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ICT for Health and i2010



Transforming the European healthcare landscape

Towards a strategy for ICT for Health

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01 ICT for Health and its future



The aim of Information and Communication Technologies (ICT) for Health (also known as eHealth) is to improve significantly the quality, access and efficacy of healthcare for all citizens. ICT for Health describes the application of information and communication technologies across the whole range of functions that affect the health sector. The European Commission has been supporting research activities in ICT for Health for the last two decades. This has placed Europe in a leading position in the use of regional health networks, electronic health records in primary care and deployment of health cards. These developments have contributed to the emergence of an "eHealth industry", which has the potential to become the third largest industry in the health sector, after the pharmaceutical industry and the medical device and imaging industry. By 2010, eHealth spending is expected to account for up to 5% of the total health budget of the European Union's Member States¹.



¹eHealth. *Health Information Network Europe. Final report*, Deloitte and Touche, 2003.

02 The need for a new landscape in European healthcare

Healthcare systems around Europe are facing major challenges related to chronic diseases, demographic changes, nursing shortages, medical accidents and rising costs. The proportion of people over 65 is expected to almost double by 2050². More elderly people will require prolonged medical care and assistance to ensure they live independently.

Action is required at all levels to change the way healthcare is delivered

Furthermore, chronic diseases are on the increase, as are their management costs. All these factors are starting to place additional strain on European healthcare systems. By 2050, average public spending for health and long-term care in countries of the Organisation for Economic Co-operation and Development (OECD) may rise to 10-13% of the Gross Domestic Product³. The emerging situation will not be sustainable unless action is taken at all levels to **change** the way healthcare is delivered.

Traditional healthcare institutions offer treatment mainly on the basis of disease symptoms. This approach is associated with high costs and a reduced quality of life for patients. Even though the advantages and benefits of preventive healthcare are widely recognised, current health systems in countries of the OECD invest only a fraction of their expenditure (merely 3% on average³) in prevention of diseases⁴. Moreover, most healthcare services are delivered inside medical premises. Despite being built for acute events, many hospitals allot a significant number of their beds to chronically ill patients, with considerable cost consequences. Efficient remote monitoring and care are thus required.

There is an urgent need to manage health risks and reduce the incidence of avoidable deaths

Evidence suggests that every year hundreds of thousands of deaths worldwide are attributed to medical accidents, adverse drug effects and preventable injuries. The **majority** of these deaths are due to communication difficulties in the healthcare process and lack of information on patients' medical history. In the USA, it is claimed that more deaths are attributed to inappropriate medical decisions than to motor vehicle accidents, breast cancer or AIDS⁵. There is thus an urgent need to manage such health risks and reduce the incidence of avoidable deaths. In addition, current healthcare services and solutions in Europe are rather fragmented. This fragmentation is detrimental to patients (limiting mobility and

A strategy to promote the transformation of the healthcare landscape in Europe

raising risks from preventable medical accidents), health professionals (making access to health records difficult) and industry (reducing the market share).

In recognition of these challenges, the ICT for Health Unit of the Directorate-General Information Society and Media has adopted a strategy to promote the transformation of the healthcare landscape in Europe. This strategy entails a blend of research and policy activities, under the Seventh Framework Programme and the eHealth Action Plan. It is part of the Commission's new strategic policy framework **i2010** "A European Information Society for growth and employment"⁶ and aims to meet important societal challenges like:

- **Enable access to best quality care** for all European citizens.
- **Facilitate independent living and lifestyle management**, addressing also the needs of specific groups such as elderly people and children.
- **Provide safer healthcare**, avoiding unnecessary medical accidents and adverse events.
- **Improve the efficiency and efficacy** of health systems.

²Eurostat news release 48/2005, 8 April 2005.

³Projecting OECD health and long-term care expenditures: what are the main drivers?, Economics Department working papers no. 477, OECD, 2006.

⁴Health at a Glance: OECD Indicators, OECD, 2005.

⁵To Err is Human: Building a Safer Health System, Washington DC, Institute of Medicine, 2000. Experts consider that the figures are likely to be of a similar magnitude throughout Europe.

⁶http://europa.eu.int/information_society/europe/i2010/i2010/index_en.htm

03 eHealth activities and orientation

Policy activities and support to deployment of eHealth services

In 2004, the Commission launched an Action Plan for a European eHealth Area that focuses on implementation and deployment aspects of eHealth systems in Europe. The main objective of this eHealth Action Plan is to enable easy and equal

Enable access to the patient's electronic health record from anywhere in Europe, whenever required

access to quality healthcare for all citizens in any place and at any time in the European Union.



On the one hand, this objective consists of developing on-line systems for empowering citizens to access health knowledge for their information and education – similar to a "Google"⁷ for Health. On the other hand, it involves support for growing citizen mobility. This, in turn, will eventually require interoperability among healthcare services at any geographical level. The Action Plan advocates the development of interoperability approaches for patient identifiers, medical data messaging and electronic health records. The ultimate goal is to enable access to the patient's electronic health record



and emergency data from any place in Europe, even outside a citizen's country of origin or residence, whenever this is required.

Interoperability will also have a profound impact on eHealth industry. While important strategic European companies are involved in this field, the majority of companies in this industry are small and medium-sized enterprises whose survival depends on the establishment of interoperable solutions.

The majority of the eHealth industry is made up of small and medium-sized enterprises, whose survival depends on the establishment of interoperable solutions

The activities under the eHealth Action Plan are expected to :

- Stimulate investment and beneficial deployment of eHealth solutions across Europe.
- Lead to extensive deployment of health information networks.
- Enable citizens to access quality health knowledge on-line.
- Provide integrated and interoperable eHealth services with full access to citizens' complete medical history and data from anywhere in Europe.
- Attract more industrial players and expand the eHealth market, which is currently one of the fastest growing ICT sectors.

⁷ While the term "Google" refers to a particular brand of search engine, the notion advocated here is of an extremely powerful, comprehensive and well-coordinated search engine that would provide a wealth of health information to Europe's citizens, health professionals and practitioners, and

designated and attributed health providers. The concept was first outlined in a document published in October 2005 by the Dutch Ministry of Health, Welfare and Sports *Better care thanks to better information - An introduction to the National ICT Institute for Healthcare.*

eHealth research and development activities



During the Fifth and Sixth Framework Programmes, ICT for Health supported research into systems for improving the understanding of diseases and enabling greater involvement of citizens in healthcare delivery. These efforts are the stepping-stone for the upcoming activities under the Seventh Framework Programme. These new activities aim to support a restructuring of health delivery systems in Europe.

This restructuring entails a two-fold paradigm shift:

- a) from **symptom-based** to **preventive** healthcare and
- b) from **hospital-centred** to **person-centred** health systems.

A paradigm shift from symptom-based, hospital-centred to preventive, person-centred health systems

Achieving this paradigm shift will ensure continuity of care at all levels, from prevention to rehabilitation, and at all places where citizens or patients may need care, whether inside clinical settings or in ordinary living and working environments (*"follow me" healthcare*). It will also enable provision of **personalised care**, from lifestyle and health status management to individualised medicines and treatment. ICT for Health can be instrumental in supporting this paradigm shift by developing systems and services to:

- Accelerate the advancement of medical knowledge and improve the understanding of disease-related processes.
- Empower citizens to become actively involved in managing their own health status.
- Improve prevention and early diagnosis of many diseases, thus reducing overall healthcare costs and improving the citizens' quality of life.
- Enhance patient safety.
- Enable cost-effective management of chronic diseases.
- Facilitate active ageing and independent living for the ageing population.

The proposed research activities are associated with three major orientations:

- Prediction, prevention and management of diseases.
- Management of health risks.
- Infrastructure for biomedical research and applications.

All these activities come under the umbrella of the **i2010 policy framework** and are particularly relevant to its Research and Innovation, Independent Living and eInclusion aspects.



Prediction of Diseases

Research activities which develop capabilities for disease prediction are mostly concerned with the topics of Biomedical Informatics, Virtual Physiological Human and Molecular Imaging.

Biomedical Informatics is a multidisciplinary field that builds on the synergy between bio-informatics and medical informatics. It provides a framework for developing, integrating and sharing biomedical knowledge from very different research disciplines such as genomics, proteomics, clinical research and epidemiology. Biomedical Informatics deals not only with the integration of health related data on different levels (molecular, cellular, tissue, organ, person and population), but also with computationally-demanding tasks of data mining, modelling, simulation and visualisation. New therapies and interventions are now being developed for predicting the onset of diseases and more accurate diagnosis. Undoubtedly, these innovative approaches rely on efficient use of the vast amounts of data generated in laboratories and clinics. *Biomedical Informatics* aims therefore at integrating knowledge from the latest discoveries in biology, medicine and ICT so as to enable effective disease prediction, prevention and treatment.



The flagship activity in the area of Biomedical Informatics is the development of a computational framework for multilevel modelling and simulation of human anatomy and physiology, the **Virtual Physiological Human**. This concept is the "grand challenge" for several disciplines at the crossroads of ICT and biosciences. Its ultimate goal is to enable scientists and medical to know as much as possible about the "real physiological human" by tackling all areas of human anatomy and physiology and integrating data from all levels. It also endeavours to enable the transition to personalised healthcare, based on the use of models, simulation and visualisation techniques for predicting the outcome of interventions (surgical and pharmacological) on the individual. *Virtual Physiological Human* can also assist the design of targeted implants and artificial organs for the individual, as well as the discovery of innovative personalised drugs.

The Virtual Physiological Human is the "grand challenge" for several disciplines at the crossroads of ICT and biosciences

Molecular Imaging holds promise not only for prediction and early diagnosis of diseases, but also for therapy and, ultimately, provision of personalised medicines and care. It enables visualisation and treatment of very small biological processes that may result in pathologies like cancer cells. The work so far has concentrated on the most imminent and fundamental technological needs, like imaging probes, imaging technologies and fusion of imaging data from multiple sources. Focused ICT research can help reap the potential benefits of Molecular Imaging e.g. through development of ICT tools to enhance the understanding of molecular images, link molecular images to decision support systems, and enable use of virtual human models for more efficient and personalised drug development.

Prevention and Management of Diseases



Research on **Personal Health Systems** is the main vehicle for enabling disease prevention and management. *Personal Health Systems* may be in the form of *wearable, implantable or portable health systems*, as well as in vitro Point-of-Care diagnostic devices. They can empower citizens to adopt an active role in managing their own health status and help them with health-related education. In doing so, *Personal Health Systems* encourage preventive lifestyle and facilitate early diagnosis of diseases. *Personal Health Systems* enable remote health status monitoring on a continuous basis, and can also assist health status maintenance and

Educating citizens on health matters

Citizen empowerment to adopt an active role in managing their own health status

remote management of chronic diseases. In these respects, Personal Health Systems are also central to achieving the systems and services that can facilitate **active ageing** and **independent living** for all Europeans, in line with the i2010 flagship initiative on ageing society.

In the Seventh Framework Programme, it is proposed to develop Personal Health Systems that focus on non-invasive, multi-parameter health monitoring; multi-analyte screening; disease management within the citizens' ordinary living environments; and substitution of missing or degraded organ functionality.

The proposed research includes development and integration of biosensors, wireless communications, control and processing units, knowledge-based systems and algorithms for decision support into wearable, implantable and portable systems. Telemedicine support services based on integrated or converged mobile, wireless and fixed communications is also incorporated to provide citizens and patients with direct interaction with healthcare providers. Wearable, portable or implantable artificial organs would, in particular, increase substantially the mobility, autonomy and independence of people with missing or malfunctioning organs.



Management of Health Risks

The need to manage health risks and improve patient safety is becoming a priority issue on the health agenda. Health risk and patient safety aspects should therefore be taken into account by all eHealth solutions. This challenge calls for the development, validation and uptake of ICT applications that will create a culture of security in eHealth and improve the management of health risks and patient safety. Such activities are key contributions within the i2010 framework, in fields like high-quality public health services, quality of life and world-class performance in innovation.

Create a culture of security in eHealth and improve the management of health risks and patient safety



Data mining techniques, adverse event reporting systems, risk assessment algorithms and decision support algorithms applied to data in electronic health records can save lives by preventing adverse drug reactions and risky procedures. Virtual clinical trials can also reduce the risk for participants in such trials.

Furthermore, health pathway models, encompassing a citizen's or patient's passage through clinical pathways, will enable prior identification of all the possible risks that could threaten a person's future health. Modelling and simulation of health pathways and patient profiles can determine quantitatively the risk associated with each treatment or operation and optimise the pathway from sickness to well-being.

Research on ICT tools for monitoring and risk management of large-scale events, like the spread of pandemic diseases or the occurrence of bio-terrorist attacks, is also crucial. It will create a better response to threats through provision of better information, but it could also play a key role in resource planning and management.



Infrastructure for biomedical research and applications



The main infrastructure for supporting initiatives on biomedical research and applications is the notion of HealthGrid. HealthGrid relates to the use of Grid technologies in the biomedical field. It represents not only access to and sharing of large distributed data sources, but also a high-performance, high-throughput infrastructure for computationally-demanding applications and a problem-solving environment for biomedical research and patient care. From the perspective of healthcare provision, HealthGrid offers considerable promise to support the deployment of health information networks and play a role in interoperability standardisation activities.



The vision of HealthGrid requires close collaboration between projects developing Grid middleware, deploying Grid infrastructures and supporting end-user biomedical Grid applications. In the Seventh Framework Programme, HealthGrid will represent an enabling technology for many research fields in eHealth. This is particularly applicable to the domain of *Virtual Physiological Human* and for technical and semantic integration of data.

04 Achieving a new European healthcare landscape

The way healthcare is presently delivered has to be deeply reformed. It is costly in terms of financial expenditure and the current quality is suboptimal. The situation is becoming unsustainable and will only worsen in the future as chronic diseases and the demographic change place additional strains on healthcare systems around Europe.

These challenges together with the requirement for access to high quality, safe and cost-effective medical care at the point of need, call for a **new healthcare delivery model** based on **preventive** and **person-centred** health systems. This new model can only be achieved through proper use of ICT, in combination with appropriate organisational changes and skills. It will introduce **a new landscape in European healthcare**, in which individual citizens are placed at the centre of healthcare process and are strongly encouraged to participate actively in it.

A new healthcare delivery model, based on preventive and person-centred health systems, which can only be achieved through proper use of ICT



To promote this transformation of the European healthcare landscape, the ICT for Health Unit has adopted a strategy that is in line with the Commission's new policy framework i2010. The approach builds upon the eHealth Action Plan and involves forward-looking research under the Seventh Framework Programme.

In this new scenario, **continuity of care** will be assured at all points of need, whether in hospital settings or in ordinary living environments. This continuity will be facilitated by the deployment of **interoperable eHealth services** across Europe, which enables access to a patient's medical history and data from any

location. Moreover, the new healthcare landscape will be characterised by enhanced **patient safety** and **personalised care**, based on:

- Management of health risks.
- Disease prediction, prevention, early diagnosis and management.
- Individualised medicines and treatment.

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