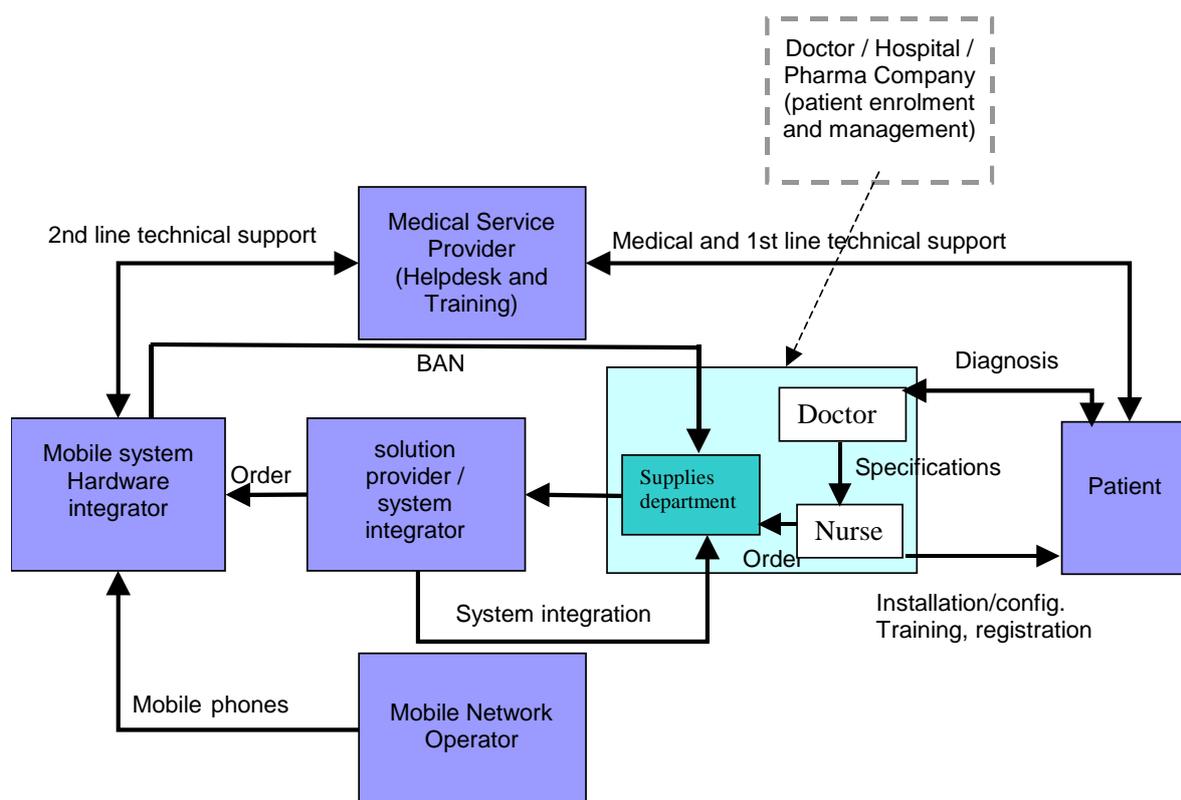


Figure 9.3: Service and supply chain

The test sites of the HealthService24 were chosen strategically so that they cover both the most commercial promising medical applications and representative European hospitals. The first trial site is in the Netherlands, at the Twente medical centre, where the focus is on high-risk pregnancies. The second site is Spain at the Barcelona provincial hospital clinic, where the focus is on COPD patients. The third site is in Cyprus, at the LITO hospital, where the focus will be on cardiac patients.

All three services have the same process workflow, since the measured vital signals are more or less the same and the service provided is identical.

9.6.2.1 High-risk pregnant women trials

The trials will use the HealthService24 to support integrated homecare for women with high-risk pregnancies. Women with high-risk pregnancies are often admitted to the hospital for longer periods of time because of possible pregnancy-related complications. Admission is necessary for the intensive monitoring of the patient and the unborn child. Homecare with continuous monitoring is desirable and can postpone hospitalisation and reduce costs, as well as offering more security for the mother and unborn child. In this trial, patients will be monitored using the patient-BAN. The maternal and foetal bio-signals will be remotely transmitted to the hospital. An additional objective of the trial will be to evaluate if such a solution postpones hospitalisation and reduces costs.

For high-risk pregnancies, MST has already a monitoring room where resident patients are monitored 24 hours per day. As a result, there is no difficulty and no additional required

personnel for the implementation of the HealthService24 trials phase 1 (P1) and phase 2 (P2). A console will be added in the monitoring room where the nurse on duty will visualize the data of the patients. In case of an incident, the nurse will contact the patient and the medical person in charge and a decision will be taken to bring the patient in the hospital or not. To be noted that in this trial the users are young and technology aware.

For phase 3 of the HealthService24 trials (HS24 v3.0) it has to be verified how the existing monitoring room can be used.

9.6.2.2 COPD-patients trials

The trials will use the HealthService24 to support remote assistance for elderly and chronically ill patients suffering from co-morbidities including the COPD. The MobiHealth nurse-BAN will be used to perform patient measurements during nurse home visits and the MobiHealth patient-BAN will be used for continuous monitoring during patient rehabilitation at home or outdoors. It is very important to facilitate patients' access to healthcare professionals without saturating the available resources, and this is one of the main expected outcomes of the HealthService24 remote monitoring approach. Measured parameters are: oxygen saturation, ECG, spirometry, temperature, glucose and blood pressure.

9.6.2.3 Cardiac patients trials

The HealthService24 will be tested by two groups of patients:

Group 1: Patients who had an acute episode and have been admitted and stabilised but need continuing monitoring of condition and drug regime for a further few days. With the HealthService24 system these patients will be allowed an earlier discharge, with an appropriate follow up (using the HealthService24) in the place of their choice.

Group 2: Patients in a suspected acute episode, brought in for examination; a decision needs to be taken whether to keep the patients at the hospital for observation, or to discharge them home. In case a patient is discharged, and there is a suspicion of an abnormal condition, the patient will be equipped with the MobiHealth patient-BAN enabling constant monitoring of the patient's state.

The support of the validation trials will require the adaptation of the existing system according to the requirements of the end-user. For this we will need to provide an operational HealthService24 system that delivers a service according to specified end-user (i.e. healthcare practitioner) requirements, and perform a feasibility study on the HealthService24 technical integration and adaptation in the healthcare provider's infrastructure. Starting with the definition of the end-user requirements (a task where the end-users have the primary role), we adapt the system according to economic criteria, the idea being to avoid a major development effort. The adaptation will focus primarily to the internationalization of the system (when needed), the configuration according to the locally available network as well as minor modifications to fulfil local requirements.