Wirhe – Wireless Solutions in Healthcare

International strategy and roadmap towards 2014

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Attaching reports

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Foreword

The wireless revolution is coming – is Finland ready?

We will live longer in the future because of better living conditions. This will create challenges in how to better take care of people. The future in Finland and other countries will depend on new innovations in healthcare sector. One piece of the solution is to adopt ICT solutions in the health care processes to reduce expenses. Efficiency in healthcare can be reached using various ICT and especially wireless solutions. Therefore, it is important to look forward and create a roadmap and strategy for how to answer to healthcare challenges in the society. The goal of this report is to propose potential answers for years 2008–2014 focusing into the use of wireless technologies in healthcare and wellness related solutions and applications.

Finland is one of the first countries facing the challenge of ageing population. At the same time, globalisation is a big challenge and huge opportunity for businesses. We have a long tradition of a well-operating and high quality healthcare system (e.g. maternity and child welfare clinics and occupational health care). The new healthcare law and structural renewals in the Finnish social and healthcare sector will give us great possibilities to renew our care processes in very innovative and citizen driven way. The adequate utilisation of wireless technologies and solutions is the key to success concerning quality and profitability in healthcare.

This report is funded by Tekes. The core values of Tekes are wellbeing, vision, trust, cooperation and development. Tekes' work is focused on three objectives: wellbeing, strong knowledge and competence base for research, and development, innovation, productivity and renewal of industries. The wellbeing objective targets to good quality of life. It includes health promotion as well as personalised and extensive care regardless of time and place. These both must be provided in a humane and socially sustainable manner. Wireless solutions will provide great opportunities to solve and facilitate these requirements and challenges in wellness and healthcare.

Wireless technologies are great enablers for citizen empowerment, development of new processes and making wellbeing and healthcare solutions accessible regardless of time and place. Still, they are just technologies. The key is to make bold decisions right now about how to develop the systems and processes related to healthcare and wellbeing.

Oct. 1, 2008

Tekes, FinnWell Program Team

Content

Wirhe – Wireless Solutions in Healthcare

International strategy and roadmap 2008 - 2014

1 Introduction

The need of an international strategy plan for wireless solutions in healthcare was originally recognised in the wireless hospital (Wilho[1]) projects of FinnWell Technology Program of Tekes in Finland. The University of Oulu was taken as responsible operator for the project which was called Wirhe. The cooperation was initiated first with University of California Berkeley in Berkeley, CA, and HealthTech Center in San Francisco, CA and spread next to Asia and Europe.

This Wirhe strategy and roadmap plan has several far-reaching aims: To increase understanding of the changes needed in the healthcare industry worldwide and how wireless and mobile solutions can be applied to enhance and improve it; to draw a roadmap with essential milestones; to plan a set of activities and efforts needed to reach the goals; to raise awareness of big challenges; and to define gaps in the process where wireless technologies can provide the solution.

About 170 experts from 15 countries participated to this roadmapping project. We used a ZEF[2] analysis method producing a report of bases, needs, vision, challenges, risks etc with 699 comments, ideas and proposals of experts. In addition, we collected a Wireless in Healthcare database including 160 products or solutions, 193 concurrent scientific and technical articles, 149 news articles during 2007-2008 and 41 conferences and exhibitions during 2008-2009.

The strategy and roadmap will be useful to 1) companies for enhancing their product and service development and marketing, 2) universities and research laboratories for focusing their research and development on the gaps found in this study and 3) decision makers of healthcare industry to enable easy adoption of wireless technologies and mobile solutions.

This strategy plan is intended to be used widely and to lead national strategies with many business opportunities to companies. It is also intended to lead to many international cooperative projects to develop standards, methods and solutions needed to build a fruitful future of wireless and mobile solutions in healthcare.

Motto: "There is nothing so powerful as an idea whose time has come." (Victor Hugo)

2 Short review on wireless in healthcare

Healthcare is a mammoth industry valued globally to worth USD 6 trillion. According to Kalorama's market study[3] USA healthcare spending alone was USD 2.3 trillion in 2007, with 8 percent CAGR (Compound Annual Growth Rate). Many global trends (aging of population, changes in environment and global climate warming) set major challenges to human health and healthcare.

Kalorama's market study forecasts rapid growth of IT and especially wireless technologies. This growth is driven by demand to enhance healthcare processes by technical products and services. Wireless technologies are seen to have huge potential. They can: improve patient care; reduce costs;

[1] www.wilho.net

[2] www.zefsolutions.com

[3] Kalorama, Wireless Opportunities in Healthcare. Kalorama Information, 2007.

streamline processes; help with regulatory compliance; and provide many other benefits. In decision making healthcare professionals need real-time access to data at the point of action for enhancing the process. Other useful applications of wireless technologies in healthcare are remote patient monitoring, e-prescription, asset management and tracking, etc.

According to above mentioned market study total market for wireless technologies in U.S. healthcare (2005) was USD 1.8 billion. It is expected to grow annually 33 percent annually through 2010, reaching a total market size of USD 7.3 billion.

Large information technology (IT) vendors including IBM, Intel, Microsoft, HP, Cisco and Google have started to focus new development on healthcare by offering new technical solutions.

IBM recommends[4] that: healthcare providers enhance management of chronic diseases and prevention of illness; consumers take personal responsibility for their health and maximize the value they get from the healthcare system; care delivery organizations and clinicians deliver higher value healthcare; and governments provide the leadership and political will power needed for innovative, sustainable solutions.

We should change our thinking from the professionals' process-based thinking and from the governments' and institutions' ROI -based thinking towards cooperative fighting against the most painful and expensive diseases such as these presented in the following table.

Table 1. The most expensive diseases in America.[5]

Disease	Patients in USA	Annual costs
Hypertension	37 million	$33 billion
Heart conditions	20 million	$68 billion
Diabetes	14 million	$28 billion
Mental Illness	31 million	$48 billion
Respiratory Ailments	50 million	$45 billion
Back problems	18 million	$23 billion
Trauma	36 million	$58 billion
Cancer	11 million	$48 billion
Arthritis and Joint Disorders	23 million	$32 billion
Total		$383 billion

Intel's research team has proposed reconceiving the disease management process[6], emphasizing development of IT solutions for chronic diseases. Patients with chronic conditions are responsible for: 83 % of U.S. healthcare spending; 81 % of inpatient stays; 91 % of prescriptions; 76 % of physician visits; and 98 % of home healthcare visits[7]. Technology is needed to strengthen patient long-term engagement in the care process. Healthcare providers can get accurate, relevant and timely information from their patients. Patients can have an intuitive, enjoyable and educational means of communication

[4] Jim Adams, Ed Mounib, Aditya Pai, Neil Stuart, Randy Thomas, and Paige Tomaszewicz, Healthcare 2015: Win-win or lose-lose? A portrait and a path to successful transformation. IBM Institute for Business Value, IBM Corporation 2006.

[5] Matthew Herper, The Most Expensive Diseases. Forbes, 2005. http://www.forbes.com/2005/04/14/cx_mh_0414healthcosts.html

[6] Intel Corporation, Reconceiving Disease Management: A Technology Perspective. Whitepaper of Intel Health, 2007. www.intel.com/healthcare

[7] Anderson G, Chronic Conditions: Making the Case for Ongoing Care. In Baltimore, MD, Partnership for Solutions, Sept. 2004. Available at: www.partnershipforsolutions.org/DMS/files/chronicbook2004.pdf

with their care team and their families. In addition to periodic mailings and phone calls, communication can occur by e-mail, videoconferences, SMS messages and other mobile services. Touch screen and other user-friendly technologies can serve people with little or no IT experience.

Wireless Healthcare's (UK) report on wireless based disease management[8] argues that wireless technologies play a key role within disease monitoring and modelling applications. In developed countries AIDS, diabetes and influenza are diseases that significantly impact healthcare providers and pharmaceutical companies.

The California Healthcare Foundation (CHCF)[9] categorizes wireless applications of healthcare in two ways: 1) Monitoring applications for cardiac, diabetic etc functions and 2) Patient communication and supporting applications. Monitoring applications can use portable, wearable or implantable sensors and work automatically. The latter applications provide patients with information and feedback directly and encourage them to take an active role in managing their health.

There are many applications available, for example, for cardiac monitoring[10] glucose monitoring[11] and multiple vital signs monitoring (portable and wearable) and even implantable monitoring integrated in pacemakers[12]. Other applications include appointment remainders, health education and promotion applications, public health alerts, compliance reminders and other treatment support and engagement applications. BeWell's Asthma Assistant[13] is just one example.

The Continua Health Alliance[14] is an extensive cooperative effort to achieve continuity in care from the developer point of view[15]. There are already 133 companies who have joined together to develop architectures, create use cases and define standards for better integrated healthcare services. They focus on three target areas: 1) disease management - managing a chronic disease outside of a clinical setting, 2) aging independently - using technology and services to live in your own home longer, and 3) health and fitness - expanding personal health and wellness to where you live and play.

Continua's ecosystem contains: sensor devices (blood pressure and glucose meters, weight scale, pulse oximeter, spirometer, fitness equipments, implanted monitors etc.); RF connectivity means (WLAN, Bluetooth, Zigbee, USB, etc.); aggregation and computation stations (PC, cell phone, personal health system etc.); and health services (healthcare provider, disease management, diet or fitness, personal health record and implant monitoring service).

On the hospital side there are many indications that wireless technologies can support improved outcomes. Solovy[16] lists ten lessons for hospitals and health systems to improve their outcome and quality: Improve patient flow, workflow and process, measure results and manage medication, use smart alerts and ubiquitous access to images, remember operation rooms and plan for the worst. Infrastructure investments are also important in addition to IT investments.

There is a great deal of research and development work proceeding worldwide to rescue healthcare from global crisis by reengineering processes, finding new service solutions and developing new technologies. Wireless technologies offer interesting new applications, but also face challenges.

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[8] Wireless Healthcare: Wireless Based Disease Management. Steinkrug Publications Ltd, 2007.

[9] Richard Adler, Health Care Unplugged: The Evolving Role of Wireless Technology. California HealthCare Foundation, 2007.

[10] http://medicalconnectivity.com/

[11] GlucoPhone, developed by HealthPia, South Korea, http://healthpia.us/

[12] Cyclos DR-T, developed by Biotronik, Germany, http://www.biotronik.de/

[13] Asthma Assistant, developed by BeWell Mobile, CA, USA, http://www.bewellmobile.com/

[14] http://www.continuaalliance.org/

[15] Randy Carroll, Rick Cnossen, Mark Schnell, and David Simons, Continua: An Interoperable Personal Healthcare Ecosystem. IEEE Pervasive Computing, Vol. 6, No. 4, October–December 2007.

[16] Alden Solovy, Ten Lessons from the Top 100. Cover 2007 Most Wired. H&HN Hospitals and Health Networks.

3 Present state of wireless in healthcare

The next analysis is based on the ZEF query and interviews which are separately reported in details[17]. The next chapters summarize the opinions of 85 experts from 13 countries covering all important groups: healthcare services, IT industry, research and supporting people.

3.1 Bases and premises

In general the experts see that the **ICT is not used efficiently in the healthcare** industry and there are **not enough useful mobile solutions** available for end users. In addition the mobile healthcare services available for professionals are **not useful enough**. All groups, people from healthcare services, IT industry, research and supporting agree on these negative statements. An example of comments: *"I have not seen an integrated total solution. There are lots of solutions tackling various different problems taking baby steps."*

The same people agree that **there is demand for wireless solutions** for professionals and wireless and mobile solutions **should be adopted more efficiently** into healthcare and they would enhance and/or improve healthcare processes. In addition the same experts believe that the customers would adapt even to continuous wireless health monitoring if they see it as sufficiently useful.

Some of the experts are concerned about the healthcare processes themselves which would need big changes. They would not like to get technology too big role. Anyway, the majority thinks positive like this one: *"Mobile solutions supported by privacy and security checks will be accepted as it will contribute to better, safer and more efficient care."*

3.2 Needs of wireless for in-hospital use

The experts see that in short term the highest need is for **alarm buttons and systems**. The highest needs both in short and long term are need for **wireless networks** themselves and need for **wireless access** to an electronic patient record system, to an electronic prescription system and to medical information. In long term also wireless sensorbelts and wristbands are also needed.

The experts coming from healthcare services see also need for wireless terminals and research experts evaluate that in long term the highest need is for implantable sensors and care actuators.

"Patients would love to have services and information access through mobile and wireless devices"

3.3 Needs of wireless for outpatient use

One need is clearly higher than any other in our list of outpatient wireless needs both on short and long range: **Home healthcare applications for special diseases**. All expert groups see it in the same way. The second is **sensorbelts and/or wristband devices for remote monitoring,** especially, in short range. Only experts from healthcare services raise **ubiquitous health services** and **rural area home healthcare applications** more important in long range. IT industry experts do not see ubiquitous health services as important as the three other mentioned above.

"Near future: remote monitoring and tele-assistance. Far future: sensor implants, implants improving body functions (for example vision, pain relieve), artificial limbs connected to neural system."

4 Vision and goals

In defining future vision and goals we used ZEF analysis to rate attractiveness and credibility of questions or matters listed on a ZEF table. The list was developed by a smaller expert group[18] starting

[17] Esko Alasaarela. ZEF-report: Wirhe – Wireless Solutions in Healthcare 2008 – 2014, Tekes 2008.

from the list of our previous wireless strategy projects. In addition, the vision and goals have been discussed in email and face-to-face interviews with about 50 experts.

List of the asked choices for cores and components of vision is as follows:

1. Wireless hospital as a core of the vision

The most important arena of developing wireless solutions in your country is inside hospitals. Hospitals will be supported by wireless networks, sensors and terminals which facilitate patients with technically high quality diagnostics and care when battling a scarcity of human resources

2. Mobile healthcare as a core of the vision

The most important arena of developing wireless solutions in your country is outside hospitals. Mobile solutions will be used to bring health services into homes, worksites and wherever end users are located. Staff would also have greater freedom of movement.

3. Integration as a core of the vision

Wireless technology must be integrated into contemporary systems so that the users can recognise its effects only as improved accessibility and usability of the services and new applications which rise from legitimate patient needs (not from technology alone)

4. International cooperation as a core of the vision

How much do you value international cooperation in developing healthcare wireless solutions? Is this credible?

5. Enhancing healthcare patient processes

Procedures include: transfer of measured data easily into the information system, accessing important information when and where it is needed, avoiding multiple booking and registering, rapid location of devices and patients when needed, etc.

6. Location and tracking technology in enhancement of health processes

Includes locating and tracking of patients and devices, as well as tracking of staff when appropriate

7. Wireless health monitoring in hospitals

8. Wireless health monitoring at homes and in worksites

9. Ubiquitous computing in healthcare industry

Ubiquitous computing is expected to enable offering of various services (measuring, identifying, locating, alarming, informing etc.) into homes, worksites, and wherever end users are located. Would this fit your vision of healthcare?

10. Comments about vision

Which objectives would be the most important to take into account?

11. Special question: Try to formulate your vision for wireless solutions in healthcare. What are the key issues? What are the key technologies? What are the expected benefits?

Matters 1-9 were called the components of vision and they were rated by 2-dimensional ZEF table with attractiveness on the horizontal axis and credibility on the vertical axis. The two last questions were answered by text writing.

4.1 Vision 2014

The result of the ZEF analysis can be seen in Fig. 1.

[18] Steve deMello and Ateret Haselkorn from HealthTech Center, Ravi Nemana from UC Berkeley, Riku Mäkelä, Kalevi Virta and Anne Turula from Tekes and Esko Alasaarela from the University of Oulu.

1. Wireless hospital as a core of the vision (69)

2. Mobile healthcare as a core of the vision (69)

3. Integration as a core of the vision (69)

4. International cooperation as a core of the vision (69)

5. Enhancing healthcare patient processes (68)

6. Location and tracking technology in enhancement of health processes (68)

7. Wireless health monitoring in hospitals (68)

8. Wireless health monitoring at homes and in worksites (67)

9. Ubiquitous computing in healthcare industry (67)

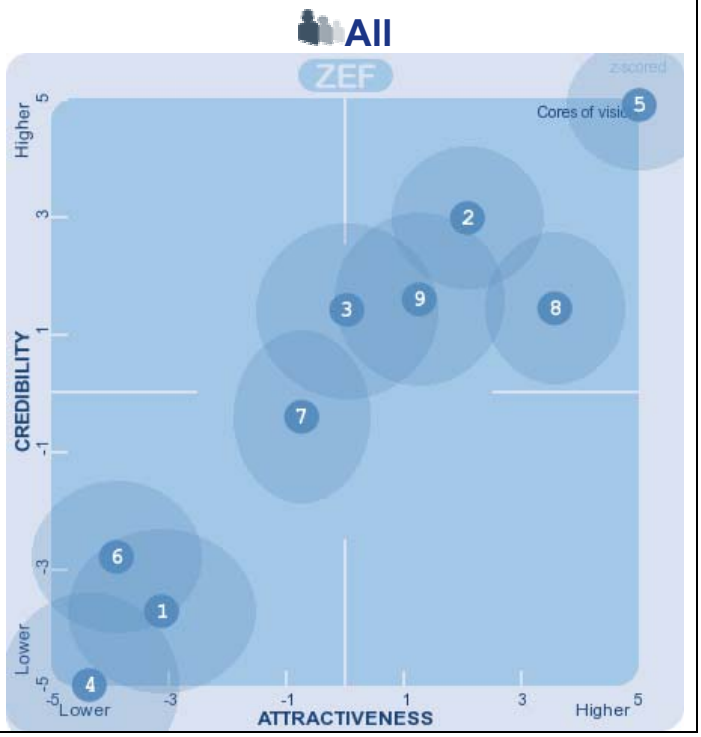

Fig. 1. The main summary of the ZEF analysis of the vision components calculated by using z-scoring to get relative results. The numbers in the chart are positioned on the average and the ellipse is proportional to deviation. The numbers left in parenthesis tell the numbers of answers in each question.

The analysis can be construed by following (after a numerous discussions with experts):

Enhancing healthcare patient processes is the most credible and attractive component of the vision. The second is **mobile healthcare as a core of the vision**. The next two are **wireless monitoring at homes and in worksites** and **ubiquitous computing in healthcare industry**. The two more: **integration as a core of the vision** and **wireless health monitoring in hospitals** are highly credible and attractive, especially, according to experts from healthcare services and research.

Although all of the original average points are situated in the upper right corner we can argue that numbers 1, 4 and 6 are clearly lower both in attractiveness and credibility than the other. Wireless hospital and wireless location and tracking can not be cores in this strategy.

Instead, the **international cooperation** should be included in it since this strategy should be international. The healthcare systems are very national by their inherent character which clarifies this evaluation result. Anyway, this analysis reveals that we have a special hard challenge to get international cooperation to work and it has to be organised and funded.

The two text questions got altogether 92 answers which strengthen and detail the interpretation. Here are two samples:

"An informed and empowered consumer is more compliant. Wireless technology facilitates monitoring at home and work. Key issues relate to privacy, security and reimbursement. The RFID, cell phones and ubiquitous technologies will continue to develop. This will significant cost savings to society as a result of better outcomes and fewer medical errors."

"Key issues: The application of wireless technologies in health care lags behind other areas. It is important to come up with a platform that can be easily integrated with the existing devices. An open platform will allow researchers to test and implement their technologies. Key technologies: PDA or smart phones enabled with wireless technology. Developing robust sensing technology. Software to

provide patients and clinicians with feedback. Expected benefits: Tremendous reduction in health care costs. Increase in efficiency of clinicians. Convenience to patients."

In short the vision is as follows:

Vision 2014

Towards 2014 healthcare will become more **mobilised** and **integrated** – close to **ubiquitous.** The **patient processes will be enhanced** and supported by **wireless monitoring and care services** at homes and worksites as well as in hospitals. Wireless technologies and mobile solutions will be applied systematically into different disease groups according to unified framework based on international development and standardisation work.

Battle against diseases is extremely complex with countless things affecting each other. New diseases emerge and pandemics create fear, new drugs must be developed, new innovations in gene technology change the playground, and so on.

Major diseases form one of the biggest healthcare costs globally. Our hypothesis is that by utilizing wireless solutions we can manage these costs more effectively. The main aim of this strategy is to offer a framework that will reveal the exact points in the health service continuum where mobile solutions will bring the most significant outcomes and improve the quality of care.

Wireless technologies in healthcare will enable, for example:

- more holistic way of considering health processes
- new opportunities due to freedom and real-time access to capturing symptoms and all information needed for immediate decision making
- development of a dedicated concept for each disease from first symptoms to complete healing or for entire lifetime
- broadening the disease management concept from single episodes to "healing management"
- preventive monitoring and caring of risk groups
- personally tailored care for each patient separately

5 Strategic focuses

What are the strategic goals we need to achieve before the vision can be realised? What should change? Which areas should we focus on? What can we organise as international cooperation on the whole? These focuses lead to work-packages in the roadmap.

5.1 Promoting of wireless and mobile solutions in national healthcare development programs

We must promote wireless and mobile solutions to national healthcare systems with arguments of usability, accessibility, mobility, real-time, savings and outcomes etc. All participating countries would need to plan their own wireless in healthcare strategies and roadmaps. Of course, this is not obligatory but would improve their opportunities to exploit the development.

5.2 International standardisation of wireless and mobile solutions in healthcare

We need to promote development of international directives and standards for wireless technology and mobile solutions in healthcare (HL7 etc.). We need to achieve global consensus on a high level to get some basic issues, for example, user and patient authentication, security of health data transmission and data storage, principles of mobile user interface, rules for responsibility of diagnostic and care errors produced by wireless and mobile solutions.

5.3 Wirhe Framework development

We need international wireless concepts[19] to fight against the major diseases with wireless supported continuum of care from preventive health management to care and rehabilitation services.

This can be done by carefully defining a framework (here called Wirhe Framework) for systematic exploitation of wireless technologies and mobile solutions in fighting against and coping with diseases (like diabetes, asthma, Alzheimer, etc.) or similar problems (like ageing, obesity, etc.). We need an overall Wirhe Framework and its modifications to each disease.

This leads to efficiency and quality, savings and outcomes which would not be possible without wireless and mobile solutions. This requires international cooperation for standards, research and product/service development.

5.4 Test-bed hospital network development

We need a network of hospitals and other healthcare service providers in each country who are ready to take new innovations in test and evaluation use. These hospitals must be open-minded to new solutions and have already outpatient services to be able to offer a continuum of care test environment.

5.5 Efficiency and quality from wireless: International benchmarking and best practise competition

We need first to define and confirm international principles how efficiency and quality rising from wireless solutions (or widely from ICT) can be measured. Many of the efficiency and quality factors can be derived from mobility of the patients and staff and wireless access of information.

We need benchmarking and best practices studies of disease management and healthcare processes in international cooperation within existing organisations and alliances like Continua Health Alliance, IHE, HL7 etc. We need to build competition to find out the best practices.

What about to establish an international “Millennium Health Prize” for top innovations in healthcare technology?

5.6 International cooperation in developing far future Ubiquitous Healthcare system and services

We need international cooperation in evaluation of future needs and brainstorming solutions for ubiquitous healthcare. There are already CHA and IHE for solving continuum of care and integration

[19] ***Concept*** here means an entity which consists of all services, systems and devices to prevent, monitor, care and rehabilitate a disease.

problems but who is looking for far future needs and solutions? And who should brainstorm the emerging mobile communication technologies in healthcare uses? A Ubiquitous Healthcare Innovator Board is needed.

6 Conceptual development – the Wirhe Framework

Future of wireless in healthcare can be seen in three ways.

1) How the healthcare processes, seen from the professionals' point of view, could be enhanced and improved by adopting mobile and wireless technologies?
2) How the health and disease management concepts, seen from the citizens' and patients' point of view, could be enhanced, improved and better adapted to their daily lives?
3) How the healthcare industry from the providers' and governments' point of view could be enhanced and improved by promoting new wireless and mobile solutions?

We should combine the professionals' process based thinking, the citizens' wellbeing and patients' disease based thinking and the governments' and institutions' ROI (Return On Investment) based thinking to cooperative fighting against the most suffering and expensive diseases and similar problems.

A healthcare process is thought to be a chain of successive activities which the healthcare professionals perform for their patient in a hospital and health centre. Broadly speaking activities of the patient's own before coming to health services and after returning back home can be considerer to belong to this healthcare process. Therefore, wireless supported healthcare processes involve most of the same activities, which the patients receive in their wireless supported disease management programs.

The disease management concept is an entity, which comprises methods, systems, services, devices and products for diagnosing, caring and monitoring a patient with a special disease during the course of the disease. Mostly the concept of disease management is attached to chronic illnesses but now we broaden it to illness episodes as well. Perhaps, it would be better to speak of "healing management concepts" or "healing support concepts".

Development of wireless supported disease management concepts needs a lot of medical and nursing knowledge. Much more than developing the devices and systems which are needed in only one phase of a healthcare process. This arises from a more holistic way of considering health processes.

Each disease needs a specific diagnosing, caring and monitoring concept, which comprises all important starting from the first symptoms or indicators and ending to no symptoms or indicators showing full healthiness. The preventive care is also needed for specific risk groups (people with genetic or environmental risks etc.).

Wireless support offers not only new chances to diagnose and care diseases in a new way but also chances to tailor the disease management concept individually for each patient. To take into account his/her special needs, wishes and situation in life. An overall goal is for all patients that they could continue their normal daily life despite of their diseases.

Public, private and self care can be seen as building blocks. They can be re-engineered to form a systematic framework (Fig. 2) for developing the wireless supported healthcare concepts. The existing wireless and mobile solutions can now be placed on the Wirhe framework.

Wireless support is very different in different diseases. It might also be tailored to meet individual patient's needs, especially, when he/she has two or more diseases at the same time.

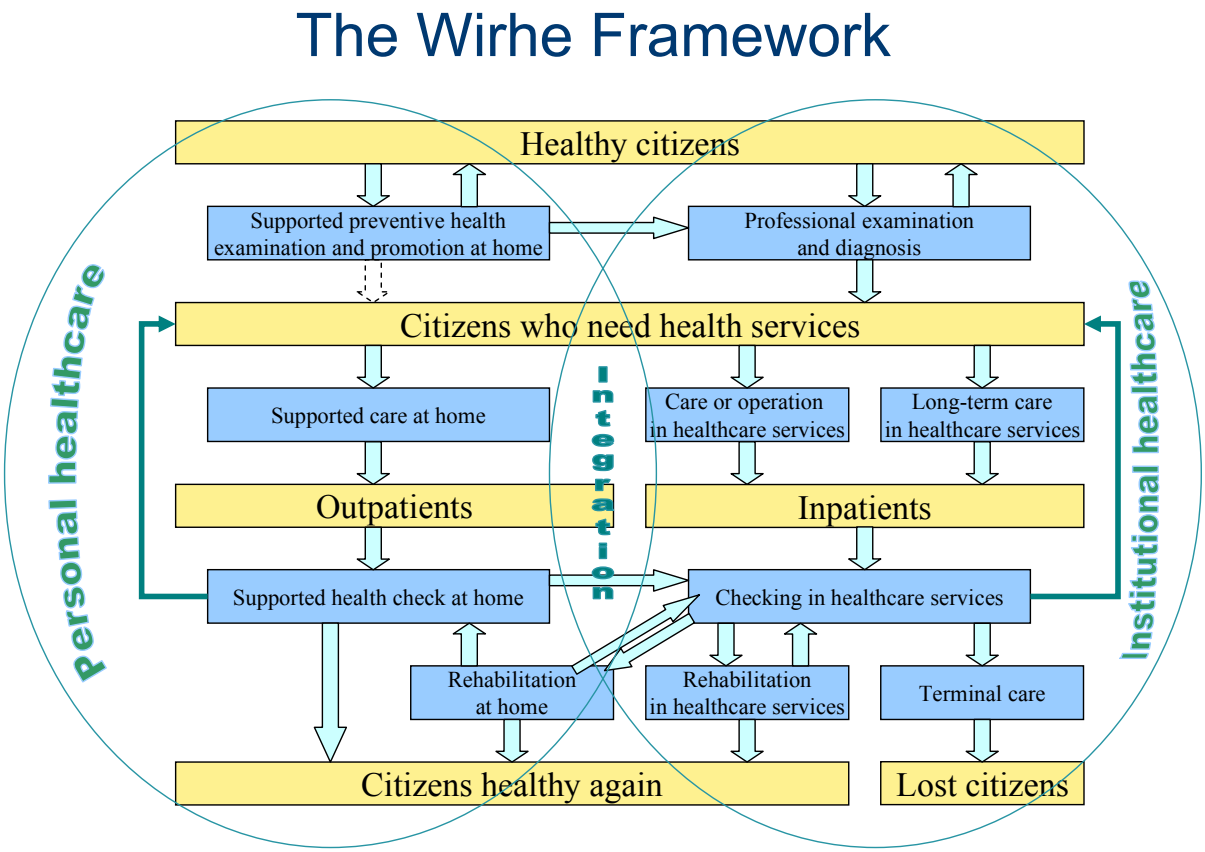

Fig. 2. The Wirhe framework shows how the patient-driven disease management (left) and the professionals-driven healthcare processes (right) will be integrated together to form unified service chain with many different paths to customers. Each blue box contains needs and both available and lacking solutions. For example, supported care at home for heart condition (arrhythmia) patient needs heart monitoring and requires wireless ECG sensor belt and a means to transmit an alert and ECG sample to a professional health service unit as soon as problems emerge in the ECG data.

7 Roadmap 2008 - 2014

What is the best path to proceed from our present situation towards our vision? Two of the 85 experts think that wireless technology is only one step in the communication path and should not be taken in any bigger role. The majority thinks that it is more like enabler; it frees staff and patients to be bound with a certain place, time or device. Many of them see it even more; it changes processes and brings new methods, processes, services, products and complete solutions. Anyway, the goal of everybody is clear: enhanced and improved healthcare.

This roadmap tells how we could help each other to proceed from present to vision by multilevel international cooperation. It does not give detailed ideas for development of technology, products, services or solutions. Companies, hospitals, universities and so on from many countries will do it in the fair competitive international business environment.

7.1 Path description

We have first to understand the present situation in each country: strengths and problems of our healthcare system and needs to improve and enhance it; technical and industrial competence of our healthcare IT companies; research competence in our universities and other research institutes; general atmosphere to adopt new technical solutions for managing health and wellness; and so on.

Next we have to define our goal, the vision, in each country. How are we going to exploit these international efforts in our country? What is our role internationally? Who are our key players? We have to ask companies, hospitals and research institutes, who would like to join us?

And next we have to plan our contribution in international consortiums which will be established for working in the planned workshops, programs and projects.

This roadmap defines only the work-packages for implementing this international strategy. There will be a lot more in national strategy plans.

7.2 Work-package program

WP1: International coordination

Objective	To implement this Wirhe strategy and roadmap on the international level
Tasks	1. To build a light but persistent organisation with facilities to work in global context 2. To promote national strategy and roadmap planning in the participating countries. 3. To organise fluent communication between participants 4. To manage international planning of programs, projects and workshops 5. To plan and promote funding for participants
Resources	Two person head quarters and one part time contact person per country (per state). Budget for travelling and networking

WP2: International standardisation

Objective	To promote development of international directives and standards for wireless technology and mobile solutions in healthcare to achieve global consensus on a high level
Tasks	1. To define needs of standards for wireless in healthcare 2. To promote standardisation committees to initiate new workgroups for wireless in healthcare 3. To plan, if needed, special independent de-facto type standards for wireless in healthcare
Resources	International project with national teams led by Wirhe headquarters. Budget for travelling and networking

WP3: Wirhe Framework development

Objective	To develop a unified Wirhe Framework for systematic exploitation of wireless in healthcare
Tasks	1. To develop the main Wirhe Framework 2. To develop specific Wirhe Frameworks for different diseases and health problems 3. To develop a web-based service to promote Wirhe Frameworks
Resources	International project with national teams led by Wirhe headquarters. Disease specific Wirhe Frameworks might be separate projects. Budget for travelling and networking.

WP4: Test-bed hospital network development

Objective	To build a network of hospitals and other health service providers in each country who are ready to take new innovations in test and evaluation use

Tasks	1. To define needs of testing and evaluation of innovations 2. To plan the role, duties and responsibilities of the test-bed hospitals 3. To plan and implement an international web-supported network where hospitals can join to start test-bed operation
Resources	International project with national teams led by Wirhe headquarters. Budget for travelling and networking

WP5: Efficiency and quality from wireless

Objective	To promote exploitation of wireless and mobile solutions in healthcare
Tasks	1. To define and confirm international principles how efficiency and quality rising from wireless solutions can be measured 2. To implement benchmarking and best practise searches and market them visibly 3. To introduce and implement an annual prize for the best innovation in wireless healthcare
Resources	International project with national teams led by Wirhe headquarters. Budget for travelling and networking

WP6: Ubiquitous Healthcare Innovator Board UHIB

Objective	To evaluate future needs and brainstorm solutions for ubiquitous healthcare
Tasks	1. To plan and establish the UHIB 2. To organise regular meetings and dissemination of results
Resources	International cooperation led by Wirhe headquarters. Budget for travelling and networking

7.3 Key players

Important key players who are expected to be active in implementing this strategy are those who have been especially active in planning it:

1. Tekes – Technology and Innovation Agency in Finland
2. Finnode – Tekes funded Technology and Innovation Offices in CA, USA
3. UC Berkeley, Citris @ Cervices and Health, CA, USA
4. HealthTech Center, CA, USA
5. University of Oulu, Finland
6. Donseo University, South Korea
7. Imperial College, UK
8. FinPro, Finland with network in 40+ countries

More key players can be found among those 100+ experts who have participated in creating this strategy plan.

Commitment is an important issue. The participants need to have roles which they feel their own and they have to benefit from participation. Therefore IPR questions and rules are important to discuss and define carefully.

Another important question is the headquarters and their role. Who is international enough to be accepted as head of the Wirhe strategy implementation? As well we need a key person in each country

to handle Wirhe strategy; and he/she should be the country head person. A sample from the experts' feedback about this question:

"If we wanted to do it right and efficiently, I'd say that first, we would want to empower an individual at the federal government level whose job it would be to get this done - in other words, there would need to be one single person accountable to the country to get stuff done and demonstrate competence and progress. That'd be #1."

7.4 Time schedule

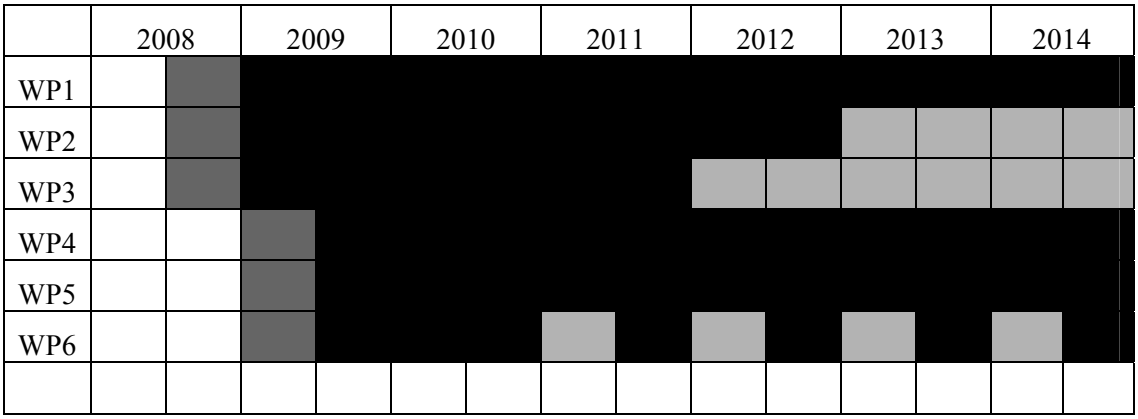

Fig. 3. Time schedule of the work-packages, where dark grey means preparation, black operation and light grey dissemination and exploitation phase.

7.5 Estimate of funding needed

	2008	2009	2010	2011	2012	2013	2014	Sum
WP1	10	200	300	300	300	300	300	**1710**
WP2	10	50	50	50	50	10	10	**230**
WP3	10	100	100	100	20	20	20	**370**
WP4		50	100	100	100	100	100	**550**
WP5		50	100	100	100	100	100	**550**
WP6		30	50	30	30	30	30	**200**
Sum	**30**	**480**	**700**	**680**	**600**	**560**	**560**	**3610**

Fig. 4. This estimate of funding (in k€) includes only the extra expenses needed for implementing this Wirhe strategy plan in max 5 countries. It does not include any development of products, services or solutions.

7.6 The next step

Next we have to discuss this strategy soundly in an international forum. We have to find a clear role for each who will join to the roadmap. This discussion can be done in different forums were healthcare is dealt. Email is also a way to do this discussion but an international face-to-face workshop would much better idea.

8 Summary

This strategy and roadmap could be useful to companies, universities, hospitals and decision makers. The companies can find new ideas for their product development and marketing efforts. They can find new ideas and opportunities to become networked internationally with each other and with other participants of the global healthcare industry.

The universities and other research laboratories can join to international cooperation and scarp their strategy of research. Hospitals and other healthcare providers can see opportunities to enhance using of their resources and improving their services.

The decision makers (governmental and local) could find wider basement for their resource allocation decisions by joining to cooperative fighting against diseases and other health problems. The commitment of payers is crucial.

Strategic international networking is a very powerful method to achieve big visions. What we have done in the mobile communication networks we can do also in mobile, ubiquitous healthcare industry.

Of course, wireless alone cannot do this all. Anyway, wireless technology can be one of the crucial cores when developing new mobile solutions and ubiquitous environment for more enhanced and improved healthcare industry in each country and even for changing our world a little bit healthier and wealthier for all of the societies and nations.

"There is nothing so powerful as an idea whose time has come." (Victor Hugo)