

# The IPTS REPORT

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## A B O U T T H E I P T S R E P O R T

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*The Report is produced simultaneously in four languages. The master copy is in English and translated versions are produced in French, German and Spanish. The fact that it is not only available in several languages, but also largely prepared and produced on the Internet's World Wide Web, makes it quite an uncommon undertaking.*

*The Report publishes articles in numerous areas, maintaining a rough balance between them, and exploiting interdisciplinarity as far as possible. Articles are deemed prospectively relevant if they attempt to explore issues not yet on the policymaker's agenda (but projected to be there sooner or later), or underappreciated aspects of issues already on the policymaker's agenda. The multi-stage drafting and redrafting process, based on a series of interactive consultations with outside experts guarantees quality control.*

*The first, and possibly most significant indicator, of success is that the Report is being read. The issue 00 (December 1995) had a print run of 2000 copies, in what seemed an optimistic projection at the time. Since then, readership of the paper and electronic versions has exceeded the 50,000 mark. Feedback, requests for subscriptions, as well as contributions, have come from policymaking (but also academic and private sector) circles not only from various parts of Europe but also from the US, Japan, Australia, Latin America, N. Africa, etc.*

*We shall continue to endeavour to find the best way of fulfilling the expectations of our quite diverse readership, avoiding oversimplification, as well as encyclopaedic reviews and the inaccessibility of academic journals. The key is to remind ourselves, as well as the readers, that we cannot be all things to all people, that it is important to carve our niche and continue optimally exploring and exploiting it, hoping to illuminate topics under a new, revealing light for the benefit of the readers, in order to prepare them for managing the challenges ahead.*



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### Special issue: Aspects of eHealth

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mHealth will lead to a huge increase in the amount of medical data being gathered and processed, shifting the balance in the doctor-patient relationship and encouraging recourse to automated decision-making, thus raising numerous policy issues.

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#### 27 Skills and Competencies for the Future of eHealth

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#### Erratum

There was an error in the format of the graphs in the article entitled "Land Area Requirements to Meet the Targets of the Renewable Energy policies in the European Union" by Boyan Kavalov (IPTS), which was published in issue 80 (December 2003). The corrected graphs are shown at the end of this issue.

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## EDITORIAL

# eHealth and the Ageing Society

Marcelino Cabrera, *IPTS*

**E**Health, the combined use of information society technologies (ISTs) in the health sector, is moving up health policy agendas at the European, national and regional levels. Productivity gains from the optimization of healthcare systems and achieving cost reductions are prime goals, while healthcare providers, health insurance organizations and politicians at all levels (EU, national, regional) are drawing up plans to support healthcare by means of the application of modern ISTs. In particular, EU policy has set up specific action plans (eEurope2002 and eEurope2005<sup>1</sup>) to contribute to the development of eHealth across the EU and thereby achieve some of the ambitious goals of the *Lisbon strategy* decided at the European Council in Lisbon in March 2000<sup>2</sup>.

eHealth is an empowering tool for European citizens and, in the context of an ageing society, for active independent living by older people in an enlarged European Union with considerable income disparities and heterogeneous healthcare systems. In this Special Issue, the topics discussed are in one way or another related to the context of an ageing society, while highlighting bottlenecks and prominent technological trends that need policy attention.

Health and social care for the elderly can be provided with new services based on appropriate ISTs, such as so-called "independent living" services. However, policy-related technological and organizational aspects of strategic plans are key

factors for success in satisfying the real needs of the elderly. The cost-effectiveness of new assistive technologies enabled by mobile and "ambient" systems, wearable and embedded devices, as well as new business and services provision models, will need to be assessed.

The case of emerging mHealth services (mobile health) is illustrative for its potential impacts on the financial and liability schemas since insurance systems may have to accommodate new expenses as a result of services delivered by mobile phone providers. Also, mHealth services will have implications for the provision of care itself, resulting in changing paradigms for healthcare professionals and patient-clinician relationships.

When combined with location data processing, mobile terminals will improve eHealth possibilities. Clearly these services will rely not only on location information, but also on the mobility of the terminals. However, before widespread use can be made of location-based healthcare services, a number of privacy issues will have to be addressed. The potential large-scale tracking of ordinary citizens (whether deliberate or incidental) will certainly raise ethical concerns that could cause delays in the deployment of these services, thus postponing the realization of their benefits.

The privacy issue can be extended to what it is agreed will become the central piece of information around which many citizen-oriented eHealth

*The views expressed here are the author's and do not necessarily reflect those of the European Commission.*

applications will be developed, i.e. the electronic health record (EHR). With the EHR, it will be possible to enable access to relevant information, collaboration between healthcare providers and telecare more effectively. However, confidentiality and privacy are critical issues that will need widespread consensus among all stakeholders (public authorities, medical professionals and citizens). The EHR, as the cornerstone of many developments in this field, undoubtedly deserves focused and coordinated actions at all levels, including EU-level.

One important, but often under-emphasized, prerequisite for the introduction of new ISTs in the health sector is the acquisition of new types of skills by citizens, patients, doctors, nurses and other healthcare professionals. Without human resource development through appropriate education and training, healthcare faces major obs-

tacles to the crucial knowledge-sharing process. This is particularly relevant considering the underinvestment in training and education that is endemic in the health sector.

The above-mentioned topics –and there are many others not discussed here due to space limitations- suffice to give an idea of the challenges that eHealth raises, particularly for time-pressed policy-makers, who need to grasp at a glance the various scientific and technological, economic, political and social dimensions. In this context, roadmaps are valuable ways of presenting and analysing the causal and temporal relations between successive or parallel steps. Equally valuable are the results from existing foresight exercises. These results can help to gain a better understanding of the expected evolution of the demand side of eHealth during the next two decades.

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### Notes

1. [http://europa.eu.int/information\\_society/eeurope/2005/index\\_en.htm](http://europa.eu.int/information_society/eeurope/2005/index_en.htm)
2. European Council meeting in Lisbon set an ambitious objective for Europe to become the most competitive and dynamic economy in the world. To achieve this, the Council later endorsed the above mentioned action plan entitled “eEurope – An Information Society for All”.

## The Challenges to the Medical Decision Making System posed by mHealth

Andrzej M. Skulimowski, *Progress & Business Foundation, Poland*

**Issue:** The classical medical paradigm assumes a personal relationship between patients and medical practitioners. This relationship is reflected in the way medical infrastructure has evolved to be tailored according to the availability of medical staff. Mobile health will have a twofold impact on health care: it will imply changes in the way healthcare is financed and a move towards unification between professional medical care and so-called "home medicine".

**Relevance:** mHealth will enable the number of medical readings taken at any one time to be increased considerably. This creates a need to integrate automated mobile medical systems into a new concept of healthcare policy and will have an impact on policy regarding medical insurance, medical liability and the funding and provision of medical care.

### Introduction

**M**Health (mobile health) is one of the major challenges being faced by both medical practice and healthcare policies. The impact of mHealth is likely to be more far-reaching than other developments such as nanomedicine and genetic therapy as it will create an urgent need to review the way healthcare is financed and blur the boundaries between professional medical help and so-called "do-it-yourself" medicine (i.e. minor treatment or self-medication without consulting a physician, but based on previous medical treatment experience, popular medical literature, or a pharmacist's advice). On current trends, mHealth systems will be more widely offered by mobile phone providers, and simple, yet important functions may even be

offered as built-in features of mobile phones. This, in turn, will imply that technology providers account for a larger than ever share of the total value of medical services. Consequently, systems for the provision of medical care may have to accommodate new expenses, incurred by services from outside of the traditional healthcare system.

On the other hand, the classical medical paradigm assumes a one-to-one (or more) relationship between patients and medical practitioners when making a medical diagnosis or another relevant decision concerning therapy or prevention. This relationship has been reflected in the medical infrastructure, which is tailored according to the availability of medical staff. mHealth would make it possible to drastically increase the number of medical readings taken at any one time, as the patient is

*The classical paradigm of a one-to-one relationship between patients and doctors is likely to be challenged by the widespread adoption of mHealth.*

*The views expressed here are the author's and do not necessarily reflect those of the European Commission.*

no longer bound by a direct link to a physician or nurse. It is expected that the number of persons using mHealth-based monitoring or therapy will soon exceed the number of medical personnel monitoring the use of mHealth equipment. This will create an urgent need to use automated medical diagnosis systems and to re-think the concept of physician-based healthcare. Furthermore, technological developments could make new policy measures necessary, especially regarding regulation of issues such as medical insurance and liability, and concerning the financing of medical services offered by electronic media providers.

While medical expert systems have been the subject of intensive R&D for several decades, they are still regarded as tools supporting decisions finally made by medical professionals. The large number of mHealth systems may mean that the number of decisions that needs to be made simultaneously far exceeds the capacity of existing medical procedures. This could lead to an incremental transfer of medical competencies to artificial-intelligence-based systems, starting with the simplest (or least controversial) decisions and eventually leading up to those involving processing large data sets and involving a degree of risk.

Although the ageing of European societies will lead to an increase in the absolute number of those needing continuous medical monitoring, older patients may, nevertheless, continue to show an above average resistance to "depersonalized" medicine. However, there is likely to be a tipping point some time in the future, after which development of automated medical decision-making systems will move much more quickly, thus changing the medical paradigms and influencing patients' habits and expectations. The corresponding scenarios, showing the possible future developments and bifurcation points in the future of European healthcare are discussed at the end of this article.

### **Mobile health: The present state-of-the-art, classification and current trends**

The emergence of new medical technologies results in changes in medical terminology and may sometimes lead to confusion. In the older medical literature mHealth usually meant "mental health", sometimes "men's health". Today mHealth (or m-health) is widely accepted as an abbreviation used to mean "mobile health", which – in turn – usually means "medical services for a spatially unbound patient". Sometimes, especially in US sources, this notion is expanded to embrace the idea of a "spatially unbound physician (or other medical personnel)", e.g. a physician using a PDA to consult medical databases during the examination of a patient. For the sake of clarity, and to concentrate on the policy and social implications of mHealth, we will adopt here the first interpretation only.

Another medical term, which has acquired considerable popularity, is telemedicine. Despite the fact that it is often confused with, or used interchangeably with mHealth, its meaning is different as it focuses on the transfer of medical data, particularly medical images. While the use of tele-medical technologies does not assume a moving or unbound patient, there is one important common point with mHealth, namely the fact that medical diagnosis takes place remotely. Conversely, virtually all mHealth applications involve the tele-transmission of certain medical data, although one can also imagine autonomous mHealth systems, whereby a treatment decision follows an automated diagnosis, and the therapy or a preventive action is undertaken by an autonomous mobile medical system equipped with diagnostic devices serving as a source of data.

Based on the definitions given above, mHealth systems can be classified according to the characteristics of the source and destination of the medical information flow:

*A rapid increase in the number of people whose health is being monitored by mHealth technologies is likely to lead to a gradual automation of many medical decision-making processes*

*mHealth is about monitoring the health status of, or providing treatment to, people who are on the move*



*Early demand for mHealth will come from patients with conditions such as heart disease, diabetes and asthma*

- patient to (medical) supervisor,
- patient to physician,
- physician to physician,
- physician to expert system,
- patient to medical CRM system (management of patients and medical interventions).

Depending on the target group mHealth systems can be classified as follows:

- mHealth for hospital patients (i.e. moving within prescribed strict spatial limits),
- mHealth for healthy people (preventive mHealth),
- mHealth for the chronically ill or vulnerable individuals.

mHealth for medical personnel would fall outside of the above categories, but – as already mentioned – we will not study this case here, concentrating instead on the direct impact of new m-diagnosis and m-therapy technologies on patients.

Another classification, which derives from the technology used in mHealth systems is given in Table 1.

More technological details can be found on the numerous web sites devoted to mHealth<sup>1</sup>. A typical mHealth system, which is a subject of this paper is presented in Fig. 1.

Finally, the future development of mobile health will be driven by its ability to respond to the

needs of the target groups, seeking location-independent diagnosis, monitoring or therapy. Priority for mHealth services is likely to be given to the following health conditions:

- cardiovascular system diseases, especially those at risk of a heart attack,
- diabetes,
- bronchial asthma, especially its acute forms.

Elderly people will generally need mHealth-based monitoring, even if their health is satisfactory, forming thus an intermediate group between mHealth focused on the sick, on the one hand, and preventive mHealth, on the other.

Preventive mHealth will address also healthy people at risk, such as:

- airline pilots and bus drivers,
- sportsmen,
- workers working in extreme or isolated environments (such as sailors),
- policemen and soldiers,
- public figures,
- prisoners,

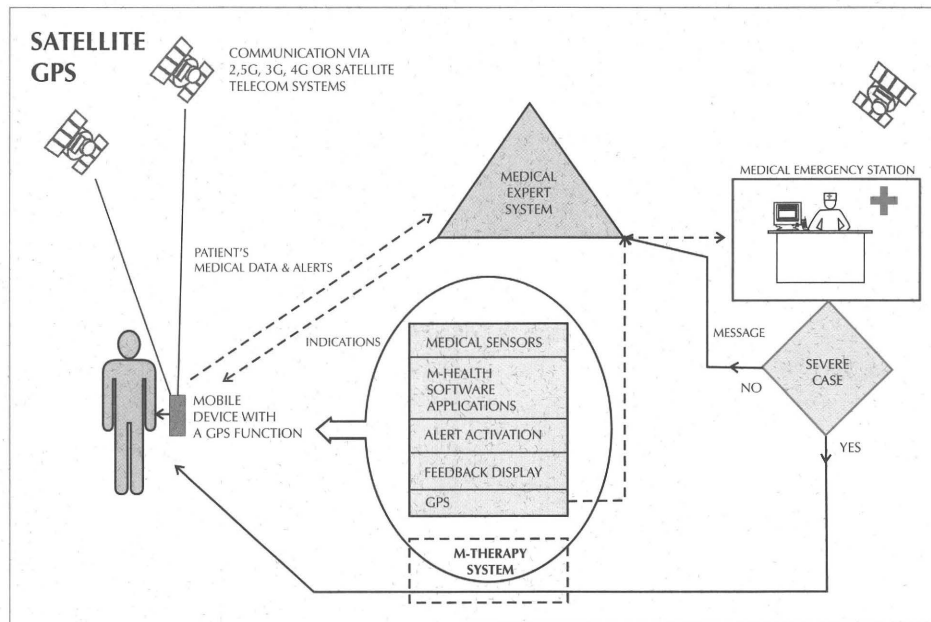
and other groups who face a subjective or objective sense of risk of injury or an acute disease.

Unlike mHealth systems targeted on the sick and elderly, preventive mHealth will focus on detecting injuries, accidents and heart attacks or strokes. Military mHealth applications are more specialized and therefore fall outside the scope of this article. Nevertheless, military mHealth techno-

**Table 1. Classification of technologies currently used for mHealth**

m-technology	transmission rate per mobile application			
	local: Bluetooth	local to medium range: WLAN 802.11a/b	long range: GSM/GPRS, CDMA	long range: UMTS
No of applications served by m-device				
single application	< 1 Mbaud	2 to 54 Mbaud	10 to 115 kbaud	0.144 to 2 Mbaud
multiple applications	< 1 Mbaud	1 to 27 Mbaud	< 10 kbaud (of guaranteed transmission capacity)	< 1 Mbaud

**Figure 1. Patient-oriented mHealth system**



logy will continue to play an important role, while civilian mHealth systems are being developed

Current mHealth devices are able to continuously monitor an individual's pulse and blood pressure, detect breathing abnormalities associated with bronchial asthma and other chronic respiratory system diseases. Sleep disorders also seem to be one of the main areas in which there is considerable experimentation with mHealth techniques. Home observations with mobile equipment are often the only practical approach that is convenient and acceptable for a large number (up to 40% of the European population suffer from some form of sleep and/or breathing disorder) of potential patients. Continuous monitoring of heart and brain functions (m-ECG and m-EEG) is possible from the technical point of view, yet difficult, due to the presence of so-called artefacts, i.e. various perturbing signals and noise. Therefore the appropriate signals are usually measured and transmitted at regular intervals instead. Similarly, monitoring blood content is both inconvenient and unnecessary, since it does not change rapidly under normal circumstances. For mHealth appli-

cations, e.g. those already widespread in diabetes, there are mobile devices allowing incidental blood analyses to be made and transmitting the results to the medical supervisor (a physician, a database, or an automated diagnosis system). Continuous blood content monitoring as well as real-time medical imaging may be useful in a hospital environment, especially when monitoring the impact of pharmacotherapy, pre- or post-operative patients and recovery processes without affecting the mobility of patients inside the hospital.

The rapid progress of telemedical systems and mHealth is a phenomenon of the last decade and it has no doubt not yet reached its culmination. Results achieved so far include the definition of a medical information transmission protocol (DICOM – Digital Image Communication) and the emergence of numerous professional telemedicine applications and the first large-scale public mobile systems offered by mobile telephony providers. The huge market for medical services, so far monopolized by incumbent healthcare organizations, will soon be invaded by low-price mobile medical services providers, using medical personnel only

*Current mHealth devices are able to continuously monitor an individual's pulse and blood pressure and to detect breathing abnormalities*

Information and  
Communication  
Technology

*The next stage in the development of mHealth is likely to involve more widespread use of lower-cost systems with less direct involvement of medical practitioners*

*One of the key benefits of mHealth is its ability to shorten the time taken to identify and react to a medical emergency. More advanced systems may one day even be able to start initial treatment before medical assistance arrives*

for operational and incidental tasks. The impact of this process on the European healthcare policy and social attitudes towards medicine will be outlined in the next section.

**Mobile health: the future technology development and its implications on policies and social perception of health care**

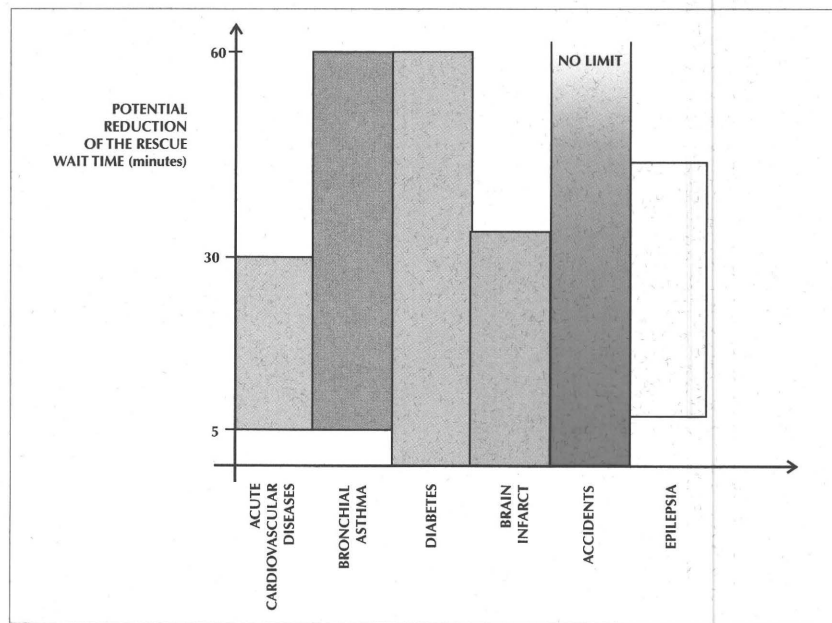
The implications of mHealth systems on health care are closely connected to the continuous evolution of medical techniques. They may be characterized by their shortening to a minimum the time taken to provide medical assistance to those in need. Currently, an m-diagnostic system with an alert function may make it possible for the device to call for medical aid sooner than the patient or his/her family or friends could. In many cases, especially when cardiovascular diseases are concerned, time is critical for the patient's survival. A more advanced system may be equipped with an auto-

nous m-therapy function, which could allow emergency action to be taken, such as delivering a nitro-glycerine injection, even before medical assistance arrives.

Figure 2 shows the estimated reduction in the expected time taken for assistance to arrive when using mobile diagnostic systems. The estimated increase in the survival rate for some major groups of patients when using m-diagnostic and m-therapeutic systems is shown in Fig.3.

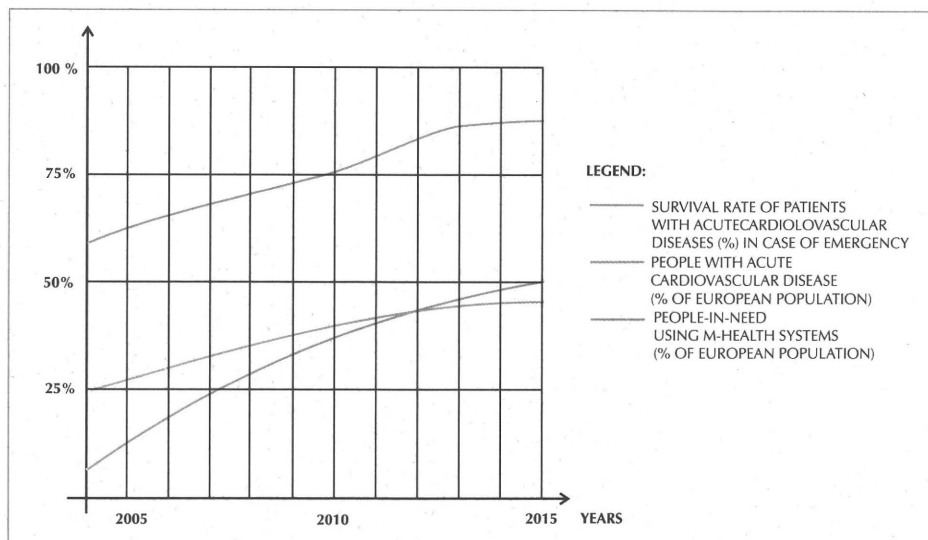
The social acceptance of mHealth is rarely questioned, since the evidence gathered with existing telemedicine applications (Mair and Whitten, 2000) shows that patients appreciate the freedom of moving, the avoidance of time-consuming stationary medical examinations and the stress associated with them, and are convinced of the quality and timeliness of the mHealth systems. Existing applications, however, are dedicated to chronic diseases, whose symptoms and therapy are

**Figure 2. Reduction in rescue wait time for a randomly moving patient**



Source: Author's estimates, 2003.

**Figure 3. Survival rate as a function of time and the percentage of patients using mHealth systems**



Source: Author's estimates, 2003.

very well known to sufferers, so the automatically generated treatment recommendations are repetitive and easily accepted. Thus, as a side effect of the expansion of mHealth systems one can expect growing acceptance of medicine without the presence of a physician, which may also manifest itself in increased self-medication (i.e. without a prescription), increased demand for medical literature and visits to medical web sites, and a growing resistance to "them and us" attitudes in medicine. Advanced medical applications available as a part of "do-it-yourself" medicine and access to medical expert systems may play a similar role as "user friendly" computer applications in the 80s, which made computing accessible to users without in-depth knowledge of programming techniques and digital electronics. It is also noteworthy that in poorer countries hopes of improving the overall quality of health care are often associated with eHealth and mHealth applications and these hopes prevail over any fears that may exist (see, for example, PRISMA Guideline 8).

Progress in this direction may be hindered by another possible future social phenomenon, how-

ever, namely the potentially growing fear that the excessive use of personal mobile electronic devices might lead to health risks. This would most likely also affect attitudes towards m-devices used for long-term health services. It cannot be ruled out that scientific evidence backing such a cautious attitude may be found in the future, which could affect the overall development of mobile technologies.

More sophisticated future mHealth applications will presumably be able to make less clear-cut decisions, based on the analysis of large data sets and associated with a certain degree of risk, thus indicating the need to make changes in the legislation concerning medical liability and data protection.

A set of procedures will be needed, backed by appropriate policy measures, which will guarantee that the risks associated with an action recommended by the autonomous mHealth system is controlled and that hard or doubtful cases will indeed be presented to a competent medical practitioner. The liability of the mobile technology provider, medical diagnostic software producer (if

*Current mHealth users generally appreciate the freedom of movement it gives them and the fact that it allows them to avoid time-consuming and stressful medical examinations*

*As mHealth systems take on more decision-making functions, safeguards will need to be put in place to ensure that difficult decisions are in fact handled by qualified medical practitioners*

*As mobile communications operators come to handle larger volumes of medical data, information needs to be protected against incidental or deliberate disclosure to third parties*

*The widespread adoption of mHealth devices could also provide a much needed boost to Europe's mobile communications operators*

different from the latter), the on-line medical team handling the hard and ambiguous cases, and patients themselves needs to be clearly demarcated.

Another issue is that - in addition to the information coming from phone calls - mobile communications providers will have access to personal medical data on mHealth system users. This information needs to be protected against incidental or deliberate disclosure to third parties, except the medical personnel directly involved in providing care. One can assume that the procedures supporting the use of mHealth systems will be outlined in the legislation and that they may become a part of the licences assigned to mHealth systems providers.

The next impact is the envisaged increase in the overall effectiveness of healthcare financing due to m-prevention, m-diagnostics, and m-therapy. It is a well known fact that spending on prevention is generally much more effective than paying for treatment once a disease has become apparent. However, often appropriate preventive programmes are not in place, or it is hard to convince some people to visit the doctor before the symptoms of disease emerge. mHealth can change this by providing easily accessible devices to perform diagnostics at home or on the move. Therefore, depending on the prevailing health care policy, the use of mHealth applications may enable better care to be provided more cost-effectively.

As exemplified by simple calculations and earlier studies (Bhargava et al., 2001), the social and economic justification of introducing mHealth systems into healthcare can be accomplished by the classic tools used for the evaluation of the healthcare policies, such as cost-benefit analysis (CBA) and cost-effectiveness analysis (CEA), which also often include an element of risk management. The diagnostic/therapeutic mHealth financing model should take into account the average price

of traditional medical services, the population density, the costs of supplementary mHealth equipment and mHealth back-office support, the estimated number of patients or vulnerable individuals, and their distribution in the area under investigation. One can consider in the same model different mHealth applications, different equipment and types of support to elicit an optimum set of diseases to be covered by the mHealth system<sup>2</sup>.

The cost-benefit analysis of preventive mHealth is even more straightforward, given the fact that prevention is cheaper in "traditional" medicine as well and that preventive mHealth applications can be more standardized and focused on non-intrusive data gathering.

Last, but not least, it is worth noting that mHealth applications may increase the potential market for 3G and 4G mobile communication systems. It may well turn out that mHealth features may be more attractive than the video transmission capability so often presented as the main appeal of 3G+ mobile phone systems, especially to older users. This could make the technology potentially good for the financial health of telecoms operators burdened by expensive 3G license fees too (in very sparsely populated areas the same argument may apply to satellite phone operators). In addition, mHealth creates another relevant field of applications for GPS/GSM systems, such as Galileo, whereby any perturbation in vital signs could be detected and reported by an mHealth application, then combined with a GPS localization function to optimize the rescue time (see the article on this topic by Rodríguez and Cabrera in this issue of the *IPTS Report*).

## Conclusions

The overall development of mHealth can proceed according to an optimistic or a more pessimistic scenario, as outlined below. Depending on



the policy approach taken, mHealth could either be used to bolster the overall quality of healthcare by providing an immediate and reliable source of medical help, it could be used as a cheap surrogate for medical services, or it could be marketed as a value-added service paid for by mobile phone subscribers together with their monthly charges. Clearly, the approach taken will determine whether mHealth reduces inequalities of access to health care services by making services available remotely and free or at low cost, or whether it widens inequalities by being marketed as a luxury for people willing and able to pay for a potentially high-cost additional service.

Even if we assume that mHealth will supplement traditional healthcare by replacing just

simple tasks or entering previously unexplored domains, the availability of mHealth services could result in a drop in demand for "stationary" (i.e. non-mobile) medical services, possibly leading the healthcare system reacting to defend its financial interests (healthcare consumes up to 20% of GDP in developed countries). Consequently, the development of mHealth will require harmonization with the overall evolution of health care.

Policy-makers need to frame regulations in such a way as to ensure equitable provision of mHealth services. Nevertheless, success of mHealth cannot be taken for granted without a positive social attitude, which may depend on a number of objective and subjective factors, some of which have been alluded to above.

### Keywords

mobile health (mHealth), telemedicine, medical decision-making, foresight, health care policy.

### Notes

1. See, for instance, [www.daou.com](http://www.daou.com)
2. taking financial contributions from medical insurance, patients' fees, community and national contributions, as inputs, and using a multiple criteria decision model in which the quality of treatment is represented by medium-term (1-2 years) and long-term (5-15 years) health indicators, one can calculate a set of optimal financing policies, parameterized by the total healthcare expenses over unit of time.

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## Location-Based Healthcare Services

Carlos Rodríguez and Marcelino Cabrera, IPTS

**Issue:** The number of mobile terminals able to calculate and use location data is expected to increase sharply in the near future. This will open up new avenues for eHealth services, whether provided by the public authorities, medical institutions or private organizations. The kinds of services likely to become possible will exploit both the mobility and portability of these terminals (hence their constant proximity to the owner) and their ability to calculate position. However, before widespread use can be made of these features, the privacy issues raised by the potential large-scale tracking of ordinary citizens (whether deliberate or incidental) will need to be addressed.

**Relevance:** In order to facilitate the mass adoption of eHealth services based on mobility and location features, policies need to carefully consider citizens' rights, such as privacy or the right to know and choose what information is shared with what organizations. Addressing these issues early in the development cycle could boost the adoption of location services (e.g. those due to be enabled by the Galileo system) and avoid delays in the deployment of new technologies and services which offer huge potential benefits for healthcare provision.

### Introduction

Combining mobile communication technologies enabling always-on broadband connections with the ability to calculate the device's position is likely to find numerous applications. In the healthcare field, being able to determine where a person is at any particular time would be of considerable use to the emergency services, for instance, as it could enable them to reach the injured or sick more rapidly. These technologies could also make it possible to track vulnerable individuals in real time to ensure their safety. However, the vast majority of uses of location-based mobile technologies are likely to be

commercial, involving the provision of specific services adapted to individuals' profiles' and their location. These services will inevitably lead to an increase in the number of actors gathering, having access to, and making use of citizens' personal and location information.

This article offers an overview of some of the wireless technologies that are currently prime candidates for applications supporting potential location-based eHealth services. It also describes a number of ways in which these technologies could benefit our increasingly mobile society through enhanced eHealth applications. The article then concludes with a discussion of concerns over the

*The views expressed here are the authors' and do not necessarily reflect those of the European Commission.*

*Combining mobile communication technologies enabling always-on broadband connections with the ability to calculate the device's position is likely to find numerous commercial and other applications*

implementation of location-based technologies, and in particular the potential threat to citizens' rights that may arise, and which could act as a brake on the deployment of these services, thus preventing society as a whole from obtaining the full benefits of eHealthcare.

### Supporting technologies

The provision of eHealth services using location information will be supported by wireless access to data of many kinds independently of the user's location. In terms of the technology used, IPv6<sup>1</sup> is currently the front runner in supporting data exchange between heterogeneous platforms. In parallel there are a variety of radio technologies, such as cellular radio, WLAN, UWB and Bluetooth, which are making wireless networking more commonplace (see Box 1).

A number of different technologies can be used to determine a person's position. The most widely used techniques today are satellite-based, e.g. the

US GPS (Global Positioning System) which makes it possible to calculate a position from the signals transmitted from a "constellation" of satellites. The main advantages of such satellite systems are their global coverage, high degree of accuracy and minimal impact on existing communication networks. However, they have a major disadvantage in that the signals are weak indoors. The European initiative to create a satellite positioning system known as Galileo could enable many kinds of services (relating to transport, civil protection, the environment, business, etc.) and offer affordable technological solutions to assist people with disabilities. About 38 million Europeans face barriers in their daily life due to their disabilities. Galileo could benefit them in a variety of situations<sup>4</sup> such as personal navigation assistance for people with impaired vision or for Alzheimer's sufferers with memory loss.

The quality of the services provided will also depend on the vertical accuracy of the positioning information. Determining the vertical position of

*A number of different positioning systems are currently in use, including satellite and terrestrial systems. The range is due to be expanded with the addition of the European Galileo system in the not too distant future*

#### Box 1. Some wireless technologies

Cellular is a generic term for mobile radio networks whose implementation is structured into cells so as to enable frequency reuse in nonadjacent cells. The most widely used version is Global System Mobile (GSM) with more than 847 million subscribers in 190 countries<sup>2</sup>. From GSM, the chronological succession of mobile generations includes High Speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS, GSM2+ or 2.5G), and Enhanced Data rate for GSM Evolution (EDGE or Evolved GSM). Other possibilities such as Universal Mobile Telecommunication System (UMTS) based on W-CDMA (WideBand CDMA), or CDMA2000, evolution of IS-95, are also cellular standards.

Wireless Local Area Networks (WLANs), including the fast growing WiFi<sup>3</sup> technology, were introduced within companies' premises to provide wireless access to employees. However, the initial assumption that the technology would be limited to intra-company use has proven short-sighted, as individual consumers are adopting WLAN to facilitate network access at home, and operators are investing in the commercial deployment of "hot spots" (physical locations where WLAN access is provided to users). In addition, other organizations such as universities, shopping malls, hotels, business centres or City Halls are expressing their interest in providing Internet access to their customers and citizens through a set of short-range, high-speed data access points.

UltraWide band (UWB) is another technology that is attracting interest as it enables the re-use of frequencies already assigned to other wireless services. However, one of the main concerns that is being analysed worldwide is the signal interference that UWB could cause to communication and positioning systems such as GSM, UMTS or GPS, degrading their security. From a regulatory point of view it is important to determine whether UWB should be permitted or not and, if so, which frequency band can be used for it.

Bluetooth is a technology that allows the variety of proprietary cables that connect one device to another to be replaced by a single wireless universal short-range radio link. Bluetooth radios operate on unlicensed frequencies and could be used in the same way as WLAN. In this case concerns about security will be similar to those concerning WLAN technology.

*Different positioning systems (both terrestrial and satellite) can be combined to obtain greater accuracy and better performance*

the user is highly valuable in high-rise buildings or underground. In order for this information to be usable, the Geographic Information System (GIS) which provides visual maps of local environments will have to map floors and show the reference height of each building. Galileo will have a vertical accuracy of 8 metres (95% of the time), but is unlikely to be available underground or deep within buildings.

The main terrestrial techniques are Cell ID (Cell Identification), which identifies the cell that is providing coverage to the target user equipment, and triangulation techniques, which combine information from several base stations to obtain a position. Some examples are Enhanced Observed Time Difference (E-OTD), which has been standardized for GSM, or Observed Time Difference of Arrival (OTDOA), which has been standardized for UMTS<sup>5</sup>.

Combinations of different techniques are also possible as a way of improving performance. In particular, it is envisaged that terrestrial and satellite schemes will be deployed together to improve the overall availability and level of service provided. These solutions will combine the indoor availability of terrestrial techniques with the high accuracy of satellite solutions.

WLAN or Bluetooth systems could also be used to determine location, under some circumstances, but these kinds of proximity positioning systems require a dense network of access points and can only be used in a predefined area.

#### **Location-based eHealth services**

eHealthcare services will use the available communications and positioning infrastructures to enhance the well-being of mobile citizens. Possible applications could include:

- Optimizing rescue and first aid missions by providing accurate location data to the emer-

gency services so they can reach victims of accidents, etc. faster and more efficiently.

- Information services (either public or private) to enhance healthcare provision, for instance by giving information about the nearest medical facilities and the fastest and most convenient routes by car or public transport, notifying users who need to obtain medication when walking past a chemists or indicating the location of the nearest public toilet to incontinence sufferers.
- If sufficiently accurate, navigation services could signal the way to blind people with sounds or to show the path back home to the mentally disabled who have become lost.
- A degree of protection against toxins or viruses could be provided by alerting citizens when they are about to enter an area where a catastrophe has just occurred (for instance, in the event of bioterrorist attack) or which is affected by an epidemic.
- Tracking at-risk individuals could assist drug and alcohol detoxification programmes by warning patients against entering certain areas or alerting support teams when a patient is in the wrong place. Tracking services could also be used to remind people suffering from Alzheimer's disease to do the right things in the right places. Tracking could also support a medical team treating an unconscious patient by informing them where that person has been.
- Scientific research could also benefit by tracking samples of people and analysing the progression of different body parameters at different locations, times and situations (this could be done in ways that protect individual's privacy by ensuring their anonymity in similar ways to those used in drug trials, for instance).
- Tracking objects could also be useful as a means of monitoring the location and use of limited equipment in hospitals, avoiding theft of expensive material or tracking the path taken by certain medicines. This could also be combined with other information such as that from sensors



checking temperature and humidity conditions so as to issue a warning if equipment or medicines have been left in an inappropriate environment.

- As other information and communication technologies advance, mobility and location will support commitments to reduce the digital divide and enhance the quality of life of the ageing population, for instance, by facilitating daily life, travelling, social networking, leisure and safety.

### Concerns vs. Opportunities

The ability to locate or track individuals raises concerns that need to be taken into account when considering possible services and their potential impact. The main concern arises from the fact that locating and tracking applications immediately conjure up images of a "big-brother" style surveillance society. This is an issue that merits attention from policy-makers because users may be unaware of all the privacy implications. Indeed, the degree of acceptance of many eHealth services (a prime example is that of monitoring vital signs) is reported to be relatively high when the individual's health is involved. The provision of healthcare seems to be an area where many citizens overcome their customary reluctance to accept technological innovations. This fact represents a major advantage, in theory at least, for the deployment of eHealth, although people's willingness to share their personal data when their health is at stake may make it necessary to regulate who is authorized to collect this kind of data, not least to prevent pseudo-medical applications collecting data for commercial purposes.

EU regulations already offer a degree of protection to users of location based services against improper use of data collected about them. Traffic and location data are regulated by Directive 2002/58/EC, which basically establishes that traffic

data must be erased or made anonymous when it is no longer needed, while location data (other than traffic data) may only be processed when it is anonymous, when one of the parties to the communication is an emergency service provider, or when the users or subscribers have given their consent to the extent and for the duration necessary for the provision of a value added service. Users' concerns are not completely covered, however, as tensions arise out of the difficulty of differentiating traffic and location data, the uncertainty over the length of time processed data will be stored, and the limited degree of trust in the entities processing the data.

Where communications contain personal data they are protected by the Privacy Directive 95/46/EC<sup>6</sup>. Medical data, of the kind needed to provide eHealth services, are covered by Article 8 which envisages higher standards of protection than for less sensitive data. This Article explicitly includes medical data within "special categories of data". Moreover, there is a Recommendation from the Council of Europe that regulates the collection and automatic processing of medical data with a view to ensuring both the security and the proper conservation of the data<sup>7</sup>. These regulations should protect European citizens from situations such as that reported by the US press<sup>8</sup> concerning the sale by a well-known pharmacy chain of information about its customers' medical prescriptions to pharmaceutical companies (the chain has since reported that it has stopped doing so).

One of the most controversial issues regarding the processing of data in the EU is whether overall health-status reports should be kept (whether by public authorities or by a trusted third party), and if so, how such reports should be regulated. This issue raises direct challenges to the right of privacy, and could seriously affect the right of access and require new procedures for obtaining informed consent. In addition, the obligation of custody of

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*Location-based services raise additional issues concerning informed consent given that users may need to give specific consent for the collection of data outside their original network of care*

*The possibility of merging location information databases from different government and private-sector sources poses another potential threat to privacy*

health data, which is currently the responsibility of healthcare institutions, will need to be revised. Although it is a widely held belief that all rights of access to the electronic health record (EHR) are dependent on the individual consciously granting access and knowing about the implications, it still remains unclear what this informed consent<sup>9</sup> means in specific circumstances, such as in the case of location-based services. Informed consent can reasonably be obtained in the context of a defined local network of care. Thus, when additional care is required outside that network, additional consent should be sought<sup>10</sup>. This is what already happens when a patient seeks treatment at a hospital.

Location based services imply, by definition, that the borders of care networks are blurred, given that the mobile citizen's location is not necessarily confined to the home. However, individuals whose vital signs, for example, are being monitored could easily forget that this means their location is also being tracked. This could add further practical difficulties to obtaining valid informed consent.

The consent to process location information for use in providing eHealth services could be obtained in a variety of ways. For instance, asthma sufferers using services reporting allergen concentrations while they travel, could give their consent to always being located or alternatively only for this service; consent could also be given each time the mobile terminal is switched on, or even each time information is required. Furthermore, according to the location data regime<sup>11</sup>, the user still has the possibility of temporarily withholding his/her consent, and different possibilities for refusal can also be established. In order to avoid problems as people travel throughout the European Union, due to differences between national legislations, general principles for the provision of user's consent and refusal mechanisms could be established.

Directive 2002/58/EC also defines an exception in which users cannot decide whether to be located or not: Article 10<sup>12</sup> establishes that temporary denial or absence of consent may be overridden "on a per-line basis for organizations dealing with emergency calls and recognized as such by a Member State, including law enforcement agencies, ambulance services and fire brigades, for the purpose of responding<sup>13</sup> to such calls". This regulation has to be understood in combination with the universal service regime which establishes<sup>14</sup> that undertakings which operate public telephone networks are obliged to make caller location information available to the emergency services, to the extent technically feasible, in the case of all calls to the single European emergency call number "112". This is in line with the coordinated approach that the Commission has taken by establishing the Coordination Group on Access to Location Information for Emergency Services (CGALIES). CGALIES was established by the Commission in May 2000 to actively involve the relevant players and to develop a consensus on implementation issues. Within this group the conclusion was that operators will pass on the best location information available to them with further performance improvement depending on commercial developments. This approach does not stipulate any further regulation in addition to that already adopted at European level. However, it is foreseen that after two years in operation the Commission will assess the need for additional steps including possible regulatory measures, aimed at raising the 'baseline' performance across Europe and speeding up implementation<sup>15</sup>.

Another potential threat to privacy comes from the possibility of merging location information databases from different government and private-sector sources. This would be natural where there is mixed provision of eHealth services by public healthcare systems and private organizations. For example, when a user dials the emergency num-

ber, he or she might be connected to an operator who analyses the situation and dispatches the appropriate emergency service (ambulance, police, fire brigade, etc.) to the spot where the caller has been located. The emergency number could be one such as 911 in the USA, the 112 in the EU or the 000 in Australia, but it could also be the number of a private insurance company which deals with private organizations offering location services to provide healthcare. Closely linked to this, albeit not specific to location-based services, is the issue of who should act as the custodian of this type of joint information. As eHealth is based on communications platforms, it could be inferred that the provider of the communication service could also manage the relationship with the service provider and share only the information that is specifically required. This could also be managed by an Identity Management System (IMS), although the way information is shared will be a tricky point if, for instance, access is not permitted to an emergency service provider who was not specifically authorized in advance.

The combination of location data with other sources of context-based personal information combined with medical reports within a seamlessly controlled environment, could provide "e-vital signs", such as information about gait, behaviour patterns, sleep patterns, general exercise, etc. whose value increases when combined with the measurement of "traditional vital signs", i.e. blood pressure, pulse and respiration. All this could support the detection of emerging medical conditions before they become critical (i.e. prevention functions), by looking for changes in the "activities of daily living" (there are algorithms that detect changes in behaviour patterns supporting both preventative medicine and identification of mental illnesses) or could provide "just-in-time" messages that could be sent to encourage healthy behaviour or reminders to do the right things when the user is in an appropriate

place (using the stairs and not the lift, drinking fluids several times a day when the user is near the kitchen, doing exercise if the user does not move for a while). However, these services could be seen as a "big brother" threat, who not only watches over but also to some extent seems to control the individual.

All generations could benefit, but the elderly in society who might require greater attention are likely to benefit most, in particular in ways that help avoid their exclusion from normal activities. Concern about old age has increasingly become a factor taken into account in recent policies<sup>16</sup> and eHealth location services could offer real support to the well-being of the elderly. However, three issues are of particular relevance in improving acceptance among old people:

- Potential users need to be better informed about the advantages of the services. Governments, through the mass media, could really help to overcome the information gap as older adults are among the primary consumers of these media. TV, being a privileged medium for reaching the elderly, could broadcast stories (e.g. documentaries) about the advantages of localization services in helping elderly people living independently, so as to help achieve these goals efficiently.
- Services and devices have to be easy to use for everybody, including people with disabilities. This is crucial as uneasiness among many patients about the use of new technologies is often an obstacle to their adoption, as is their preference for human contact rather than dealing with a machine. Highly user-friendly interfaces are therefore a prerequisite for eHealth services.
- Location-based eHealth services should be useful and affordable for everybody. This is needed to widen the range of services, but also to create greater access if the goal is to achieve an inclusive information society and avoid opening up digital divides.

*The potential would exist for location-based systems to give users timely prompts when in appropriate places so as to encourage healthy behaviour*

*Liability concerns, for example, if a patient receives inadequate treatment as a result of inaccurate location data, may hinder the deployment of location-based eHealth technologies*

*There is a need for organizational and administrative changes, interoperability, and reduced bureaucracy to bring the personal medical environments closer together*

Health related commercial activity is one of the biggest market sectors in the economy<sup>17</sup>. The deployment of eHealth services with location information will facilitate the integration of the European satellite location system, Galileo, in the life of European citizens. The relevance of the systems involved and the sensitiveness of the data calls for a strengthening of security when establishing requirements for service provision and also when protecting system integrity.


Another issue to be considered is that location-based eHealth services could raise a number of complex liability issues, for example, if a patient receives inadequate treatment as a result of inaccurate location data. This possibility might make service providers reluctant to expose themselves to potential liabilities, thus hindering eHealth deployment. One option for minimizing these problems might perhaps be to limit the liability of location service providers in exchange for thorough testing of all location-computing devices.

Frequencies need to be assigned carefully to ensure the quality of the transmitted signals and absence of interference. In order to facilitate access to services for all users, including those travelling across the EU and requiring location-based eHealth services, the applications should be developed in a way that ensures their compatibility. Taken together, these issues suggest that frequencies assigned to eHealth location based services should be harmonized at the EU level so as to ensure the same quality of service when travelling not only within the user's home country, but also abroad within the EU. Finally, it is important to underline the need for organizational

and administrative changes; support for systems interoperability; streamlining bureaucratic procedures to bring the personal and medical environments closer to one another; training health professionals on the potential of eHealth, while seeking to overcome organizational reluctance; and, providing users with enhanced possibilities for information and choice.

### Conclusions

It is anticipated that healthcare will become an important area for applications based on existing and future ICT infrastructures. The range of new applications used in the provision of healthcare is expected to blossom with the arrival of location-based services, which, in conjunction with increased mobility, will enhance the quality of life of European citizens both in terms of prevention and treatment. Important issues that could be taken into account by policy-makers when considering the mass adoption of eHealth services based on mobility and location possibilities, include supporting the adoption of Galileo, providing secure services, improving quality of life for the elderly, protecting consumer's rights, increasing the interoperability of systems between different organizations and countries, and enhancing the compatibility between applications.

In the context of the ageing European society, the use of location-based eHealth services is set to become an important part of healthcare delivery. In order to maximize the potential benefits, policy-makers should consider the potential threats to its deployment, including in particular the privacy and consent issues. 

## Keywords

eHealth, mobility, location based services, ageing society, privacy

## Notes

1. IPv6 (Internet Protocol Version 6) is the latest level of the Internet Protocol (IP) and is now included as part of IP support in many products including the major computer operating systems.
2. <http://www.gsmworld.com/technology/gsm.shtml>
3. Wi-Fi (short for "wireless fidelity") is the popular term for a high-frequency wireless local area network (WLAN). Wi-Fi is specified in the 802.11b specification from the Institute of Electrical and Electronics Engineers (IEEE) and is part of a series of wireless specifications together with 802.11, 802.11a, and 802.11g. All four standards use the Ethernet protocol and CSMA/CA (carrier sense multiple access with collision avoidance) for path sharing.
4. [http://europa.eu.int/comm/dgs/energy\\_transport/galileo/applications/disability\\_en.htm](http://europa.eu.int/comm/dgs/energy_transport/galileo/applications/disability_en.htm)  
or Galileo Newsletter, Number 26, November 2003, available at:  
[http://www.genesis-office.org/galileo\\_newsletters/galileo\\_newsletters.html](http://www.genesis-office.org/galileo_newsletters/galileo_newsletters.html)
5. Documents regarding location techniques were covered at LOCUS deliverables, such as "Overview of Location Services", by Baumann, Collomb, Dien, Fischer, Paris, Pilloni and Rodríguez, available at [www.telematica.de/locus](http://www.telematica.de/locus). See also Caffery, Gordon and Stüber "Overview of Radiolocation in CDMA Cellular Systems", IEEE Communications Magazine, April 1998, or Drane, Macnaughtan and Scott "Positioning GSM Telephones", IEEE Communications Magazine, April 1998.
6. Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data. Available at [http://europa.eu.int/smartapi/cgi/sga\\_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=31995L0046&model=guichett](http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=31995L0046&model=guichett)
7. Recommendation 97-5 (13-2-97) of the Committee of Ministers to Member States on the protection of medical data. Available at <http://cm.coe.int/ta/rec/1997/97r5.html>
8. Interview with Prof. Arthur Miller by Alison Bass, at CIO Magazine, November 1st, 2001, available at <http://www.cio.com/archive/110101/miller.html>
9. Informed consent is understood as the acceptance by a given patient of a diagnostic or therapeutic procedure after he or she has been suitably informed in order to become freely involved in the clinical decision. Basic requirements are: freedom, competence and sufficient information. For more information see, for example, the Bioethics Committee of Catalonia at <http://www.gencat.es/sanitat/portal/cat/coninan.pdf>
10. "eHealth Horizons", <http://www.doh.gov.uk/ipu/whatnew/ehealthhorizons.pdf>
11. Article 9, Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector (Directive on privacy and electronic communications). Available at [http://europa.eu.int/eur-lex/pri/en/oj/dat/2002/l\\_201/l\\_20120020731en00370047.pdf](http://europa.eu.int/eur-lex/pri/en/oj/dat/2002/l_201/l_20120020731en00370047.pdf)
12. Article 10, Directive 2002/58/EC.
13. "Responding" should be understood as "taking care of the situation" independently whether the call was started by the user or by the emergency services.

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14. Directive 2002/22, Article 26 Directive 2002/22/EC of the European Parliament and of the Council of 7 March 2002 on universal service and users' rights relating to electronic communications networks and services (Universal Service Directive). Available at

[http://europa.eu.int/eur-lex/pri/en/oj/dat/2002/l\\_108/l\\_10820020424en00510077.pdf](http://europa.eu.int/eur-lex/pri/en/oj/dat/2002/l_108/l_10820020424en00510077.pdf)

15. CGALIES reports are available at [www.telematica.de/cgalies](http://www.telematica.de/cgalies). Possible scenarios for regulation were introduced within LOCUS D4 at the 5th CGALIES Plenary meeting 11th-12th June 2001, available at

[www.telematica.de/locus](http://www.telematica.de/locus)

16. See as a recent relevant example of an EU initiative "The future of health care and care for the elderly: guaranteeing accessibility, quality and financial viability", Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions; com (2001) 723 final. Available at

[http://europa.eu.int/comm/employment\\_social/news/2002/jan/com2001\\_723\\_en.pdf](http://europa.eu.int/comm/employment_social/news/2002/jan/com2001_723_en.pdf)

17. Pamela Whitten, "E-health holds promise and many questions",

<http://www.asaging.org/at/at-226/infocusagebandc.html>

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# Electronic Health Records: a key enabler for eHealth

Andreas Ligtvoet, *RAND Europe*

**Issue:** Electronic health records open up new options for healthcare delivery: better access to relevant information, consultation and cooperation between healthcare providers, and monitoring and care delivery at the patient's home. However, issues of confidentiality and privacy need to be balanced with the requirements for increased communication between medical practitioners.

**Relevance:** If the health applications enabled by electronic health records are to be taken up, they will need widespread consensus among all stakeholders (public authorities, medical professionals and patients). This will require focused and coordinated action at both national and EU-level.

## Introduction

Over the last few years, the Lisbon objectives and the eEurope policy actions have painted a strategic vision of the direction that Europe is heading regarding competition and services in the information society. The use of eHealth has a role in the constant challenge of balancing the requirements of reducing the cost of healthcare (due to budgetary constraints), while at the same time aiming to increase access and quality.

eHealth offers the potential to enhance the capacity to monitor and protect public health through better health surveillance. Having a comprehensive system for monitoring chronic non-communicable diseases - based on small monitoring devices - will provide medical researchers and

public health officials with comprehensive health data on the population, thus enabling them to identify opportunities for improving the health system. Furthermore, citizens can be better informed by high quality health-related information services. They will provide online access to health information, support communities, pharmacies, decision aids, and tools to handle administrative tasks. Patients can test specific conditions, such as blood glucose levels, respiratory rates, etc. or produce an ECG using e-devices at their own home (referred to as patient self-management or telemedicine). Many senior citizens will become housebound but will still need services, training, and reinforcement of medical self-management, as well as continued connection to clinicians and contact with other patients. And finally, integrated patient management aims to provide mechanisms for client case management and efficient sharing of information

*eHealth offers the potential to enhance the capacity to monitor and protect public health through better health surveillance*

*The views expressed here are the author's and do not necessarily reflect those of the European Commission.*

*eHealth-related developments are transforming the traditional organizational model into a network organizational approach where the user is the focal point of health and social care*

*eHealth requires the storage and transfer of medical data; thus the development of the electronic health record is a key enabler of progress in the field*

between care professionals, such as the exchange of data (medical, administrative or financial) which today remain a cause of problems in healthcare.

These developments can have a number of advantages: specialized clinical expertise may be made available in rural settings and it may become possible to obtain a second opinion in medical specialty areas; medical facilities within the EU are to be interlinked and accessible to all, particularly when patients seek treatment in other EU member states (improving access). These changes transform the traditional organizational model into a network organizational approach where the user is the focal point of health and social care: instead of the doctor acting as sole manager of patient care, patients are becoming partners in managing their own care; new technologies will enable safer independent living and increased social inclusion (improving quality of life).

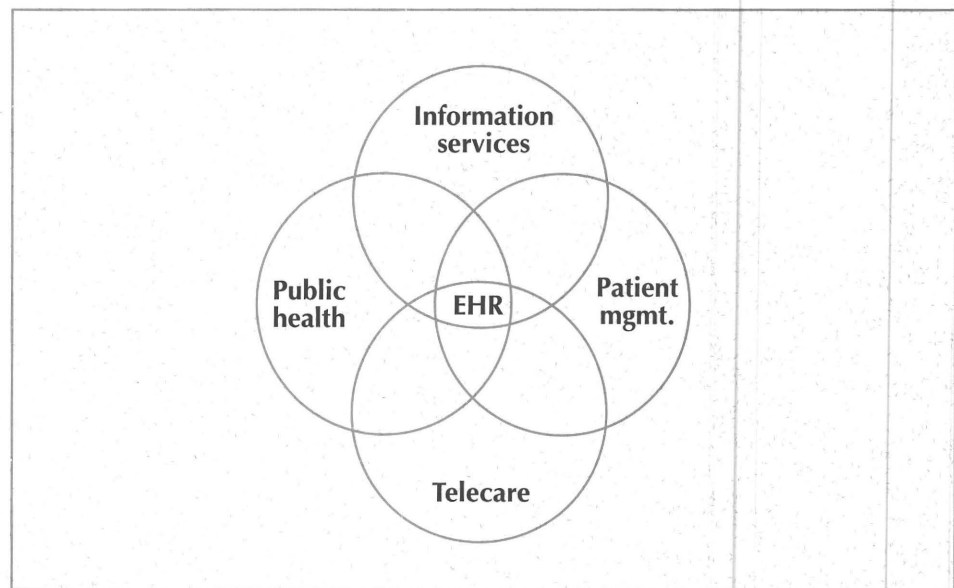
The basis for these developments is an electronic health record (EHR; the central role of EHR in the services described is depicted in Figure 1). All developments in eHealth rely on the transfer

and storage of medical data. On the one hand this enables the foreseen applications, but on the other hand it opens up a whole range of discussions on organizational change, technical implementation and security & privacy. Before the records can be used ubiquitously, however, there should be more clarity on these issues.

**Electronic health records**

In their simplest form, electronic health records are hospital records for a single inpatient stay or social insurance account records. However, in the future they could also contain the record of the individual's genome, or the entire history of an individual's interactions with the healthcare system. The electronic health record is widely cited as a critical key to modernizing healthcare in the EU. It may save resources and effort by eliminating duplicate testing and the need for doctors to take down notes on a patient's history repeatedly. The added advantage - since the advent of mobile communications - is that the data can be stored in one place (helping ensure data integrity) but accessed

*Figure 1. Different e-health services enabled by electronic health records*



via wireless networks (GPRS, 3G, WIFI) at another and thus cater to the needs of mobile carers (nurses and doctors making house calls) or telemedicine applications. Ideally these EHRs will be easy to use by different specialists, easily accessible (for example, via mobile devices and terminals) and ensure secure transmission of personal data.

The data collected can make a major contribution to health monitoring, medical research, and the measurement of system effectiveness by providing aggregate health information. Health information systems have the capacity to exchange information electronically with private providers of medical services such as clinics and laboratories. Standardized definitions and access to databases will permit more useful analysis of information on incidence and prevalence of chronic diseases and injuries, risk factors and conditions, services, programmes, and outcomes. When linked with clinical decision-support systems, the electronic health record can facilitate evidence-based diagnosis and treatment. Through the use of the Internet, smart cards, and other information technology, patients will be able to access their own electronic health record and take on the role of 'partner' in managing their own health (although this may lead to opposition from health professionals who disapprove of laypeople interfering with their job or self-medicating). The storage of large amounts of personal data in one central EHR database has advantages, as we have seen. However, it also raises concerns about the accessibility of these data: medical information is information of the most private nature. More than with other data, care should be taken to restrict access and anonymize where possible. Here we see that the interests of the different stakeholders in the process may come into conflict.

### Stakeholder requirements

It is today very clear that technology is only part of the story: successful implementation of EHR also

depends on the acceptance of the stakeholders involved and their willingness to alter their traditional way of working.

Arguably, as end-user of many of the services, the most important stakeholder is the patient. Present and future patients expect specific information to be available about their condition so as to allow them to have an informed discussion with their care provider. Furthermore, they expect all assessment, treatment and care to happen at a time and place of their choosing and to be protected from unsafe and poor quality products and services ordered via the Internet. But most importantly, they expect privacy and confidentiality; i.e. that patients themselves should be in charge of their own medical records.

EHRs could be implemented so as to be provided on-line over a (secured) network or embedded on a smartcard. Smartcards can provide persistent and portable information storage as well as identification, digital signature, security and payment functions. It is also clear that that Privacy Enhancing Technologies, such as data scrambling and biometric or other forms of identification are required when handling personal data, on both the citizen's as well as the professional's side. For example, pharmacists would only need to access a limited subset of the individual's complete record.

However, health- and social-care providers, hospitals or any wider consortia of service providers in public and private sectors expect services to support (and not hinder) them in their routine tasks. Medical records and other health applications will have to be accessible from mobile devices in order for healthcare professionals to be able to work effectively. As health records need to be accessed from different locations using different devices, the information provided should be scalable so that it will also be usable over connections with less bandwidth or without full audio/video capabilities.

*In the future electronic health records could progress from being a simple record of a hospital stay to containing the individual's genome or an entire history of interactions with the healthcare system*

*Technology could empower patients, enabling them to take greater control over their electronic health record and take on the role of 'partner' in managing their own health*

*Electronic health records (EHRs) could be implemented so as to be provided on-line over a secured network or embedded on a smartcard*

*As health records need to be accessed from different locations using different devices, the information provided should be scalable so that it can also be used over connections with less bandwidth or without full audio/video capabilities*

As with many other ICT applications, the service stands or falls with the standardization that is applied to both the data-format and the software and equipment handling the data. If the exchange of health records both nationally and internationally is to take place in an effective and efficient manner, interoperable standards will have to be laid down at a transnational level. To avoid vendor lock-in and to facilitate uptake, the standards used should be open and accessible to scrutiny.

### Analysis

Like in many fields of IT, the technical theoretical vision has given rise to considerable expectations, but the realization of these expectations is taking longer than anticipated. It is therefore crucial to analyse the strengths, weaknesses, opportunities and threats (so-called SWOT-analysis) of the present situation to be able to come up with

policy recommendations that build on what is available while trying to target the stakeholders' requirements. For EHR, an analysis of the kind alluded to highlights the following points for attention.

### Synthesis

When combining the strengths, weaknesses, opportunities and threats above, we can arrive at the following synthesis, reasoning from the patient outward to the healthcare system:

- Patients will need to feel comfortable about having their data stored on electronic media. Although it is often said that a patient will accept anything in order to improve his/her quality of life, a far stronger position would be to provide adequate protection of data by using privacy enhancing technologies. User interfaces will need to be simple so that the patients feel in control of their data. Also, care should

#### Strengths

- There are many international and EU projects that aim to implement electronic health records.
- There is consent among European Health ministries that this is a high priority issue.
- Healthcare professionals understand the benefits – that an interchangeable patient health record could facilitate cooperation among professionals, while preventing repetitive tasks and costs.

#### Opportunities

- As 'managers' of their personal information, citizens will be empowered to manage their own healthcare.
- Not duplicating data when a patient moves from one care institution to another reduces the risk of data errors and enables institutions to focus on their primary task of caring.
- Information brokers and middleware solutions will become an important area of development.
- The diversity of solutions already available presents a rich learning opportunity.
- There is an opportunity for close cooperation on standards setting.
- Continuing proliferation of eHealth applications is likely to provoke moves towards providing shared access infrastructures.

#### Weaknesses

- There are relatively few examples of so-called 'transmural care'.
- Cooperation between different care institutions remains difficult.
- The implementation of the required systems is often seen as an activity falling outside an institution's normal budget.
- The willingness and ability of healthcare staff to accept and manage change is seen as a major obstacle to implementing EHR.

#### Threats

- A shift in professionals' attitude is required: it should become a client-oriented process. This requires people to cooperate beyond the boundaries of their institutions, to describe the medical history of patients so that it suits all users of the information.
- Clearly, this requires large coordination efforts.
- If the question of data protection and certification is not addressed, the take-up of services might encounter resistance.



be given to explain the process of data capture and retention.

- Secondly, obstacles may need to be overcome in order to encourage adoption of new technologies by practitioners. Getting the primary care physician, who is often the patients' first contact with the healthcare system, to 'buy in' is critical. But achieving this will take more than just money and clever software. If widespread use of EHR is to become a reality, physicians will need to be motivated to adopt new work practices and tools. They will need to see a strong business case outlining the tangible benefits as well as assurances about the reliability of the technology, the appropriateness of the user-interface, available training, and technical platforms. Standardization of the exchange of electronic health records and adoption of national standards for entering data is needed in order to avoid misinterpretation of information.
- Thirdly, there are the technical challenges related to developing the hardware, software, and technical support to operate and maintain the EHR network. Interoperability of EHRs is critical and will hinge on the development of consistent standards for data collection, storage, and retrieval across organizations and jurisdictions. For the development of a user interface, key content elements such as the patient's problem list, and the management strategies (including diagnostic testing, medications, and progress notes), will need to be captured. A structured problem list could be the means of helping the provider to navigate easily and intuitively through the relevant summary of patient information. Data entry must be designed to help the users keep the data accurate and meaningful.
- Fourthly, and finally, there are the challenges faced by the healthcare system and policy-makers. Confidentiality and protection of patient data is something that needs to be emphasized in any European regulations that are adopted relating to e-health system security. In this field,

in particular, a well-coordinated approach between the authorities at European, national and regional level is needed in order to foster the exchange of experience and information.

## Conclusions

It has become clear that implementation of ICTs in healthcare can and will only succeed if the services are adapted to the specificities of the existing healthcare system. Nevertheless, the system itself will need to evolve in order to facilitate better health services. The crux of EHR as an enabler of services lies not only in the "e" of electronic, but also in the organizations, budgets, stakeholders, communication and cooperation that provide the context of the services.

The implementation of an electronic health record crosses the boundaries between healthcare and ICTs, as well as invoking organizational, political and economic issues. If the development of EHR is to progress on any level (local, regional or EU-wide), there should be close cooperation between the responsible administrative authorities; including those at European level if feasible.

However, a number of other issues need to be tackled, in particular, legal and regulatory issues concerning the ownership of data, safety and confidentiality of data and minimal requirements to ensure this. In addition, liability in the case of data-loss, corruption or accidental disclosure will need to be addressed. Citizens need to trust that their data is in safe hands; professionals need to be free to use optimal technology that suits their needs. Although it remains a challenge, finding the correct balance between these needs seems solvable.

- The knowledge in the shape of experience and existing pilots in Europe will need to be collected and monitored.
- On-the-ground experience can be benchmarked and tested in different healthcare contexts:


*Apart from overcoming the technical challenges, both patients and medical practitioners need to be convinced of the benefits of EHRs if they are to be motivated to adopt them*

*The implementation of an electronic health record crosses the boundaries between healthcare and ICTs, as well as invoking organizational, political and economic issues*

one solution might be more appropriate in one country than another.

- More effort is needed to resolve the mentioned legal issues and to harmonize the regulatory and legal frameworks in the different member states.
- In some countries efforts to raise awareness will

be needed, either because of lack of information or because of bad examples in the past.

This will facilitate the role of eHealth initiatives in balancing the quality, cost and accessibility of healthcare systems in Europe. 

### Keywords

electronic health record, EHR, patient dossier, ICT, e-health, privacy

### Note

1. Transmural care is the care that goes beyond the walls of one single institution. It is care tailored to the needs of a patient and provided on the basis of collaboration agreements between generalist and specialist care providers of different organizations such as hospitals, revalidation homes, and home care organizations.

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# Skills and Competencies for the Future of eHealth

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Information and  
Communication  
Technology

**Issue:** An important prerequisite for the widespread introduction of new technologies in the health sector is the acquisition of new types of skills by citizens, patients, doctors, nurses and other healthcare professionals. These skills translate to new abilities, competencies and, above all, mindsets and attitudes to new ways of working that are more responsive to the needs of citizens.

**Relevance:** Human resource development through appropriate education and training is a key factor in coordinating efforts by stakeholders, introducing new working methods and gradually transforming traditional healthcare service providers into agencies that provide a wide range of eHealth services. This is particularly relevant considering the under-investment in training and education that is endemic in the health sector and which create blockages in the ways knowledge is shared.

## Introduction

**E**Health is an umbrella term encompassing a broad range of ICT-driven activities that are transforming the delivery of healthcare. Such activities normally involve the use of digital data that is transmitted, stored, and retrieved electronically for clinical, educational and administrative purposes, whether at a fixed location or remotely. The important implications of eHealth are becoming more and more apparent to patients, health workers, administrators, and practitioners as new applications allow the provision of medical support remotely at any point in time and facilitate access to, and exchange of, pertinent health information on demand.

The introduction and effective delivery of eHealth concerns all players in the healthcare sector. These include hospitals and other healthcare facilities, public and private insurance firms, organizations developing and applying technological solutions, as well as a variety of user groups - citizens, patients and their environment, doctors, nurses and allied healthcare professionals. The growing body of literature on eHealth has extensively dealt with the rise of new technologies and the bottlenecks and challenges facing eHealth strategies in the 21<sup>st</sup> century. Less attention has been given to ways of increasing awareness and general understanding and utilization of ICT-driven activities among all the parties directly involved. For this, it is important to recognize that technology alone

*eHealth is an umbrella term encompassing a broad range of ICT-driven activities that are transforming the delivery of healthcare*

*New types of skills, and changed attitudes to novel ways of working are required for the ubiquitous introduction and effective exploitation of ICTs in healthcare*

*The views expressed here are the authors' and do not necessarily reflect those of the European Commission.*

*The need to equip health-care professionals with better ICT skills has been on the agenda for over a decade*

*The modernization of public service provision with the use of ICTs is a challenge to existing forms of organization in the health sector and implies some kind of organizational change*

*Appropriate education and training is a key factor in introducing new methods of work for healthcare service providers and in empowering citizens to use ICTs to obtain medical information*

cannot guarantee optimal results. New types of skills, competencies and, above all, mindsets and attitudes to novel ways of working are required for the ubiquitous introduction and effective exploitation of ICTs in healthcare.

### **ICTs and the changing nature of skills in healthcare delivery**

For over two decades now, ICTs have been gradually introduced into the healthcare system creating turbulence in its traditional structure and organization and requiring all those working in the area to keep pace with new technologies. As early as 1990, the European Council issued Recommendation No R(90)21 which alerted governments of member states to "...ensure that, as soon as possible, those staff involved in healthcare receive appropriate, multidisciplinary training, both theoretical and practical, for health information systems within an overall public context" (Grimson, et. al., 2000). At that time, the predominant ways in which ICTs were introduced and applied within the healthcare system related mainly to administrative, managerial and financial functions. The integration of some of the 'back office' components of the healthcare system that was made possible with ICTs required health practitioners to transcend the strict boundaries of their profession and acquire a new set of skills that may have been unnecessary a few years ago. These were mainly leadership competencies - such as strategic and tactical planning, persuasive communication, negotiating skills, financial decision-making, team building, conflict resolution and interviewing - as well as some basic ICT-related technical skills (Schwartz, R., 2000). Even at that time the need for increased information technology 'upskilling' created an additional burden on the already demanding schedule of healthcare professionals. The latter viewed ICT training as peripheral to their activities, or at worst, as an unnecessary burden which consumed valuable time (Grimson, et. al., 2000).

The current widespread use of ICTs in the health sector has important implications not only for the support of administrative and functional tasks but also for the actual delivery of healthcare. eHealth applications offer the potential to cut costs, increase the efficiency with which care is provided, deliver healthcare services remotely, simplify diagnostic and therapeutic processes, and enable better care to be provided in the patient's personal environment. At the same time, they can increase patients' levels of awareness and understanding about their own health and encourage a degree of self-care.

The modernization of public service provision with the use of ICTs is a challenge to existing forms of organization in the health sector and implies some kind of organizational change. In fact, technical innovation to a large extent depends on organizational innovation in order to achieve real improvements in efficiency and quality of service. On the other hand, the translation and implementation of new modes of service provision into practice is always a serious challenge to management. Still, the potential of eHealth may fall flat without the active involvement of healthcare professionals and citizens in the choice, deployment, and assessment of relevant technologies. For these user groups to participate in a meaningful way in these procedures they have to be empowered and informed about the benefits ICTs can bring to healthcare delivery.

Human resource development through appropriate education and training is a key factor in introducing new methods of work for healthcare service providers and in empowering citizens to use ICTs to obtain medical information. The nurturing of competencies and skills and the introduction of new working methods have become key factors in the successful re-engineering of service suppliers as they transform into agencies providing eHealth services. Changes to strategies, structures



and methods of service delivery are dependent upon a creative and innovative workforce. The latter needs to adapt its skills, competencies and, above all, mindsets and attitudes to new ways of working that are more responsive to the needs of citizens.

The availability of an appropriate mix of competencies and skills is central to the wider diffusion and take up of e-health. The care provided by specialized professionals requires adherence to evidence-based clinical protocols, nursing processes, clinical judgement, and skills/experience in communications, technology, and computers. Thus, although technical skills are necessary to

set up eHealth applications, the delivery of these applications to citizens also requires strong interpersonal and managerial skills since quite often providers are required to manage people over the network. While the technical skills are concerned with the communication technologies used and the clinical processes enabled by those technologies, the interpersonal skills are concerned with relationships between system personnel, providers and patients, and the way in which those relationships are organized.

Furthermore, the notion of 'civil servant' in the health sector needs updating to meet the requirements and opportunities of the Information Society.

#### **Box 1. What competencies and skills are needed for eHealth? Evidence from survey findings**

Skills and competencies in new healthcare delivery models and new professional roles have been identified as being crucial to the delivery of even the simplest eHealth services. A number of surveys have looked into the particular types of competencies and skills that are considered as being central to the diffusion and take-up of eHealth. Some of the key findings of these studies concerning healthcare professionals and citizens are highlighted below.

- In the US, the Michigan telepsychiatry research project identified confidence building to senior administrative staff regarding capabilities and use of technologies as an important issue in providing eHealth services (Whitten, P. & Rowe-Adjibogoun, J., 2002).
- In the UK, a survey on Primary Care Staff's use of the Internet in Scotland found that time constraints and concerns that they lack the necessary skills were highlighted as the most common reasons for not accessing the Internet (Wilson, 1999).
- A survey on nurses' responses to telemedicine found that nurses need to obtain technical skills, on how to install, calibrate and operate equipment, as well as to recognize and fix technical problems. Also, they need training in team building so that project nurses are able to build and develop problem-solving skills as a group (Dansky et al., 1999). Furthermore, awareness on a nurse's new role as "e-nurse" needs to be built among senior management and key nursing managers in order for them to gain good appreciation and true understanding of what nurses are doing over the telephone and accept their new role (Larson-Dahn 2002). The care provided by the nurse requires adherence to evidence-based clinical protocols, nursing process, clinical judgement, and skills/experience in communications, technology, and computers (Richardson, R.J., Schug, S., Bywater, M., Williams, D.L. 2002).
- Leadership skills are also recognized as being very important, since the role of a "champion" is considered critical for getting a new eHealth project off the ground and sustaining interest among participants when problems occur. (Larson-Dahn 2002, Norris 2001). Survey findings suggest that the development of people-based skills such as cooperation, leadership, and creative thinking are just as important as - if not more so - than actual technology developments (Ball & Lillis, 2000; Silber 2003).
- In Europe, the SeniorWatch<sup>1</sup> survey took into account information gathered about computer usage, skills' self-assessment and attitudes towards new technologies and came up with a typology of citizens' computer involvement. According to this typology the majority of older citizens (over the age of 50) (69.7%) have either advanced IT skills or are familiar with the use of computers, or they are keen to learn about technology, whereas 31.3% do not use a computer or are not keen on familiarizing themselves with this technology. The proportion of users drops with age and so does the proportion of computer-literate individuals.
- The evidence from the Flash Eurobarometer survey (2003) shows that among computer users only a small proportion (23.1%) of people within the European Union use the Internet to get information about health. A positive attitude about the Internet is a given amongst young people in contrast to older people (55.7% in the 15-24 age group vs 26% of people over 55).

*Although technical skills are necessary to set up eHealth applications, the delivery of these applications to citizens also requires strong inter-personal and managerial skills*

*For citizens/patients, the ability to benefit from developments in eHealth critically depends on their familiarity with technology, their interest in ICTs, and in the Internet in particular*

The public service ethic remains vital in the sector. However, in the eHealth era it should incorporate customer relations' management approaches, efficiency measures, and modern management techniques.

Similarly, for citizens/patients, the ability to benefit from developments in eHealth critically depends on their familiarity with technology, their interest in ICTs, and in the Internet in particular. People with no experience and no interest in computers and electronic devices are unlikely to be able or willing to seek medical information from Internet sites or receive care and support at a distance. By contrast, people who already use computers or are keen on learning about technology and wish to gain some basic computer skills are more likely to have a positive attitude towards eHealth applications and benefit from their wider deployment.

### **Towards a typology of eHealth competencies and skills**

The findings of the survey alluded to above suggest that the required skills and competencies for eHealth can be grouped into the following broad categories:

- **Basic computer skills:** these skills include use of computers, use of web technologies for accessing portals and for using personalized services, together with eHealth applications for delivering simple telecare services.
- **Organizational and managerial skills:** including the so-called 'soft' type of skills similar to the leadership competencies identified earlier in the paper, which are necessary for the effective development and delivery of eHealth services. These skills are necessary for dealing with new organizational structures, new service delivery models, changes in working methods, new job roles, etc.
- **In-depth understanding of the functional capabilities of eHealth technologies and applica-**

**tions:** this encompasses the ability to have a thorough understanding of how eHealth applications such as integrated patient management and electronic health records, epidemiological networks, telecare and independent living devices and services, etc., fit into, and are an integral part of, the formal healthcare delivery system.

- **In-depth understanding of legal, ethical, and economic issues surrounding eHealth:** this refers to the necessary knowledge and capabilities that need to be acquired in order to manage the relations between the different stakeholders in an eHealth environment, such as identifying their rights and obligations, defining service level agreements, understanding the problems surrounding the security and confidentiality of personal and health data, ways of preventing and/or dealing with malpractice, etc.

Note that the proposed grouping intentionally does not include advanced technical skills such as information management, health informatics, software design, etc. These skills can be obtained formally and nowadays are the subject of specific postgraduate courses designed specifically for the needs of healthcare professionals.

The above grouping places particular emphasis on the 'soft' types of skills required as opposed to the more formal 'hard' type of advanced computer and technical skills. This is because, as often demonstrated in surveys and case studies, the former are often accountable for the weak communication links and information flows among actors within the system. In addition, the above categorization of skills and competencies suggests that some types of skills, such as basic computer skills, the understanding of complementarities of eHealth and traditional healthcare practice, and their legal and ethical implications, should be generic for all user groups, while other types are more specific to individual application areas of eHealth.

eHealth competencies and skills are particularly necessary in relation to four major eHealth application areas (including their application sub-areas):

- Public Health Policy & Prevention: this refers to the collection of healthcare event, environmental, and socio economic information that enables data mining for healthcare strategy planning. Essential skills for healthcare professionals involved in this area include the ability to understand the functional design and use of personalized web services as well as the ability to understand the structure and information needs of Public Health Policy and Prevention in order to come up with new algorithms to fit in new types of data.
- Information services to citizens: these encompass activities providing information to citizens on issues such as good health and lifestyle advice and empowering them to know when professional help is required, and where and how to obtain it. Essential skills for healthcare professionals involved in this area include the ability to contribute to the structuring and updating of citizen information services and to the functional design and use of personalized web services.
- Integrated Patient Management & patient health records: these concern activities surrounding the efficient and secure sharing of information between health and social care professionals and the establishment of an environment to provide support for integrated client case management. Essential skills for healthcare professionals involved in this area include the design and use of evidence-based eHealth clinical protocols, the ability to understand the structure and functional capabilities of integrated patient management systems and patient health records, the operation, updating and maintenance of Integrated Health records, and the efficient management of personal and health information security and confidentiality.
- Telecare & Independent living services. These comprise tele-consultations, telehomecare, vital signs monitoring, and services for the elderly and disabled that support independent living. Essential skills for healthcare professionals involved in this area include basic technical knowledge on how to operate telecare and independent living services, ability to form telecare and independent living Service Level Agreements with third parties, ability to evaluate the equipment and services delivered, and also the management of personal and health information security and confidentiality.

### **The way forward: Recommendations for the future of eHealth education**

One of the principal barriers to the adoption of telecare is the resistance of health professionals - primarily doctors - to the use of new technologies in their daily practice. Survey findings confirm that the inability of healthcare staff and healthcare professionals to accept and manage change is seen as a major blockage in implementing eHealth (Richardson, et al., 2002). Health professionals in general are averse to using high technology equipment when treating patients, especially if treatment takes place from a distance. Often, they perceive the implementation of the service as a threat to their authority. From another perspective, health professionals find that education and training in ICTs do not fit in with their busy schedule and could in no way substitute for the personal relationships they develop with patients. In the UK, for example, doctors argue that in the fourth and fifth years of their medical training and in their first years as junior hospital doctors there is no time for training in ICTs because priority is given to clinical work and it is in practice very difficult to fit in training on 'fancy ICT systems' (Mansell and Curry, 2002).

For many years, the inclusion of IT skills in the training of healthcare professionals has been a low

*eHealth competencies and skills are particularly necessary in relation to four major eHealth application areas: public health policy, information services, patient management and telecare/ independent living services*

*One of the primary barriers to the adoption of telecare is the resistance of health professionals the use of new technologies in their daily practice*

*An important prerequisite for engaging more and more professionals in formal training in health informatics is first to raise their awareness of the potential of ICTs and adjust existing mindsets*

priority in most countries. This approach has caused significant discrepancies in the health system since the on-going under-investment in professional education and training has been occurring in an environment characterized by rapid technological and organizational change. Today, the introduction of medical informatics onto the curricula of medical schools at both undergraduate and postgraduate levels is gaining more and more ground, as it is becoming widely recognized that the ability of physicians to use ICTs is vital for the effective management of medical information. Courses in this area are designed to equip medical students and other health professionals with the necessary formal informatics competencies that will allow them to function as users and producers of medical data. Internet technology is often used in medical training and in the teaching of health informatics as it allows better communication between participants and better support for students. The primary goals of such courses include (Parry et al., 2001):

- Raising health-care professionals' understanding of health informatics and computer technology, including the effective use of common software, communication tools, and some of the concepts underlying the use of computers in healthcare.
- Providing academic recognition of informatics skills by awarding a diploma.
- Developing a network of expertise, and
- Reaching people working in relatively remote environmental settings.

However, 'soft' types of skills are equally, if not more, important for the transformation of the healthcare system into an eHealth system. Therefore, an important prerequisite for engaging more and more professionals in formal training in health informatics is first to raise their awareness of the

potential of ICTs and adjust existing mindsets and attitudes to the transforming norms and practices in healthcare delivery. In other words, apart from basic computer skills, health professionals need to be provided with the necessary education and training that will allow them to understand the functional capabilities of eHealth technologies and applications as well as their legal, ethical, and economic implications in order to have at least some input into technology choice and assessment. Furthermore, people-based skills, such as co-operation, leadership, and creative thinking are critical for inspiring participants and sustaining their interest at turbulent times.

Continuing medical education activities need to endorse this approach. In the same way as other professionals (e.g. engineers, industrialists) deliberately enrol in postgraduate training in order to develop the key technical, organizational, and administrative competencies that they need in order to be able to deliver value-added services to customers, health professionals also need to empower themselves with the necessary knowledge of health informatics as well as with an essential understanding of the broader functional, legal, ethical, and economic implications of eHealth. More training programmes addressed to all groups of health professionals - doctors, nurses, allied healthcare professionals- should be designed along these lines. The importance of eHealth and the variety of eHealth services need to be explained through concrete examples so that the full benefits are appreciated and key messages are delivered to multi professional groups. Multimedia and web-based technologies can effectively support the delivery of such training schemes and establish a user friendly interoperable systems infrastructure for eHealth education.



## Keywords

E-health, skills, competencies, education, training, patients, healthcare professionals

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## Note

1. The SeniorWatch project launched a pan European survey of elderly people in Europe relating to eHealth and telemedicine issues. Fieldwork was carried out by national organizations in all European Union Member States. Geographically and socio-demographically stratified random sampling was used, with computer-assisted telephone interviews. The interviews were conducted in June and July 2001. Altogether 9661 interviews were performed. The cases were weighted according to the share of the population the respective age groups represent of the older population in each European country.

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## Science and Technology Roadmapping: implications for eHealth

Mark Boden and Olivier Da Costa, *IPTS*

**Issue:** Recent S&T roadmapping studies have focused on the potential of various emerging information and communication technologies to help meet the challenges faced by European healthcare systems dealing with an ageing population, the enlargement of European Union and growing healthcare budget constraints. Roadmaps are an effective and intuitive way to present and analyse the causal and temporal relations in these roadmaps.

**Relevance:** Roadmaps are valuable for policy-makers or executives with limited time to grasp at a single glance the various dimensions, whether scientific and technological, economic, political or social, of such a complex issue as eHealth.

### Introduction

Technology roadmapping is a widely used methodology, employed by individual companies, entire industries and public research institutes (Da Costa et al. 2003) as a way of bringing together various stakeholder perspectives so as to develop an overview of how a technological field, or an industry is likely to develop over a set future period. This approach can be applied to analysing the scientific and technological, economic, political and social dimensions of a wide range of fields, and the interactions between them. It is therefore highly appropriate to a complex area such as eHealth (see Box 1).

### Dimensions of the Challenges and Policy Issues

Increasing demands on European healthcare systems are a consequence of the changing demo-

graphics<sup>1</sup> and economic development of Europe. The effective delivery of healthcare represents a challenge to which a combination of emerging technological developments could respond. The HCTRM set out four key drivers of change emerging over the next decade to shape the future of healthcare delivery.

- **The ageing of the population** will have significant implications, particularly for pension systems, public sector budgets, and healthcare delivery. However, demographic change offers opportunities to improve the quality of life of older people, and new business possibilities for industry.
- With **enlargement of the European Union**, rights and access to quality healthcare may be threatened by changes in the structuring and financing of healthcare systems. These may be compounded by the utilization of cross-border services and shortages of skilled labour, particularly if healthcare professionals seek better paid jobs in the present EU15.

*The views expressed here are the authors' and do not necessarily reflect those of the European Commission.*

**Box 1. The IPTS-ESTO roadmapping exercise**

In August 2002, the IPTS and the European Science and Technology Observatory (ESTO) launched a project aimed at developing science and technology roadmapping (S&TRM) as an input into policy making at European level. The project was underpinned by three main issues:

- What are the major societal challenges facing Europe?
- What are the emerging technological responses to these challenges?
- What are the pathways between these challenges and responses?

Two pilot roadmaps, addressing these questions in particular contexts, have recently been completed:

- "The Healthcare Technologies Roadmap: Effective Delivery of Healthcare in the Context of an Ageing Society," (Braun et al. 2003);
- "Ambient Intelligence in Everyday Life" (Friedewald, Da Costa 2003).

In the Healthcare Technology Roadmap (HCTRM), Information and Communication Technologies (ICT) were identified as a core technological cluster, comprising a range of developments relevant for the prevention, diagnosis and monitoring of illness, its treatment and aftercare, as well as in supporting information systems and services. Conversely, in Aml@Life, health was one of six key application areas for ambient intelligence technologies.

The ICT cluster of HCTRM and the health application area of Aml@Life overlap significantly. While these two roadmaps were constructed relatively independently, their results concur to underline the particular relevance of the development of eHealth.

- The **key technological breakthroughs** impacting on healthcare include developments in computers and robotics, genetic engineering, pharmaceuticals, and the growth of replacement tissues and organs<sup>2</sup>.
- **Changes in health policies and systems** are a consequence of growth in public sector expenditure on health over recent decades. More recently, health systems have sought to reduce costs while improving quality and accessibility. The new EU public health programme (Official Journal 9/10/2002) is promoting a more integrated and intersectoral health strategy, encouraging cooperation between Member States.

Within this context, there is a clear danger of a widening of the 'health gap' between regions and social classes. A recent report delivered to the European Council (European Commission, DG Employment and Social Affairs 2003) examines the challenges faced by healthcare systems in the European Union and the need to ensure a good balance between three objectives:

- **Broad and Equal Access to Healthcare** relies heavily on governments taking responsibility for structuring and financing healthcare systems. Insurance status or the place of residence

should not condition access to a specific treatment. However, disparities in organizations and financing influence medical practice, for instance in the area of minimally invasive surgery and telecare. Ideally, healthcare professionals should use the best technologies available, and in so doing, facilitate their dissemination.

- **High Quality Healthcare Delivery** depends on the one hand on the increased empowerment and greater expectations of healthcare consumers, and, on the other on the awareness of, and access to, healthcare innovation among professionals.
- **Financial Sustainability of Healthcare Systems** relies on balancing policy and legislation with market forces within the healthcare industry, particularly sustained investment in R&D activity, to ensure the availability and accessibility of healthcare services for all citizens.

The combination of the above drivers and policy challenges provided the context in which the HCTRM examined emerging technologies and Aml@Life the health application area.

The main goal is the provision of customizable telecare, which can be easily deployed and adap-

*In the context of EU enlargement and rapid technological change, there is a clear danger of the 'health gap' between regions and social classes increasing*

*The provision of customizable telecare which can be easily deployed and adapted in individuals' homes to meet their particular needs is a key goal*

*Improved measurement, recording, and analysis of data and increasing availability of minimally invasive surgery and telecare should enable patients to benefit from improved prevention and treatment of illness*

### Box 2. Complementary Perspectives on the Development of eHealth

The HCTRM, was an issue-driven study in which eHealth was considered from a technological perspective. The basic methodology centred on a matrix-based framework in which to describe and analyse the current state of healthcare technologies (Footprint Matrix) and to articulate a vision of the future situation (Matrix 2020).

The objective of Aml@Life was to examine the potential of full integration of "Ambient Intelligence" (Aml) in everyday life, thereby raising the issue of universal access to new technologies and functions. Aml refers to a vision of the future of ICTs which puts human beings at the centre, i.e. where technologies are designed for people rather than people having to adapt to technologies. People would be surrounded by intelligent intuitive interfaces embedded in all kinds of objects and environments and capable of recognizing and responding to the individual needs in a seamless, unobtrusive and often invisible way (Ducatel et al. 2001).

Within Aml@Life, health was one of six major application areas considered from a demand perspective. Since Ambient Intelligence is truly cross-cutting, most ICTs have been examined. Aml@Life complements the HCTRM with intermediate pictures, major milestones, potential breakthroughs or disruptions and critical paths for the developments of key technologies and functions.

In the HCTRM **Footprint Matrix**, the following ICT developments were shown as currently having a major impact on the delivery of healthcare:

- The integration of ICT, medical imaging and robotics, which is improving surgical treatment by making it less invasive, reducing risks and reducing the length of hospital stays;
- e-Health, which embraces ICT-driven activities transforming the delivery of healthcare (Richardson et al, 2002), and includes telecare (health and social care provided remotely, generally to people in their own homes) and telemedicine (the provision of health care and education at a distance, using telecommunications technology);
- Decision Support Systems and Bio-informatics, which contribute to and support diagnosis, prognosis, studies, prescriptions and other treatment options. The connection of the locus of healthcare delivery and national electronic information networks can help improve diagnosis, treatment and aftercare.

The HCTRM **Matrix 2020** sets out a vision of relevant emerging technological developments and issues in their application. In particular, **telecare** was found to be a key eHealth-related application for improving the quality of life and longevity of patients, particularly older and disabled people in rural areas (Tang et al. 2000; Bradley et al. 2003). With an ageing population, financial constraints and growing acceptance of the delivery of healthcare at home will mean that demand will be high, as has been borne out by various pilot telecare projects (Curry et al. 2002).

ted in individuals' homes to meet their particular needs. This relies on a number of key enabling technologies, which include high-speed wireless communications, digital interfaces, database and data mining technologies, sensors and actuators. Specific applications will include passive devices to detect accidents and hazards; memory aids; lifestyle and physiological monitoring systems; specialized telephones and videoconferencing; speech recognition for data capture and computer command; and mobile devices to connect with computer systems during the patient care process.

Telecare will be also integrated into **assistive equipment**, such as walking sticks, bath seats, grab rails, and wheelchairs, particularly in the context of the **smart home**. Health applications for Aml technologies have been found to be very demanding

but also very promising, in terms of improving the process of care delivery and facilitating linkages between the different actors. However, although prototypes can be expected within the next 3-5 years, widespread use of most of these applications is not expected until 2010.

Bringing together the implications of the two roadmaps, patients should benefit from improved quality in the prevention and treatment of illness and in aftercare and rehabilitation thanks to improved capabilities in the measurement, recording, and analysis of data and to the increasing availability of minimally invasive surgery and telecare.

Healthcare professionals will benefit from easier access to patient-specific information and to general professional information. They will be able to match



**Figure 1. AmI@Life Roadmap for health applications**

Application	Key Function	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	>2020		
Prevention	Monitoring Consultation Information and Education Prediction					Simple prototypes			Maturation of technology													
				Pilot Systems			Widespread use															
				Non personalised services			Personalised Services															
Cure	Diagnosis Treatment and Surgery Monitoring					Simple, data-based prediction			Advanced, diagnosing prediction													
						First Prototype Systems			Partly automated diagnosis													
						First prototypes				Automated Diagnosis												
Care	Monitoring					First simple prototypes			Maturation of technology													
	Attending				First simple prototypes			Maturation of technology														
Health management and administration	Identification and authentication				Prototype		Commercial Systems															
					Prototype			Advanced Systems														

measurements and observations with recorded information about the user, even including data such as eating habits. Later on, when gene-based treatments become available, healthcare practitioners will be able to access the patients' genetic data. Given the current early state of development of pharmacogenomics, relevant integrated information systems are not likely to be available in all EU healthcare systems until 2020. Patients might one day also carry smart-cards containing such genetic data.

Healthcare professionals will also be able to take advantage of AmI-based decision-support systems and support services in health management and administration. For instance, prototypes for the identification and authentication of medical personnel and patients should be available within the next two years, with wider introduction possible after 2007.

Wider diffusion of health information and education systems, already feasible, will facilitate better informed encounters with patients and with other care professionals. Advanced applications using mobile communication are likely to become available after 2004.

The availability, as early as 2005, of sensor technologies will underpin advances in alert and alarm systems and robotics. These will be further developed with the availability of micro actuators after 2006.

As a consequence, monitoring, which relies mainly on the combination of sensors monitoring vital functions and networking technologies, will particularly benefit from the development of AmI technologies. The first prototypes of AmI-based monitoring systems should appear in about five years while 'intelligent' and context sensitive monitoring systems are unlikely to be feasible before 2020, given the high degree of uncertainty surrounding the development of Artificial Intelligence.

AmI-based prediction and diagnosis relies on data monitoring, and after 2007, should develop from the measurement of predefined indicators, such as blood sugar level and heart rate, to knowledge-based systems capable of diagnoses based on a range of indicators. Tele-consultation is already in use (e.g. on ships), and will embrace AmI technologies as they become available. The need for visual communication between patients and healthcare professionals will be met by widespread availability of broadband networks.

On the 2020 horizon, telecare and minimally invasive surgery should be widely used together.

Ultimately all AmI-related functions in the health field are likely to tend towards convergence in a single system. The overall healthcare system will benefit from the optimization of resource use, scale economies, better use of public health information and a more highly-skilled workforce. There

*Healthcare professionals will also be able to take advantage of ambient intelligence (AmI) based decision-support systems and support services in health management and administration*

*Monitoring capabilities will be particularly enhanced by the development of ambient intelligence (AmI) technologies*

*AmI-based prediction and diagnosis should progress from the measurement of predefined indicators to knowledge-based systems capable of diagnoses based on a range of indicators*



*The provision of healthcare is changing, with a blurring of the boundaries between private and public health care, greater emphasis on prevention, increased decentralization, etc.*

may also be major implications for the organization of care, with more delivery in the community and minimization of inappropriate admissions, long stays and readmission. There will be increased emphasis on chronic disease management and support for patient self-management.

Possible areas for further research in the field include artificial intelligence tools for screening clinical data and alerting physicians; expert systems for decision support; and nanotechnology and its convergence with biotechnology. The future opportunities for industry include: construction of smart homes and retrofitting of the existing housing stock; production of sensors and sensor systems; compilation and maintenance of large, searchable databases.

### Policy Implications

The provision of healthcare across Europe is becoming much more complex. The roles and responsibilities of the institutions, practitioners and even users are changing. The general trends which will influence policy considerations include:

- increased blurring of boundaries between public and private sectors;
- more emphasis on prevention of illness;
- growing pressure for moving healthcare from expensive intramural settings (e.g., hospitals) to extramural settings and the community itself;
- transformations of the organizational structures and the workforce driven by the introduction of new technologies into the system;
- stronger decentralization and individualization of healthcare;
- development of networking, especially in secondary healthcare structures due to better access to information;
- development of trans-European R&D capacity and healthcare provision;
- development of new tools to monitor healthcare expenditures.

In particular, the implications of the development and diffusion of e-health for the three objectives defined by the European Council include:

- **Broad and Equal Access to Healthcare.** E-health developments affect both information and provision of healthcare. However, the privacy of patient information remains a source of concern.
- **High Quality Healthcare Delivery.** The measurement of the 'quality of healthcare' remains an issue for further research. The advances in eHealth will impact on the potential to evaluate healthcare quality.
- **Financial Sustainability of Healthcare Systems.** The major cost factor for healthcare systems has traditionally been (skilled) labour. However the growing cost of medical systems stems from the increasing use of technology that once it becomes available, may be used indiscriminately by physicians to provide a return on investment.

The main drivers and factors influencing the diffusion of healthcare technologies, including eHealth, have been identified as: the cost of development and provision, research and development, availability of skills, organization of healthcare system, ethical concerns, cost of use and reimbursement. Most of these factors are healthcare provider, industry, system or policy related.

Future deployment of eHealth is conditioned by an adequate understanding of the **social context** by the public authorities, healthcare providers and other stakeholders. Without appropriate government policies it is unlikely to occur (Barlow et al. 2003). Key areas for policy intervention include:

- Encouraging patient (user friendliness) and service (infrastructure and skills) **accessibility**;
- Encouraging **dialogue between stakeholders** on conflicting themes: ethical issues, data privacy, etc.;

- **Legal and ethical framework:** confidentiality of personal data, respect of privacy threatened by automatic monitoring of lifestyles, ethics, patient involvement in decisions over his/her own treatment, need for personal forms of care and support, etc.;
- Provision of objective, comprehensive, readable, accurate and up-to-date **information on medicines** to the public;
- Provision of **training in technologies for general practitioners**;
- Mechanisms for reimbursement or payment for services;
- **Health education and training** to reduce the 'health gap';
- Public and professional **acceptance of technologies**.
- **Systematic evaluation of e-health outcomes** at the patient and at the whole system level using robust evaluation methodologies so as to overcome healthcare professionals' concerns.
- Support for the emergence of a new type of **care professional**, the 'telecarer'.
- Availability of **standards** for interoperability and compatibility of technical systems.
- Deployment at **European, national or regional level** depending on the viable scale for the particular service and taking into account the local specificities.
- Mechanisms to foster learning across projects and localities and develop a coherent knowledge base.
- Encouragement for the inclusion of telecare and telemedicine in mainstream care delivery, without being overly prescriptive but developing an institutional framework which allows care providers to use it as an option when appropriate.

In the two roadmaps, examination of the key trajectories of scientific and technological development in their socio-economic context, with the contributions of expert knowledge and opinions, has identified and illuminated issues of concern for policy. The ability of the roadmaps to generate perspectives on policy implications demonstrates the potential value of the roadmapping approach in policy intelligence.

## Keywords

eHealth, delivery of healthcare, science and technology roadmapping, S&TRM, policy intelligence

## Notes

1. Life expectancy at birth has increased by six years in the EU on average from 1970 to 1996 and is now between 75 years and 79 years in all Member States.
2. The global HCT & pharmaceutical market in 2001 globally was 600 billion US\$, with HCT representing one third and pharmaceutical two-thirds (Eucomed).

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# eHealth and the Elderly: a new range of products and services?

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Information and  
Communication  
Technology

**Issue:** Care services for the elderly, whether healthcare or social-services oriented, will become increasingly important in the ageing European society. eHealth and eCare can help to provide such services efficiently with appropriate technological and organizational support.

**Relevance:** Policy-related aspects in technology and organizational terms and the strategic actions plans are key factors for a successful matching of elderly people's needs and demands with suitable social and healthcare services. The consequences in terms of social aspects, health impact, funding needs and public-private partnership for future models need to be taken into account by policy-makers.

## Introduction

People today are living longer than ever before. According to UN global statistics<sup>1</sup>, the proportion of persons aged 60 years and older is expected to double between 2000 and 2050, whereas the proportion of children is projected to drop by a third. The fastest growing group of the older population is the very old, that is, those who are 80 old years or more. In Europe, between 1998 and 2025 the proportion of persons classed as elderly will increase from 20 to 28%.

Over the next few decades, as a consequence of increasing life expectancy, the number of adults with disabilities and the elderly populations will grow dramatically. The fastest-growing component of persons who may need assistance for their long-

term care support is the non-elderly disabled. These are people who are living longer lives due to advances in medical technology but who require support services to cope with chronic health conditions and functional limitations. It is estimated that chronic illnesses will represent more than 60% of all diseases worldwide by the year 2020 (see reference 2). A trend toward a marked increase in the incidence of chronic diseases is also apparent in developing countries<sup>2</sup> and healthcare for the chronically ill has become a priority in Western societies<sup>3</sup>.

The ageing of the European population is having an impact on the provision of adequate services and is a cause for concern about spiralling costs of social and health care. While some of these areas are not amenable to the use of technology (such as funding issues, pensions and benefits) the care-

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*Traditional models of care provision need to change to take into account the blurring of the boundaries caused by an increasing number of elderly people in society who suffer from some form of disability as a "normal" part of ageing*

*Changing family structures may mean that fewer children and other relatives will be available as informal carers for the elderly in the future*

related issues can be improved substantially by the deployment of ICTs. Only limited pilot projects have been implemented so far, but the massive change in the age pyramid is making it necessary to expand existing projects and make intensive use of all the resources available. It is not a matter of responsibility for health or social care, but of changing the policy priorities to cover the needs of a fragile and resource-consuming population. Innovative options need to be considered that go beyond increasing the human resources or technologies available. Today's elderly people are generally better educated than in the past and have a strong desire to remain independent. The main goal should be to keep elderly people integrated within their community as far as possible, so as to preserve their personal autonomy, high quality of life, while ensuring their personal security and protection. The increasingly intercultural mix of the elderly is another factor influencing the solutions to be provided. The role played by relatives acting as informal caregivers and the support that they need<sup>4</sup> have to be considered when planning solutions for the elderly or other vulnerable groups.

### Changing models

The fuzzy boundaries between health and social care, the disabled and the elderly are just some of the areas that need to be revisited. Traditional models of care provision (whether social-services or healthcare oriented) are changing rapidly. The impairments associated with "normal" ageing sometimes verge on disability, making terms such as "disabled" or "elderly" often somewhat subjective. Planned care for this situation needs to strike a balance between the health and social components of care, varying according to the balance between the need for each. A comprehensive approach is required to cope with this changing environment. eCare based models, which are supported by assistive technology, with their ability to provide combined support for social, health and

personal care, and constitute a promising new approach for efficient integrated care delivery, and one which could improve both quality of services and resource allocation. Advantages of such models include a high degree of flexibility, the setting up of partnerships, and working arrangements that are not bound by geographical considerations.

There is a general recognition of the need of improvement of current healthcare models to match the actual requirements of elderly persons. As regards the provision of healthcare services for elderly patients with chronic conditions, efforts have been underway for a number of years to pursue more effective and efficient alternatives<sup>5</sup>.

The family and social context in which care is delivered is also changing rapidly. The increased number of one-parent families and the significant decline in birth rates implies fewer children and relatives will be available to provide care for the elderly than has been the case traditionally.

Social-care models are also evolving to tackle these circumstances. Many countries are facing the situation in different ways. In Japan, in the city of Fujisawa, a consortium has been created to give a comprehensive response to the lack of informal and family caregivers, assuming new roles for monitoring and care of the entire population and specially the elderly. The project's motto, "Creating a town that cares for you"<sup>6</sup>, gives a clear idea of the comprehensive approach. In the United States of America, it is at level of the individual states that most actions are taking place. In most cases global approaches to caring for the elderly through specific agencies or State Departments are underway. The need for a global approach has been stated in assessment studies conducted in Florida and New Hampshire. In the US, it is usually public funding and private, not-for-profit or commercial providers that deliver care. On the other hand, in Canada, for example, there is a long standing movement to



modify the Health Canada Act to include some entitlement to homecare though public funding.

At world level, the United Nations and the Second World Assembly on Ageing, has put forward the International Plan of Action on Ageing, 2002, which calls for changes in attitudes, policies and practices at all levels in all sectors to enhance the way care is delivered to the elderly, through actions including:

- Harnessing scientific research and expertise and realizing the potential of technology to focus on, *inter alia*, the individual, social and health implications of ageing, in particular in developing countries.
- Promoting the use of technology and rehabilitation services designed to support independent living.

There is considerable analysis going on in many countries about the healthcare delivery model itself as a result of the impact of the ageing of the population on healthcare systems. Whether public or private it is necessary to review and update strategies and tactics and, in most cases, the model of service provision. The fact that the European Union as a whole does not have a common health policy is making it more difficult to adopt a global approach towards this issue.

### Challenges

Transformational forces are in play, shaping future systems (see Figure 1) and promising new solutions. However, new solutions can also mean new challenges. New technologies will address many of the technical issues, but there are some

#### Box 1. Patterns of evolution and technological developments

Advances in sensor technology, wireless communications and computing technologies are facilitating the development of new tools and models of services to support independent living and enhanced quality of life for the elderly and the chronically ill. The potential of the Internet, mobile communications, portable devices and electronic instrumentation in the development of e-Health services for patient monitoring and follow-up is evident (see reference 1).

New enabling assistive technology is emerging based on ambient intelligence, embedded and wearable devices. Infrastructure and usage models for wearable sensors that measure physiological parameters and other personal data in users' daily environments are currently the focus of increased study (see reference 1).

Sensors can be integrated into the environment in which users live their everyday lives. An increasing number of applications are addressing home monitoring. Elderly persons can be kept under constant surveillance by assistive telecare centres. If problems arise, it may be possible to take immediate remedial action. The chronically ill could thus be able to live an almost completely normal life, knowing that any problem would be detected and reported swiftly and then easily controlled by the remote medical centre.

Personal monitoring and telecare concepts are converging with smart home, networked home and home automation approaches. The evolution of technologies such as X-10; CE Bus; and Home API should be viewed as potential elements supporting future technological developments.

Emerging and innovative new care services for homes, nursing homes, collective residences, assisted social facilities, etc. create the need to study a new range of care professionals and organizations. New models of services for personal management and independent living support must be conceived and put in practice. New developments relating to wearable devices, presence technology, pervasive computing, smart sensors, jointly with electronic fabrics, batteries, and wireless body and personal networks should make it possible to overcome some of the current limitations on implementing services to facilitate personal ambulatory care, follow-up and monitoring independently of place and time.

Based on a major Canadian project known as the National Evaluation of the Cost-Effectiveness of Home Care, there is growing evidence that investing in home care can save money while improving care and the quality of life for people who would otherwise be hospitalized or institutionalized in long-term care facilities.<sup>7</sup>

Aspects such as the education of the persons concerning his health prevention and maintenance, the importance of adequate follow-up and coordination among care services at all levels are the basis of newly proposed models. One such model<sup>8</sup> has been adopted by the WHO work group on "Innovative Care for Chronic Conditions".

*The fact that the European Union as a whole does not have a common health policy is making it more difficult to adopt a global approach towards the issue of the ageing of the population*

**Figure 1. Future Health Systems and Transformational Forces**

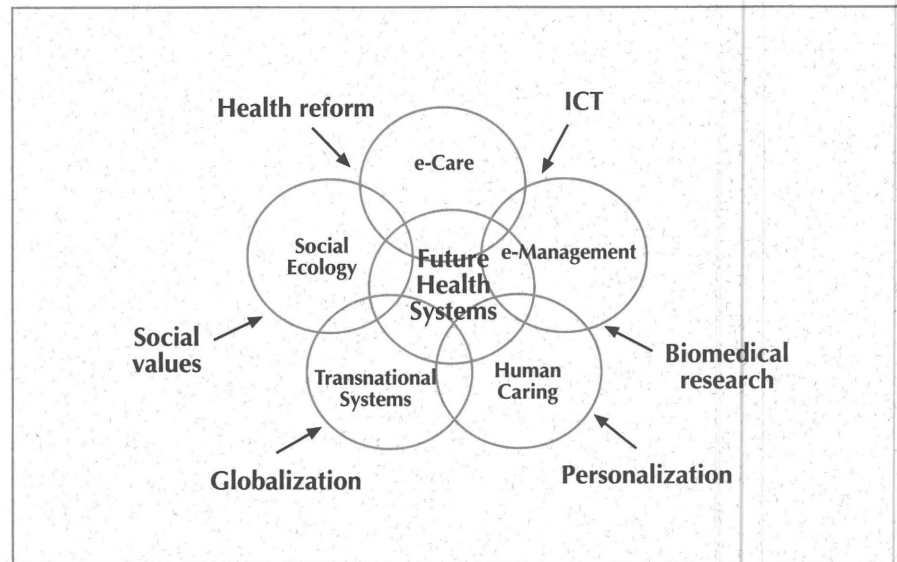


Fig.1. Diagram, modified from Caro's Model, showing Future Health Systems under the confluence of major transformational forces.

issues that lie beyond the technology which are part of the new social and relational context of the emerging e-Society.

- a) Personalization

Each person should be given special attention matched to their particular needs, and in the case of the elderly, these personal needs clearly change with time. Ageing conditions vary from one person to another. Physical and mental conditions vary over time following differentiated profiles demanding custom tailoring of services and devices. "Personalization" of services could become a central component of future fee-paying health services.

- b) Context dependence

Context is a very important element of the interaction between people and things. The emergence of convenience as a major force in many service's transaction is making it necessary to pay attention to context sensible environments. Context-aware systems describes the special capability of an information infrastructure to recognize and react to the

real-world context, including user identity; current physical location; weather conditions; time of day; date or season; and whether the user is asleep or awake; sitting or walking.

- c) Access for all.

Usability aspects such as human-machine interfaces need to be addressed. As new technologies develop, they will open up completely new ways for people and machines to interact. Experience using some of today's electronic appliances highlights some of the aspects that could be improved (consider, for instance, the difficulty many people, not just the elderly, have programming their video recorder).

- d) Multilingual environments

Increasing numbers of elderly people are living in foreign countries. In parallel, more and more immigrants are working as nursing and caregivers. Systems including automatic translation could be of great value in supporting communication in this context.

- e) Greater emphasis on prevention

Design of new services should consider preventive care assessing lifestyle of aged persons. This means starting to take care of the elderly as soon as possible. In fact a comprehensive e-services approach should be interpreted in such a way that personal follow-up and preventive care could be implemented continuously throughout a person's life. This approach should be linked to the concept and practical implementation of Personal Health Records.

- f) The quest for e-services deployment and sustainability models

Ensuring wide usage of e-services means to pass from mere research pilot trials to wider common usage.

New technological applications and services do have costs associated with them, and it is reasonable to ask who is going to pay for them. The success and diffusion path of new eCare services for the European citizens is difficult to assess. Specific actions and programmes could accelerate adoption and reduce risks, thus potentially making benefits available earlier and more widely than if no action were taken at all. Certainly, the social environment is a result of many evolutionary paths that converge in various ways to create new ways of life and values for citizens. Different viewpoints and approaches to exploiting the capabilities of e-services can coexist. It might be appropriate to stimulate thinking on how to progress towards developing e-services in Europe.

- g) Training health-care professionals

There is a critical shortage of nurses, social workers, and other support personnel to care for the elderly as well as a limitation of public resources. There is therefore a risk that much of the potential of ICT for personal eCare may not be realized. Part of the problem is that technology is frequently underutilized because it does not fit

naturally into existing working patterns. Another part of the problem is the limited role of technology in training behavioural and teamwork skills. What is lacking is a body of research that addresses the important role that behavioural training can play in improving the performance of care teams, and how to integrate behavioural approaches with available ICT technologies.

The information processes of decision-making, planning, communicating, and maintaining situational awareness can be improved by means of technology, but only if designed with teamwork processes and human factors principles as part of the operational structure.

A key issue is the hands-on development of teamwork skills. Healthcare and socio-sanitary organizations support individual technical skills development but have limited models for collective or team-based skills development. This training gap is noteworthy because much of the work of treatment is embedded in the teamwork behind delivering that care. Both of these issues can be addressed through a research agenda that extends advanced simulation tools into new areas of care services for the elderly.

- h) Holistic approaches

People's health is the product of their total environment, including the air they breathe, the family they grow up in, the education they receive, the religion they adopt, the work they do, the income they receive, the genes they inherit, the recreation and leisure they enjoy, the place they live, the food they eat, the healthcare they receive, and the identification and position their culture gives them. All of this should be part of the knowledge and efforts to improve care and the ability to prevent disease. For the emerging e-society, digital access and digital literacy will be one additional factor to consider individual's well being. Comprehensive plans including health, social care, hous-

*In addition to the technology itself, personalization, context dependence, access for all, multilingualism and a greater emphasis on preventive care are all important issue that need to be addressed when defining future systems*

*Although much treatment relies on teamwork, healthcare organizations tend to support individual technical skills development rather than collective or team-based skills development*

*Homecare today cannot be conceived of without the support of ICTs, whether used directly by the person receiving care or as a tool to support informal caregivers*

*When discussing the conditions affecting health systems, it is all too easy to refer to the ageing of the population as a negative factor influencing the cost or the increasing need for care*

ing, food programmes, research, caregivers support, etc. are implemented in some US States such as Florida or New Hampshire. In the US, the existence of Departments with cross-sectorial competences, like the Department of Elder Affairs or the Agency of Ageing facilitates planning and management of global funding<sup>9</sup>.

It is desirable to promote partnerships between all levels of government, civil society, the private sector and older persons themselves, as has been recommended when translating the International Plan of Action of the UN Ageing Conference into practical actions.

The main effort in policy terms is to include the new forms of care, eCare, and e-homecare in the services offered to elderly citizens and supported by public funding to the extent determined by every country. In technological terms the main effort would be directed towards promoting standardization and interoperability, or even, as is planned in some countries, defining a common open platform for ICTs for care. Homecare, as the most visible facet of the care to the elderly, will be the next essential service<sup>10</sup>. Homecare today cannot be conceived of without the support of ICTs, whether used directly by the person receiving care or as a tool to support informal caregivers. As a basic element supporting the care of the elderly today and in the future, ICT is the central condition to fulfil essential requirements for adequate eCare, i.e. providing a single point of entry and access, and ensuring coordination and continuity among care levels.

Sometimes, when discussing the conditions affecting health systems, it is all too easy to refer to the ageing of the population as a negative factor influencing the cost or the increasing demand for care. It is, however, something that can be anticipated and planned for appropriately, and of course, although it is changing the pattern of the services demanded, it is also possible to extract some of the

positive factors of the growing numbers of the elderly, because future generations of old people will often be much healthier than their counterparts in the past.

## Conclusions

Significant increases in life expectancy, a growing elderly population, advances in medicine, the ICT revolution, and socio-economic policies are setting the stage for long-term care challenges this century. When dealing with care for the elderly we are concerned with quality of life and quality of care, personal responsibility, independent living, entitlements, homes of the future, and the organization of care systems. There is a general effort in most countries exploring new service provision models to improve the current situation and to meet the demands of a growing elderly population in ways that ensure sustainability in the future.

The blurring of the boundaries between health, social and personal care is directly influencing the new models for service provision to the elderly population. eCare is emerging as a valuable and comprehensive approach to coping with the need to coordinate social-, personal-, and health-care provision. Such models, supported by ICT, have the potential to improve the overall quality of life of citizens while reducing the management burden. Access, quality, and cost-effectiveness can and must be maximized through the application of information technology and virtual organization<sup>11</sup> theory.

The development of eCare in the networked-based knowledge society should be characterized by globalization of the solutions<sup>12</sup>, the requirement of interoperability<sup>13</sup>, and organizational and cultural changes<sup>14</sup>. eHealth is now thoroughly accepted as being more an organizational formula than a technology<sup>15</sup>; this is even more evident in types of applications for the management of elderly and the chronically ill. Innovation in emerging e-servi-



ces for health care is always a high-risk endeavour, more so when it involves new ways of organizing the provision of patient care<sup>16</sup>. The development of the eCare model requires a blending of technology and health service expertise and it will depend on strategic partnerships between provider organizations and technology companies. Implementation of the model will require cooperative development that involves state, local and business organizations.

### Keywords

elderly people, eHealth, eCare, homecare, ambient intelligence, assistive technologies, wearable devices, e-services

### Notes/References

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## B R I E F N O T E

## eHealth-related aspects of foresight

Anette Braun, VDI-TZ

Health-related aspects of foresight exercises can illuminate the broader context for eHealth developments in the future. Results from existing foresight exercises can help us gain a better understanding of the evolution of the demand side of eHealth that might be expected over the next two decades. These results also allow us to see whether foresight exercises can serve to quantify and qualify the future potential of eHealth applications in the context of an ageing society and an enlarged European Union.

Even though ICTs are an issue in many foresight exercises, where they take on the role of "underpinning" or key technologies, the statements on eHealth in prospective initiatives are very limited and somewhat ad hoc, possibly because these are documented more explicitly elsewhere, e.g. in na-

tional Information Society initiatives. They are very often mentioned as one of many issues of ICT development, and are scattered across different foresight exercises. Many foresight exercises set out some techno-economic intelligence relating to eHealth, but in most studies, eHealth seems to play a role in visions for cross-cutting areas - such as healthcare systems change - rather than representing a visionary field in itself. Nevertheless, optimism about the relevance and *the transformative potential of ICT in the healthcare sector* is often projected.

The eHealth-statements and visions made in international foresight exercises can be summarized and clustered chronologically into the "roadmap" shown in the table (Table 1) in order to portray the larger context for ehealth developments of the future.

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**Table 1. Roadmap for the eHealth developments of the future**

Year	Forecast	Source of Forecast	Reference
2004	Electronic Smart Card first model tests begin	Germany	BMGS, Bundesministerium für Gesundheit und soziale Sicherung, <a href="http://www.bmgs.bund.de/deu/gra/spi/3628.cfm">http://www.bmgs.bund.de/deu/gra/spi/3628.cfm</a>
2004	ehealth will become a socio-economic driver in healthcare systems design	OECD	OECD, <a href="http://www.oecd.org/document/28/0,2340,en_2649_33929_2536540_1_1_1_1,00.html">http://www.oecd.org/document/28/0,2340,en_2649_33929_2536540_1_1_1_1,00.html</a>
2005	Electronic Health Records accessible	UK	UK Government, Peter Drury, DH Information Policy Unit at the ETHEL Conference on 29.11.2002 in Belgium and UK foresight panel health care 2020 (2000), <a href="http://www.foresight.gov.uk/index.html">http://www.foresight.gov.uk/index.html</a>
2005	eHealth reduces costs	Austria	Delphi Report Austria, <a href="http://www.bmbwk.gv.at/medien/4230_tech2.pdf">http://www.bmbwk.gv.at/medien/4230_tech2.pdf</a>
2006	electronic prescriptions implemented	Arthur D. Little	Arthur D. Little Int., Inc., E-Health - quo vadis?, <a href="http://www.pharmaflash.de/webdownload/pharma042001.pdf">http://www.pharmaflash.de/webdownload/pharma042001.pdf</a>

*The views expressed here are the author's and do not necessarily reflect those of the European Commission.*

**Table 1. Roadmap for the eHealth developments of the future (continued)**

Year	Forecast	Source of Forecast	Reference
2006	online patient identification systems implemented, digital TV used for delivering health-related services	Ireland	Ireland, New connections, A strategy to realizes the potential of the information society, March 2002
2006	eHealth priority in national RTD programmes and health policies	Island and Malta	Malta, <a href="http://www.eforesee.info/malta/report.pdf">http://www.eforesee.info/malta/report.pdf</a> and Island, Building the Knowledge society, Report to government, December 2002. <a href="http://www.isc.ie/downloads/know.pdf">http://www.isc.ie/downloads/know.pdf</a> , Seite 64
2006	Electronic Smart Card available	Germany	BMGS, Bundesministerium für Gesundheit und soziale Sicherung, <a href="http://www.bmgs.bund.de/deu/gra/spi/3628.cfm">http://www.bmgs.bund.de/deu/gra/spi/3628.cfm</a>
2008	Electronic Health Records fully functional	UK	UK Government, Peter Drury, DH Information Policy Unit at the ETHEL Conference on 29.11.2002 in Belgium and UK foresight panel health care 2020 (2000), <a href="http://www.foresight.gov.uk/index.html">http://www.foresight.gov.uk/index.html</a>
2010	Cost-effective telematic sensors available	Germany	Germany, Futur Leitversion, „Ein Leben lang gesund und vital durch Prävention“ Berlin, Juli 2002, <a href="http://www.futur.de/de/dateien/Praevention.pdf">http://www.futur.de/de/dateien/Praevention.pdf</a>
2010	Effective preventive models available	EU Commission	European Comission, User friendly society, ISTAG, Scenarios for ambient intelligence 2010, K. Ducatel, M. Bogdanowicz, F. Scapolo, J. Leijten & J-C. Burgelman, February 2001, IPTS, Page 30, <a href="http://www.jrc.es/cfapp/reports/details.cfm?ID=587">http://www.jrc.es/cfapp/reports/details.cfm?ID=587</a>
2010	The average OECD citizen possesses a smart card that points to his or her health history	PRISMA	Prisma Forecast, <a href="http://www.prisma-eu.net/prisma2002/pages/index.htm">www.prisma-eu.net/prisma2002/pages/index.htm</a>
2010	Remote delivery of health care from a central-ised facility feasible with consequent positive effect on social cohesion	IPTS	IPTS, Seville, Emerging Thematic Priorities for Research in Europe Working Paper 4th December 2000, <a href="http://www.pcn.prd.fr/doctspdf/IPTS_FINALReport11.pdf">http://www.pcn.prd.fr/doctspdf/IPTS_FINALReport11.pdf</a>
2010	Around 50 billion Euro invested in information systems for hospitals	Germany	CFO NEXUS AG, Germany, Informationstechnologie für das Gesundheitswesen, <a href="http://www.nexus-ag.de/presse/berichte/imagebrochure.pdf">http://www.nexus-ag.de/presse/berichte/imagebrochure.pdf</a>
2010	Around 5% of healthcare expenditure spent on the telematics industry	EU DG IFSOC	EU Commission, Directorate General Information Society, Dr. Rosalie Zobel, Director Components and subsystems, ehealth 2003 conference, Brussel 22-23 May, <a href="http://europa.eu.int/information_society/europe/ehealth/conference/2003/doc/zobel.ppt">http://europa.eu.int/information_society/europe/ehealth/conference/2003/doc/zobel.ppt</a>
2010	Most health services coordinated by a gate-keeper system, where primary care providers, following guidelines, refer to secondary or tertiary care	PRISMA	Prisma Forecast, <a href="http://www.prisma-eu.net/prisma2002/pages/index.htm">www.prisma-eu.net/prisma2002/pages/index.htm</a> and e-Health-Congress in Zürich, 18.-20. Oktober 2001, PrimaryCare 2001;1:758-761, <a href="http://www.primary-care.ch/pdf/2001/2001-25/2001-25-315.PDF">http://www.primary-care.ch/pdf/2001/2001-25/2001-25-315.PDF</a>
2010	Sharp increase in systems and organizations that supply information to support health care	UK	UK foresight panel health care 2020 (2000), <a href="http://www.foresight.gov.uk/index.html">http://www.foresight.gov.uk/index.html</a>
2010	eHealth will dramatically change models of governance and the provision of health services by national and regional administrations in Europe.	PRISMA	Prisma Forecast, <a href="http://www.prisma-eu.net/prisma2002/pages/index.htm">www.prisma-eu.net/prisma2002/pages/index.htm</a>
2010	Many individuals have longitudinal records	PRISMA	Prisma Forecast, <a href="http://www.prisma-eu.net/prisma2002/pages/index.htm">www.prisma-eu.net/prisma2002/pages/index.htm</a>
2010	eHealth delivers continuous training to health professionals	Deloitte and Touche	The Deloitte & Touche, Market Analysis on the emerging European Health Telematics Industry, February 2000, <a href="http://www.ehto.org/hps/HIST-rep.pdf">http://www.ehto.org/hps/HIST-rep.pdf</a>

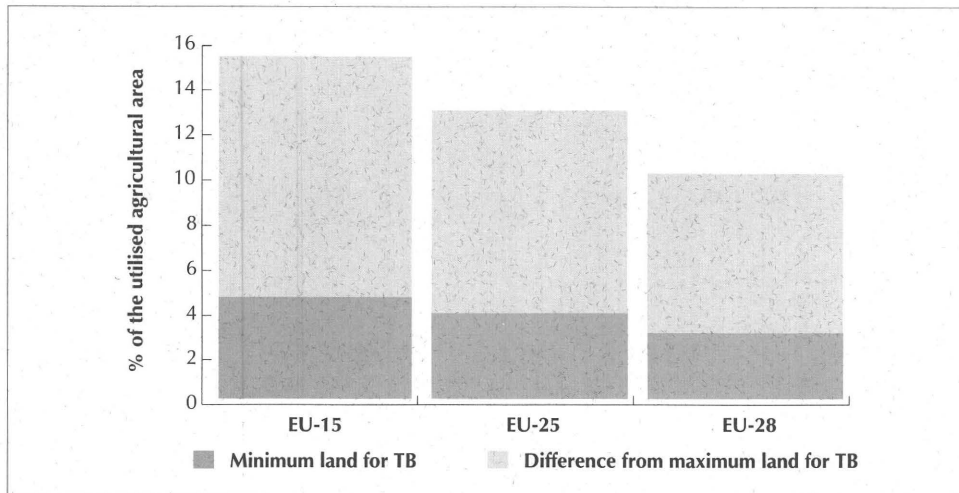
**Table 1. Roadmap for the eHealth developments of the future (continued)**

Year	Forecast	Source of Forecast	Reference
2010	Around twenty-five percent of data generated automatically Around fifty percent of health data will be com-parable Sixty percent of population have longitudinal records	Institute for Alternative Futures	Comparing Forecasts for Medical Records, Data Systems, and Related Policy in 2010, Element Extrapolative "Best Guess" Forecasts Visionary Forecasts, Institute for Alternative Futures, <a href="http://www.altfutures.com">www.altfutures.com</a>
2014	eHealth replaces the entire physical basis for the organization of the health sector	APEC	APEC, <a href="http://www.apectf.nstda.or.th/">http://www.apectf.nstda.or.th/</a>
2018	Biochips available for microsystems technologies	Canada	Canada, National Research Council Canada, Industrial Technology Foresight: Needs and Science Horizon Priorities, Ottawa, 2000. Partnership Group for Science and Engineering, Setting Priorities For Research In Canada, Ottawa, 2000.
2018	Chipcards replaced through increasing tele-networking of clinical with ambulatory sectors	Austria	Delphi Report Austria, <a href="http://www.bmbwk.gv.at/medien/4230_tech2.pdf">http://www.bmbwk.gv.at/medien/4230_tech2.pdf</a> and FISTERA, WP 1.2003, review and analysis of delphi Austria <a href="http://fistera.jrc.es/docs/D1_Case%20A%20Final.pdf">http://fistera.jrc.es/docs/D1_Case%20A%20Final.pdf</a>
2018	Combination of IST and neurophysiology	Austria	Delphi Report Austria, <a href="http://www.bmbwk.gv.at/medien/4230_tech2.pdf">http://www.bmbwk.gv.at/medien/4230_tech2.pdf</a>
2020	Patient profiling possible	Germany	Germany, Futur Leitversion, „Ein Leben lang gesund und vital durch Prävention" Berlin, Juli 2002, <a href="http://www.futur.de/de/dateien/Praevention.pdf">http://www.futur.de/de/dateien/Praevention.pdf</a>
2020	Entire healthcare and teaching of patients Norway and staff by means of eHealth	Norway	<a href="http://odin.dep.no/aad/engelsk/index-b-n-a.html">http://odin.dep.no/aad/engelsk/index-b-n-a.html</a>
2020	Broad availability of computer screens in sur-geries and emergencies	UK	UK foresight panel health care 2020 (2000), <a href="http://www.foresight.gov.uk/index.html">http://www.foresight.gov.uk/index.html</a>
2020	eHealth will become accepted and contribute to the reduction of health care costs	Germany	Vision 2020 - experts4U - <a href="http://www.experts4u.de/internet/projekte/vision2020/infos.html">http://www.experts4u.de/internet/projekte/vision2020/infos.html</a>

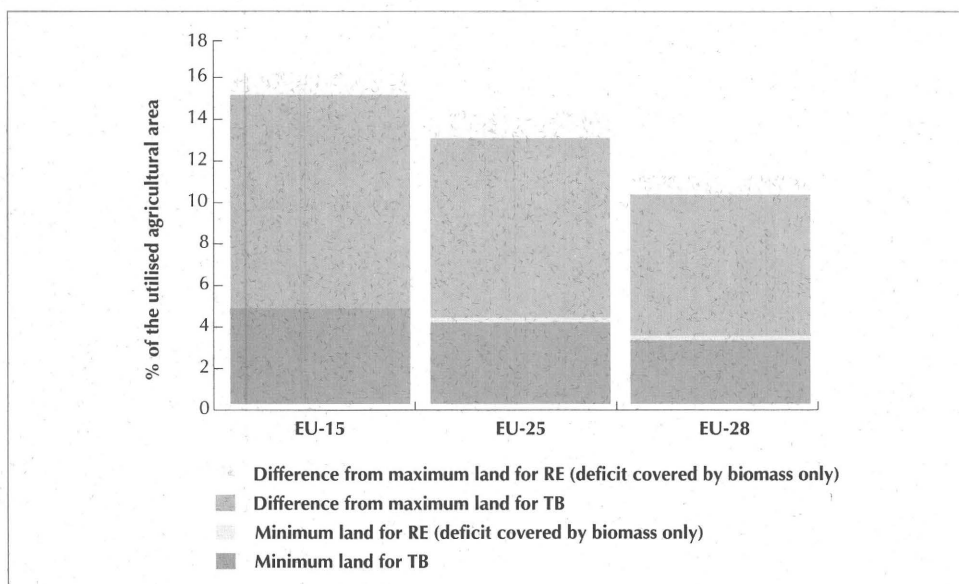


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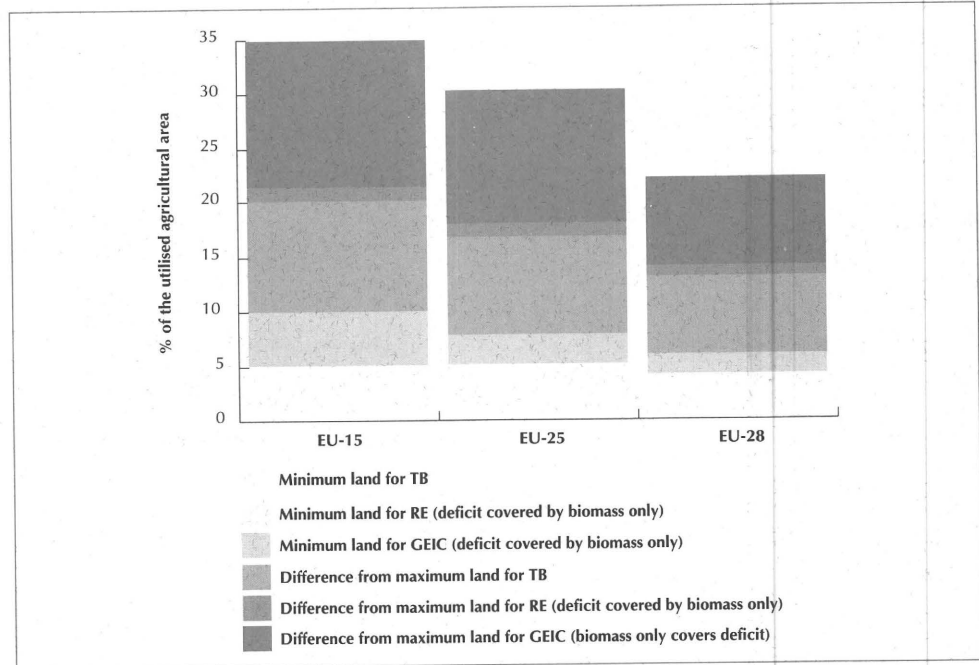
*Figure 2. Land area requirements within different EU scopes to meet the 5.75% indicative target for Transport Biofuel (TB) in 2010, under different crop composition scenarios (% of the UAA)*



*Figure 3. Best estimates of the land area requirements within the EU-15, EU-25 and EU-28 to meet the 5.75% target for Transport Biofuel (TB) and the 22.1% target for Renewable Electricity (RE) in 2010 simultaneously (% of the UAA)*

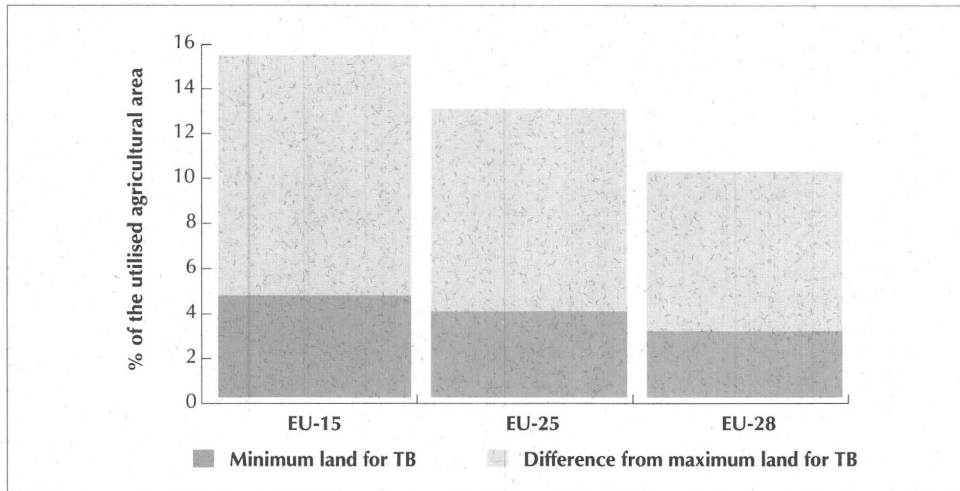


**Figure 4. Best estimates of land area requirements within different EU scopes to meet simultaneously the 5.75% target for Transport Biofuel (TB), the 22.1% target for Renewable Electricity (RE) and the 12% target for GIEC in 2010 (% of the UAA)**

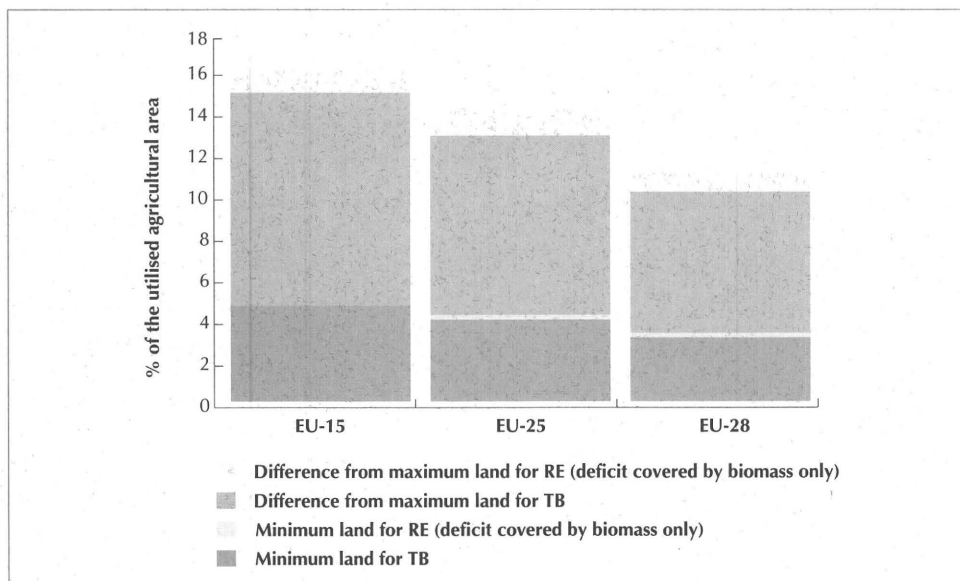


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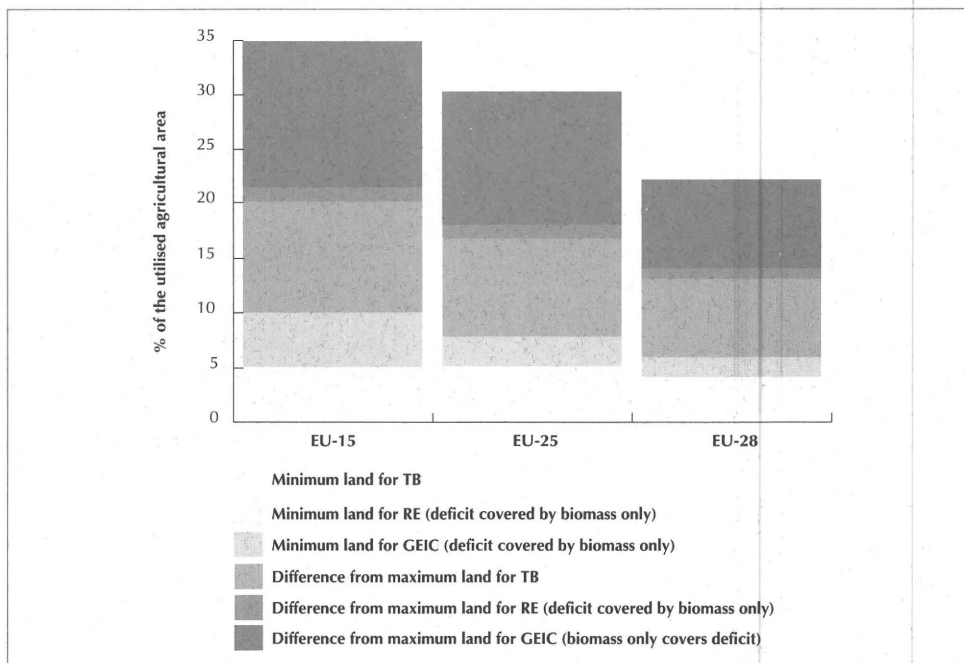
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**Figure 4. Best estimates of land area requirements within different EU scopes to meet simultaneously the 5.75% target for Transport Biofuel (TB), the 22.1% target for Renewable Electricity (RE) and the 12% target for GIEC in 2010 (% of the UAA)**





## IPTS Publications

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- Steer Davies, G., Eder P. (editor) Freight transport intensity of production and consumption  
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