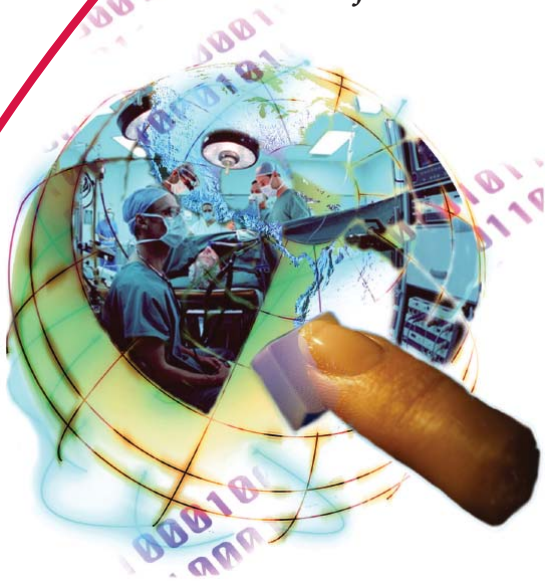
The Coherent Healthcare Society

A scenario for the role of technology in the future world of healthcare



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CSC helps clients in industry and government use IT to achieve strategic and operational objectives. The company offers a broad suite of services within management and IT consulting, systems design, integration, application software, e-business, Web-hosting as well as IT and business process outsourcing.

Headquartered in El Segundo, California, USA, the company was founded in 1959 and is now represented in 800 offices worldwide.

CSC has 90,000 employees worldwide and more than 2,500 employees in Scandinavia.

For more information, visit the company's web site at: www.scandihealth.com.

CSC Scandihealth A/S is the leading Danish developer and supplier of electronic patient records, homecare solutions and clinical quality assurance systems. We develop healthcare IT using the latest technology and create coherence between systems - for the good of our customers.

Since 1972, we have excelled at developing and supplying healthcare IT to Danish hospitals. We have created an unrivalled product range, a unique pool of know-how within the healthcare sector and an in-depth knowledge of the world of our customers.

More than 280 employees are primarily working with the development and supply of healthcare IT. The knowledge and expertise of our employees encompass technology as well as healthcare: a combination providing us with a sound basis for further developing and delivering healthcare IT solutions that allow our customers more time to concentrate on their own core services.

For more information, visit the company's web site at: www.scandihealth.com.

It is almost half past six in the morning and today's news will wake you up in just a couple of minutes. All through the night, the integrated insulin regulator in your body has controlled and maintained the insulin level at a reasonable level. Suffering from diabetes used to be a drag when you had to administer the insulin doses yourself by means of injections. The regulator registers and logs the insulin level together with other vital data, and regulates the level by means of a small insulin container located under the skin of your belly.

At half past seven you wake up to the sound of the news. Your news agent has picked the financial news and the latest national news. You have received three new messages and a confirmation of a new doctor's appointment for to have your insulin container refilled. During the night, the insulin regulator has registered that it is time for a refill and has made an appointment with your local GP, after consultation with your own calendar. In addition, it has sent the vital data that has been registered recently. "Stop news!" you say, as you get out of bed.

The pace of the technological development is daunting, and more and more new services become available. Telemedical diagnostics and treatment, smart environments, functional food, and close integration with the environment, just to mention a few of the services that are available to people in the affluent countries.

The local and global healthcare society is changing. Norway has joined the EU and is closely integrated in the European healthcare network. Global specialisation, integration and exchange of information and co-operation characterise the healthcare services of the future. Patients are free to choose where they want to be treated and have good access to healthcare information and services via the global network. In addition, they have ample opportunity to acquire knowledge and information about their own health, which is something that especially appeals to women.

The Coherent Healthcare Society

Content

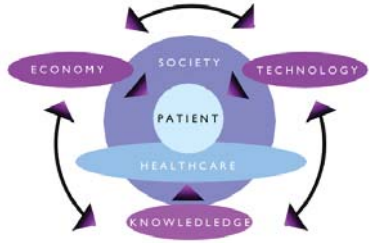
The Age of Opportunities

The advance of technology is changing the healthcare industry, and information technology will constitute a key factor in this development.

Futurologists have tried to predict the development of the society in the industrialised countries and called the vision »The Citizen-centric Information Society« or »The Dream Society«. If we are to believe this prediction, the future will bring about major changes in our consumer patterns and our use of health services. We will demand products that give us an experience, identity, and a feeling of control. We want unlimited access to information, anytime and anywhere, and will make heavy demands on technology to get the right information to the right person at the right place and at the right time. We will spend more time at home and want to perform more and more tasks from our homes. Technology will increasingly become an integral part of everyday life, but also more invisible.

Up to this day, organisations and enterprises within different industries have undergone radical changes, as they have seized the new opportunities within technology and organisation. Today medical technology and IT offer treatment methods that were once inconceivable. In addition, new ways of communication, co-operation and organisational opportunities are emerging. The advance of technology and/or combinations of known technology present great opportunities for the health services of the future. At the same time, society is faced with great challenges in terms of an increasing number of old people, new pathological pictures, increased healthcare costs, etc. How will the development of the society affect the health services, and what demands will be made for technology to be used within healthcare?

This report does not purport to be futuristic; rather it addresses the technological development and presents a future that uses existing or emerging technologies. The pace of the technological development is breathtaking and driven by market forces, research and new discoveries within medicine, biology, physics, and chemistry. Every day we are presented with new gadgets that are the result of new research and development. In the time to come, we will see technology that at first will seem absurd and useless for health purposes, but within a few years it will have found a form that makes it indispensable. We will experience technology that uses existing knowledge and adapts to the current situation. »Intelligent« technology will know our habits and try to fulfil our needs before we even realise we have any Technology will endeavour to support the values we treasure the most within healthcare.



THE INTERNATIONAL SOCIETY

National and international health services are affected by, for example, economy, technology and knowledge. The patient is the health services' most important client. Political and demographic trends, at national and international level, set the agenda for the technological development, the emergence of knowledge, the organisation of the health services and last, but not least, the everyday life of the patient. This report intends to give the reader an experience of technology as a present resource and business partner in the future world of healthcare.

A New Health Future

A host of different trends affect today's society and the future of the health services. Ethical problems also have a major influence on the shaping of the health services. The possibilities are immense, but do we want these possibilities? The pros and cons of our desires, and the possibilities available to us are changing overnight. For example, will our children be open to possibilities that we deem unethical today?

Trends

Population	Changes in the ratio of old to young, increased wealth and education characterise the population, in addition to increased degree of consumer awareness (»consumerism«).
Market	Globalisation of the health market. Increasing degree of market orientation, international commercialisation, privatisation and specialisation. Higher degree of user payment and »the money follows the patient« – even across country borders.
Economy	Increased expenditure on healthcare intensifies the focus on the reduction of costs. In addition, the demand for healthcare services exceeds the supply.
Health	Emergence of a new health perspective with increased focus on prevention and general health assessment before treatment. Our lifestyle affects our state of health more than ever, and increased travelling activities enhance the risk of rapid spreading of diseases.
Organisation	Increased degree of alliances and co-operation across countries and regions, in addition to merging and integration of healthcare institutions. Patients become more knowledgeable, informed and interactive in relation to their own health.
Technology	Technology is more closely integrated in our everyday lives and in healthcare. New possibilities and solutions emerge.

Today's Healthcare is Undergoing Multiple Changes:

From Local Periods of Care to Coherent, Cross-Organisational Periods of Care

The core services of the health and nursing care sector – prevention, diagnosing, treatment and nursing care – are increasingly performed by individuals and institutions working in co-operation. Exchange of information with other actors within the sector increasingly takes place electronically, for example electronic prescriptions, referrals, and medical discharge summaries. In Denmark, a national health data network (MedCom) that facilitates such communication has been established. The growing globalisation of healthcare services will also boost the demand for communication across country borders.

From Patient Administration to Patient Relation Management

The Patient Administrative System (PAS) of today aims to solve the major administrative challenges related to logistics, planning and reporting. Actually, it is not the patient, but data about the patient that must be administrated! The health service of the future perceives the patient as "customers/clients" and will integrate the various systems (PAS, EPR (electronic patient record), scheduling, laboratory systems, etc.) in a common "Patient Relation Management System (PRM)". The primary functions will benefit immensely from this new technology that can be adapted to the clinical setting; consequently, administrative activities can be reduced as well.

From Documentation of Decisions to Documentation of Processes

Years of registering data for administrative purposes will be replaced by registration of data in connection with the clinical process. Systems are to an increasing extent required to support process-oriented thinking. This shifts the focus from documentation of the decision, which is the basis for the medical professional paper-based record, to documentation of the process.

The objective of the first generation of electronic patient records (EPR) was to replace the paper-based record. Thus several of these systems resemble the paper-based record in terms of structure and functionality. The similarity to the paper-based record was supposed to reduce the need for training. The next generation of EPR systems challenges this and will concentrate more on improved support of healthcare professionals by means of process-oriented solutions.

Focus on Clinical Quality and Accreditation

The increased focus on the clinical process and quality development/assurance has fuelled the development of a large number of clinical databases. However, only a few have reached the maturity level required for actual operation today. Often developed at low cost in clinical environments and trade organisations, the databases are now being replaced by national databases for collecting clinical quality indicators. At the same time the accreditation processes are playing an increasingly important role in the daily work at the hospitals. The accreditation process has in several cases resulted in enhanced focus on medication administration as a source of error in patient treatment, and consequently some EPR projects have redirected their focus to get the medication administration process under better control.

From Monolithic to Component-based Architecture

Introducing an EPR system is a major organisational re-engineering process. Projects are often split up into a small number of projects or modules, for example medication and scheduling. The purpose is to reduce the dependency on the individual supplier and focus more on optimising the individual processes. However, a component-based structure demands more in terms of integration and standardisation between various modules.

Integration and Standardisation

Specific integration platforms and modules for, say, medication administration are available today. Still new modules and specific components are developed for health-related areas. The last decade has witnessed a strong international focus on standardisation of IT systems communication and architecture within healthcare (CEN, ISO, HL7, etc.).

Individualised Patient Treatment Based on Standards

Free choice of hospital, the growing demand for possible treatment and consumer-driven healthcare, increase the need for targeting healthcare services such as patient counselling and standardisation of episodes of care. The aim is to ensure uniform and correct treatment of the patient. In this day and age, healthcare professionals are expected to have a thorough knowledge about the individual's episode of care. In the future the various roles are increasingly supported by specific clinical management tools.

The Expert Patient – Participating in Decision-making and Monitoring

Patients suffering from chronic diseases and other patients with expert knowledge about their own diseases and treatment methods are sometimes perceived as a threat against the healthcare establishment. Patients who are more actively involved in the decision-making processes, for example monitoring, may have a positive effect in terms of economy and efficiency. "Intelligent" devices for self-monitoring and access to your own medical record via the Internet are examples of such perspectives.

More Efficient Use of High-cost Technology and Expert Knowledge

Thanks to increased centralisation and rationalisation, institutions are emerging that exploit knowledge and high-cost technology to a higher degree. Local hospitals are closed down in favour of specialty clinics at central hospitals. The geographic distance between patient and expertise has accentuated the need for telemedical solutions. Such solutions would enable remote diagnostics, improved check-up possibilities, access to special expertise and elimination of distance between patient and expertise, thus reducing admission time and the number of complications. Telediagnostics offers access to specialist assessment and evaluation of symptoms and vital data 24 hours a day.

Commercial Health Services

As reduction of waiting times, finance, and resource issues dominate the political backdrop, the supply of commercial health services is escalating. Norwegian patients have been offered treatment abroad because private clinics and hospitals in Denmark and Sweden have excess capacity. The future world of healthcare may be characterised by increased national and global competition for the patients.

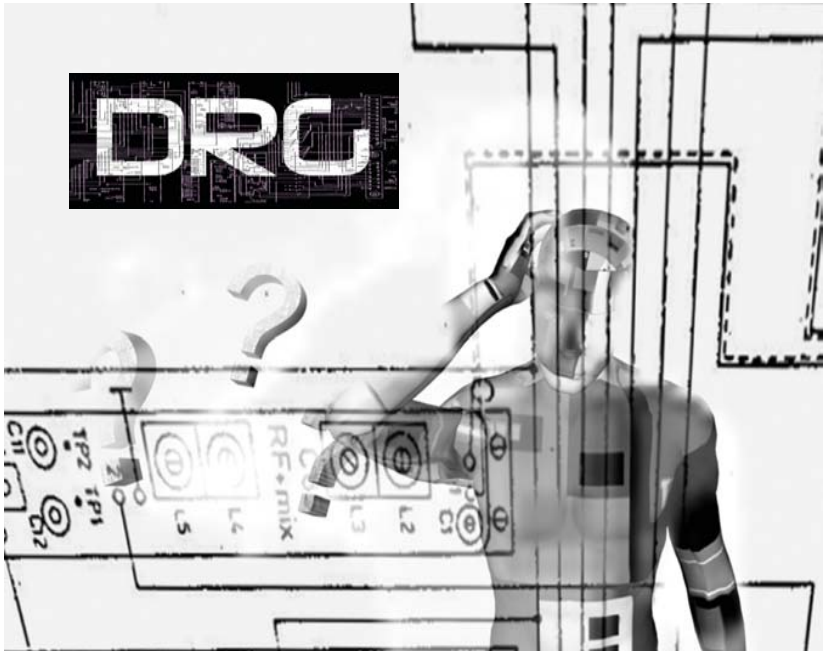
Management Information, Cost Minimisation, and Financial Control

A cost effective health service hinges on management tools that offer professional, administrative and financial overview and analysis, also known as Business Intelligence (BI). The information requirement comprises vertical management information, on-going dialogue between politicians, administration, various enterprises and citizens (information, follow-up, quality assurance) and horizontal management information, i.e. information targeted for management level (planning, operations, etc.).

»The money follows the patient!« is one of the catchphrases that regularly crops up on the political scene. Thanks to the implementation of the American DRG system (Diagnosis Related Groups) in the Scandinavian health service, as well as an increased degree of performance financing, a business approach towards future health service management is gaining momentum. In the DRG system, costs and the correlation between correct diagnoses and services will have an impact on the financial framework available to the health service provider.

It's Time to Embrace New Technological Possibilities!

Technology per se cannot solve the challenges facing the healthcare industry. An EPR project comprises some 20 percent technology and 80 percent organisational development. All thanks to the use of technology. Some healthcare professionals still have never used new technology such as PCs, and several think that technology promotes provider-patient alienation. The future must focus on training, user-friendliness, and adaptability. Technology is a tool, not a goal in itself.



Futuristic Scenario

How will technology influence the future world of healthcare?

The Patient
- an Active and Informed Life

The world has come to a halt for Lars Hansen. Although he only has a few hours of work left, it feels like an eternity. The headache that has been slowly progressing since lunchtime now feels like a heavy ring pressing on his head. Lars is working as an IT associate at the new national Centre for Social and Health information (SSI), the healthcare institutions' answer to the growing international competition within the healthcare and social sectors. It is still too early to assess the effect, but an aggregation of all Internet activities is likely to boost the potential for web-based services offered to the public. Lars takes an aspirin. The headache is getting too severe and something has to be done. Lars is testing the new voice recognition system for the national health portal, so he decides to test it with a very relevant and pressing medical case.

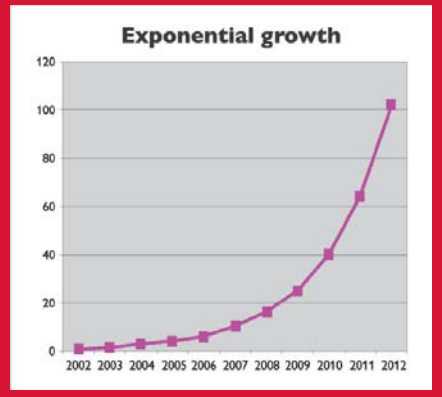
The futuristic scenario is made up from various different trends; technology trends, health trends, social trends, statistics, available technology and research material, etc., and is divided into the various phases or situations found in the everyday life of a patient. The scenario addresses medical technology, biotechnology and information technology, but with special emphasis on information technology.

Moore's Law
- Continued Exponential Growth in Performance

Moore's law was formulated by Gordon Moore, founder of Intel Semiconductors. In the 1960s he predicted that the number of transistors on a microprocessor would double approximately every 18 months. This development still holds true, despite various predictions.

Exponential growth not just affects electronics. Disk capacity and bandwidth have followed a similar trend, but at a higher rate – disk capacity now doubles every ten months while bandwidth doubles every six to nine months!

The illustration shows how fast performance grows exponentially. The graph shows the classic Moore's law, that is, doubling every 18 months. In ten years' time computers may be 100 times more powerful and feature 100,000 times more storage capacity in the same space. Hewlett Packard has just presented its prototype of a polymer memory chip with a density 100 times higher than today's disks. The chips will not be commercially available for another few years.



Technology Offers New Opportunities

Technology may change our future by integrating people and organisations more closely, presenting new trading patterns, access to information and new treatment methods. This development also means facing new challenges, such as increased monitoring and control.

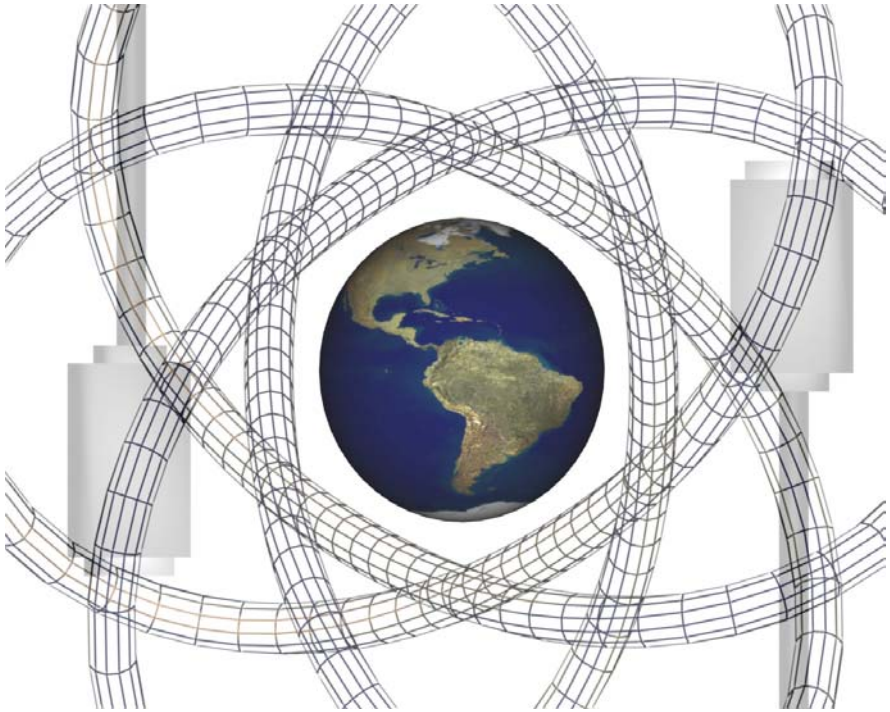
For the past hundred years, medical development has had a positive effect on public health, prolonged the life expectancy and improved the quality of life. Medical technology still remains one of the major drivers of this development, and today contributes with exciting new development within areas like gene therapy, imaging, nanotechnology, designer drugs, various types of surgery using surgical robots and endoscopy.

The mapping of the human genome has enhanced our understanding of the human organism. Our quest to solve the riddle of life has also fostered research in technological solutions that can handle and contribute to the understanding of the new and huge volumes of data. The integration between different types of technology and biology presents new and revolutionary ways of integrating man and machine more closely. IT is the language of genetics, just as mathematics used to be the language of physics.

The boom in information technology is expected to be a key factor within healthcare in the time to come. Today new technology is used for communicating information, telemedicine and automating work processes, but the degree of IT support for the core patient-related processes is still minuscule. While advanced and costly technology, especially within digital imaging (CT, MR and PET scanning), is used to an ever increasing extent, only limited funds have been invested in modernisation and new development of administrative and clinical IT support.

Various types of technology have triggered fundamental changes, for enterprises, organisations, and various professions alike. CSC's experts expect the following ten technology trends will lead to radical changes in the society of the future:

Drivers	Trends
Ubiquitous bandwidth	Anytime, anywhere digital services will be available.
Smart environments	Homes, offices and everyday objects will become networked and intelligent.
Built-in network	A network available anytime and anywhere, spawning new products and services, and new ways of exploiting information.
Knowledge discovery and exploitation	Knowledge will become a tangible asset; decision-making will be faster and more informed as the information available increases.
High performance	Ultra fast computers will enable us to model and mine increasing amounts of data.
Digital money and electronic micropayments	Programmable digital currency will reshape how we buy and sell.
Privacy, security and information survivability	Keeping our secrets secret and our business processes fail-safe will be even more critical as the digital age advances.
Virtual spaces and simulation	Testing ideas and experiences virtually. New knowledge awaits us.
Human-computer interaction	Everyone will communicate more naturally and effortlessly with computers. Ultimately, technology disappears and blends into our natural environment.
Miniaturization	Microscopic machines will revolutionize our lives and the way work is done.



More and More become Networked!

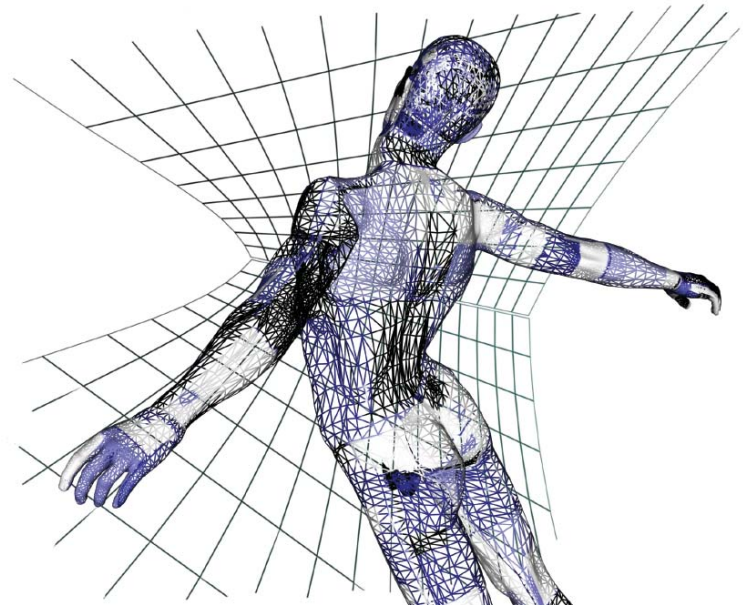
60 percent of all households in Norway and Denmark have access to the Internet. By the end of May 2002, 67.5 percent of the Swedes had Internet access from their home. The younger generation uses the Internet the most, and the use decreases with age. The difference in the men-women distribution is less noticeable, but more men than women tend to access the Internet. If we look at Western Europe as a whole, Internet access totals some 39 percent (116 million people). This proportion is estimated at 67 percent in 2006.

Source: EU, Forrester Research, Nielsens-Netratings

The General Practitioner
- Everyday Life Made Simpler

»...shouldn't we refer her for surgery? At her age and with a back injury this severe, I see no other options". Per Olsen, a general practitioner, looks at his colleague at the hospital while sipping his coffee. These Internet-based conferences really save time, and Per spends quite some time talking to his colleagues in this way. "I think you should schedule a pre-admission examination for her at our Polyclinic, but of course I trust your evaluation", the colleague smiles.

Per Olsen takes one last look at the collection of images that clearly shows the patient's back injury and closes the conference. He opens his appointment book. Minutes later the patient has been scheduled for an appointment at the hospital, and a message that confirms the appointment has been sent to the patient. A patient's guide is automatically sent together with the message and a new message in her calendar. Although the importance of IT is gaining momentum in his everyday life, Per Olsen and his seven colleagues at the health centre still have a waiting room. However, patients are seldom waiting there for very long. Previously, chronic patients (for example diabetics) often came to have their medication adjusted, but now this has been replaced by self-monitoring and automated alerts based on treatment plans that are run centrally. Sometimes Per also receives messages from his "regulars". Among the messages received is an inquiry from a new patient whom Per has not met before. A younger man who suspects he suffers from hypertension asks for an appointment tomorrow morning. By answering a number of standardised questions he has described his medical history, and it appears that his blood pressure has been measured at 210/140 in a health shop and that the patient suffers from daily headaches. Per confirms the appointment and is ready to see his next patient who has just arrived in time for her appointment.



Healthcare – an Expanding Market

The proportion of old people in Scandinavia and Europe is growing. In Norway the +60 age group is expected to grow from 20 percent in 2000 to 26 percent in 2020. At the global level, the UN expects the number of old people worldwide to grow from today's 600 million to 2 billion in 50 years. Thus around 2050 there will be more people in the +60 age group than under the age of 15. This increase is related to higher life expectancy together with the low birth rate among young people.

Scandinavia has experienced a boom in healthcare costs over the last years. In addition to demographic changes, increased popular wealth, higher education, and information access have accentuated the pressure to expand the supply and quality of healthcare.

The state of health of people in the affluent part of the world is increasingly affected by diseases and ailments that are more complex, difficult to define, and less visible. Calculations show that some 50 percent of our health problems can be attributed to our lifestyle, among other things smoking, lack of exercise, alcohol consumption, drug abuse, and adverse drug reaction. In the US alone, some 300,000 people are estimated to die every year from diseases caused by obesity, something that costs the American society some 177 billion dollars.

Diseases attributable to lifestyle and age are somewhat more predictable than other diseases, which may make it simpler to balance healthcare development in relation to the expected future need. In this context it is striking that 90 percent of the world's health research focuses on diseases that affect only 10 percent of the population on Earth.

Remote Healthcare

The definition of telemedicine can be found in the prefix tele, which means »remote« or »at a distance«. Telemedicine is the practice of delivering healthcare between distant locations a few feet or thousands of miles away among healthcare providers and patients.

There are different kinds of telemedicine today. Teleconferencing makes it possible to transfer images and audio, and enables the specialist to assist in, for example, a surgical operation via the network. Remote monitoring is the registration and monitoring of the condition and vital data of the patient via the network by means of small sensors. Telemedicine also comprises transmission of control signals via the network. For example, signals can be used for controlling a surgical robot over the network. However, it is essential that telemedical solutions are adapted to the properties of the available communication channels, such as transmission capacity and delay.

Videoconferencing is the most basic telemedical service and makes it possible to get assistance from specialists in other parts of the world. However, transferring audio and images may be costly, especially when using high-quality satellite transmission.
Remote monitoring is the use of sensors that transmit various kinds of data and can simplify the exchange of information between healthcare personnel. An example of this is FieldCare, SINTEF's new solution for disaster or crisis areas.

FieldCare provides wireless communication between medical personnel, transport workers and hospitals. This simplifies the evaluation, planning, and initiation of treatment for the involved parties. The injured are equipped with a small electronic tag (Personal Information Carrier) that contains medical information about the patient. The tag sends the patient's data to the computer of the chief medical coordinator, thus presenting a local overview of the situation. The medical personnel are equipped with small handheld PCs/PDAs (Personal Digital Assistant, e.g. Palm or PocketPC) that allow them to read data. Doctors can also dictate messages directly into their PDAs. The advantage of such a solution is effective and efficient communication, locally at the scene of the disaster as well as regionally (from the scene of emergency to the hospital/A&E). In addition, medical personnel have access to decision support through the system or via electronic communication with other medical personnel.

The wounded are wearing small, electronic tags around their neck. Medical personnel are equipped with PDAs. This facilitates communication from the victims to the treatment centre.

Photo: Courtesy of SINTEF Telecom and Informatics

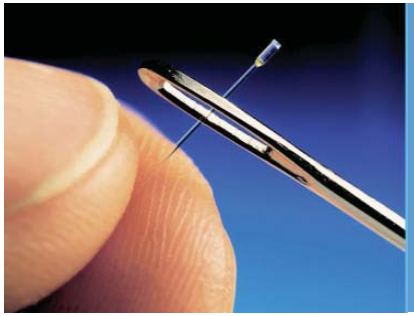
Another aspect of telemedicine is integrated solutions that register position-based emergency calls from people and other data systems. For example, healthcare personnel can track the position of the ambulance at any time. Continuous connection between ambulance and hospital allows transfer of clinical data from the ambulance to the hospital. Paramedics can also receive decision support in the form of statistics, information about diseases, the patient's medical history, optimised routing information, etc.

Geographic and technical limitations can lead to the development of proprietary telemedical devices capable of operating with a relatively limited transmission capacity. The price/performance ratio in relation to future computers, together with miniaturisation, will provide us with small, low-cost, but advanced multi-purpose sensors. The sensors are suitable for monitoring various non-emergency conditions and allow patients to take measurements at home. Miniaturisation enables implantation of sensors into the human body for transfer of data via the network. Other types of implants are small devices developed to dispense precisely controlled doses of medication to specific sites of the body.

The telemedical development has also been inspired by needs other than distance. Humans have limitations in relation to precision, repetition rate, speed, or simply room for fingers. Surgical robots are available, controlled and managed by humans. The surgical robots can be used over short and long distances. For example, a field hospital can access expert competences through specialists that perform diagnostics and treatment comfortably seated at their workstations outside the war zone.

Robots in the operating theatre, like the da Vinci Surgical System, enhance the surgeon's skills and allow fine tissue manipulation, and thus minimise invasive procedures.

Source: Intuitive Surgical, Inc.
da Vinci is a registered trademark of Intuitive Surgical, Inc.

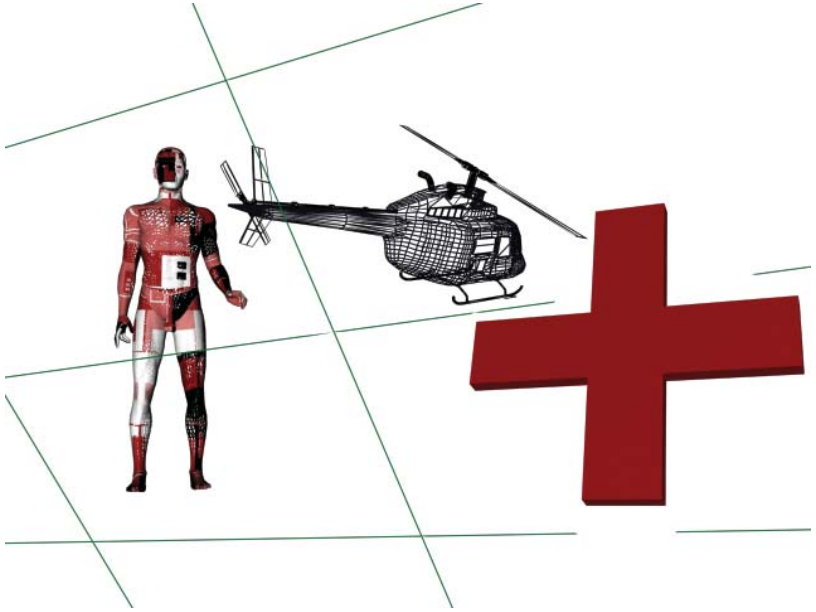


Connected to a catheter, this micromachine is introduced into the body during or after surgery. The sensor at the tip provides high fidelity measurement of the blood pressure, for example at the heart. The device, which costs some $20, is ideal for disposable applications.

Source: FISO Technologies, Inc.

Disaster Medicine
- Export of Competences

At the hospital Per's colleague, Martin Hansen, senior consultant, has already started on the next consultation. "The patient obviously has a severe injury of the spleen". Martin enlarges the image and through the VR scan (Virtual Reality) he takes a closer look at the growing shadow that reveals an injured spleen in the patient in Afghanistan. Martin is part of an international corps of medical specialists that are able to examine, assess and operate patients in disaster areas all over the world using the latest telemedical technology. Thanks to a number of mobile robots that are capable of performing everything from scanning to laser surgery and VR visualisation, advanced medical procedures can be performed at a number of mobile hospitals without the presence of specialists. Martin puts on the VR glove-and-helmet kit. 10 years ago this kind of equipment was mainly used for computer games, but now it makes it possible to be "present" anywhere in the world. Through the glove he can feel the patient's abdomen and via the helmet he visualises the patient. The patient is a 30-year-old man who has been trapped in a collapsed building after an earthquake with more than a thousand injured. He is awake, but appears to be in shock. Martin explains to the man what is going to happen and the system automatically translates what he is saying. The man nods, he understands, and Martin starts to palpate the man's abdomen. Martin finds that the injury is acute and requires immediate surgery. He briefs the assistant in Afghanistan about his findings and asks her to prepare the patient for surgery and continue the treatment for shock.



On the screen Martin sees that the abdominal team at the field hospital won't be available for another 10 hours or so. "We have to find out whether he will survive that long", Martin ponders, "but the other patients in the queue cannot be moved". It would have been great if he had been able to remove the spleen of the patient using telesurgery, but technology is not that far advanced yet. Martin is contemplating the alternatives. Should he ask to have the patient transferred to the field hospital in Kandahar or perhaps ask for assistance from one of the other international help organisations in the region? A quick look-up in the CTR (Central Triage Register, that is the central patient register for the disaster area) reveals that Red Half Moon has available capacity at their field hospital just a few miles away. Martin asks his assistant to contact them and arrange an immediate operation. Then Martin explains the patient what it going to happen and clicks on to the next patient on the list. The next patient is a little boy from Kashmir who has been hit in the abdomen by an antipersonnel mine. He has a wound right above the liver, and Martin's job is to investigate what damage the mine fragment has caused.

Knowledge as merchandise

The continuous proliferation of the Internet has changed the value of information. Conventional dissemination of information through magazines and books is facing competition from free service providers in all fields. The work and distribution of information is a costly process and the economic viability of this will be subject to assessment. Today a number of Internet-based information services also charge a fee to ensure the quality of the information.

VR – On-site from Afar

Virtual Reality (VR) is a technology that enables interactive access to a relatively realistic visualisation of a data model. The user can navigate inside the data model, thus simplifying the handling and processing of abstract data. The classic VR kit comprises shuttered or semi-transparent goggles and other units such as gloves. These units are used for user-computer communication. The user will feel the pressure and resistance in the glove, dependent on the actions performed. For example, if the user grasps an object that the computer projects to the goggles, the glove will press against the hand and make the user feel what he/she is grasping. VR holds a great potential for simulation applications, for example surgical training on simulated patients. In Germany, a research centre in Karlsruhe (Forschungszentrum Karlsruhe) has specialised in virtual human models for surgical training.

Interview

IT May Improve Efforts in Disaster Areas

Dr. Jens Hillingsø, PhD, abdominal surgeon and former chairman of Doctors Without Borders in Denmark.

– Disaster medicine of today is a special discipline that calls for expert assistance in a great number of fields. However, sufficient means are seldom available. One could wish for access to advanced technology and specialists within medicine and surgery, in particular specialists within orthopaedic, neuro, thorax and abdominal surgery, but it will never come true because the action areas are difficult to access, not to mention the limited financial resources. What you have to focus on in a disaster area is a primary assessment of the extent of the damage. Then prevention of communicable diseases must be set to work as soon as possible, through vaccinations and setting up water supply, sanitation, and housing. Then follows the monitoring of epidemics, the general state of health, and finally all these efforts must be coordinated.

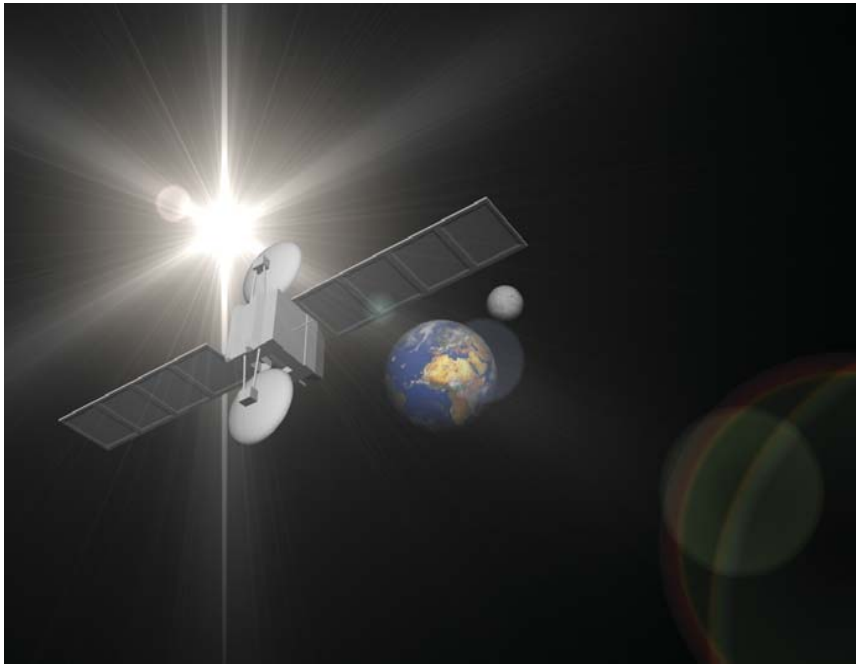
– The key words are prioritisation, logistics, and communication. As disaster medicine mainly focuses on the treatment of many, perhaps several thousand people, the most critical resources are manpower, time, and medicine. Transport of the injured is also vital if it is possible to set up reception services for the most seriously injured patients as will often be necessary in war zones.

– When it comes to technological aids in a disaster area, we need several different solutions. Mainly solutions that enable ordering of services, ensure communication lines and monitoring. It would have been a great help if we had a system that could monitor the resources locally, regionally, and »at home«, that is, at the hospital or the command post assisting with the relief work, not to mention to be able to order relevant equipment, food, medicine, and necessary personnel. Another problem is that more often than not there is no electricity or good communication lines in a disaster area to ensure communication locally, regionally, and against the central system by means of a self-contained communication solution based on wireless or satellite technology. If the system also were able to receive data from surveillance satellites, we would have had a better overview of the movements at the frontlines or major groups of refugees; also, it would have made it simpler to get one's bearings and monitor the relief/operating area. Satellite-based surveillance can also enhance the security for relief workers, presenting an overview of the position of the personnel and making it simpler for the individual relief worker to establish his position. The risk of getting lost will be greatly minimised.

– Telemedical conferencing using images could become a valuable tool in difficult emergency cases, allowing doctors situated in other parts of the world to contribute to patient diagnosis. By means of a PDA, the doctor could transfer images of skin changes or skin injuries to a colleague or a specialist sitting in another part of the world. Such a solution can present good communication links between the medical personnel and specialists in other parts of the world where medical personnel can receive guidance and support, and in some cases delegate some of the work to specialists within the field in question.

– You could also have mobile devices for ultrasound scan and MR scan where doctors on-line can receive guidance on how to move the ultrasound probe across the patient, and at the same time have the scan assessed by a specialist at another site. Mobile laboratories for blood analysis could enable on-line storage of values and automatic presentation of the proposed preliminary diagnosis. Alternatively, the blood sample could be »encoded« digitally into a kind of bar code and sent to other parts of the world for interpretation. The result of the blood sample could be returned electronically.

– Easy access to works of reference with relevant pictures would make a good decision support. In addition, voice translation solutions would make it easier for doctors and patients to communicate by means of the computer rather than an interpreter.



Consultation
- New Resources and New Opportunities

Lars Hansen has no problems finding his »new« GP. The patient's guide he has received contained a video presentation of how to get there, a pleasant introduction to Per Olsen and his professional profile. Lars feels quite at home although he has never been there before.

Lars is greeted by a receptionist who asks him for his ID card. The card gives the GP full access to all the data that Lars is prepared to disclose. If Lars had been ill before, the GP would have had access to data about previous episodes of care, in addition to laboratory results and x-rays via the network. Now the GP will have to make do with Lars' current medical history, which means that the nurse is already asking Lars to take a seat in the patient monitoring room. In the small room it is possible to make various investigations that require quiet surroundings such as measuring the blood pressure. Lars is listening to relaxing music while his blood pressure is being measured and is just about to fall asleep when the nurse returns half an hour later.

Per Olsen, the GP, explains that the blood pressure is still too high, but the reason is not clear. A micro blood sample immediately shows that Lars is low on potassium.

The GP recommends Lars to go through an investigation programme with blood samples and 24-hour urine samples combined with a scan of the kidneys, adrenal glands and the renal arteries at the central hospital. "Do you know when I'll be scheduled for this?" Lars asks. "Let me see!" The GP asks the system to plan the investigation programme. "You have several options here, you can start in a month at the central hospital or in a week at the private UltraHealth clinic in Healthtown. But in that case you have to pay yourself if you are not insured", the GP says, "but you are, I see". Lars does not hesitate. "Make an appointment at the UltraHealth clinic".

When Lars leaves the health centre, he is equipped with a small bracelet, which is a blood pressure measurement device. "This is a new state-of-the-art blood pressure measurement device that allow for wireless connection to the network. That way we can keep an eye on your heart and blood pressure 24 hours a day!" the GP claims. "All you have to do is to carry the device at all times, and your data will automatically be transferred to your medical record". The GP scans the barcode on the blood pressure device that immediately starts to blink faintly.

The Health Society of the Future

More often than not, patients contact healthcare providers because of health problems. In future patients may still rely on the healthcare industry to solve their problems through the core services of diagnostics and treatment, but the patient focuses on the solution of the actual health problem. The very existence of the healthcare industry hinges on its ability to fulfil the patient's wish to get well, to receive optimum treatment, guidance, and counselling.

From the patient's point of view it is often very difficult to get an overview of the health services. The experience of good treatment and service is closely related to the personal contact and to the information that healthcare staff offers the patient. When a patient contacts her general practitioner, she expects the doctor to know about the unknown, that is, what is going to happen to me, where must I go and how do I get well again? When arriving at the hospital she expects the staff to know what is going to happen and what plan to be implemented. It is important that the patient is treated as a unique person who is given the best treatment the hospital can offer. When received for treatment, the average Scandinavian patient will not make any financial assessment or assess the extent of the technical aids. The technology required to deal with the disease in question is expected to be available to the hospital. Only few patients have knowledge about any complication risks and the actual cost of the treatment. On the other hand, the structural quality and service that the patient receives will be essential for most patients. This could be anything from waiting times, single room or common room, access to telephone and television, food and rest room facilities. The professional quality of the actual treatment will of course be of great importance for some patients, but these mainly constitute the small proportion that experience complications during treatment.

From the point of view of the healthcare provider, patients must be treated as fast, economically and efficiently as possible. The aim is to carry out patient treatment fast and without complications. The general practitioner knows how to solve most health problems. The health problems that are referred to specialist healthcare are often complex and present special requirements of professional quality, overview, coherence and process.
In order to perform the treatment with the highest degree of professional quality, medical personnel must be given the necessary training and expertise, and the technology and other resources that enable efficient and fast treatment must be available to specialists. The realisation of this has triggered a growing centralisation of specialties.

Nowadays patients are admitted to the hospital through the emergency services or through a referral from the GP. In emergency cases there have often been no time to plan the treatment in advance, and therefore planning is made on the spot based on the available information. It may be possible to get information from the patient or the patient record, but more often than not the patient is perceived as a condition rather than part of an episode of care. When the situation has been stabilised and relevant information has been collected (previous admissions, medication, etc.), treatment can be planned and performed. In addition, patients with long-term periods of care may experience a number of situations where information about the patient is passed on. For example information about state of health, test results, treatment outcomes and further course of treatment. The general practitioner sends a referral; the hospital assesses the referral and passes on the referral, etc. These patients are often treated by specialists from other departments or hospitals, and by the general practitioner who must be informed about the treatment outcome. When the patient is discharged, a medical discharge summary is sent to the referring healthcare provider and, if necessary, a discharge note with recommended treatment plan to the healthcare provider responsible for nursing care/home care. The pharmacy will receive the prescriptions electronically and the patient need not waste time waiting or appearing at the pharmacy in person. The patient can make an appointment for a check-up via the Internet. The last few years, hospitals have focused on standardisation of core processes, for example through accreditation. Work processes (methods and procedures) are analysed, described and compared with international standards. At the same time standard clinical pathways

A New Perspective on Health

Historically and to this day, health has mainly been conceived as the "absence of illness" and the treatment plan has aimed at treating an illness. This treatment-oriented approach has shaped today's hierarchical structure within healthcare where a biomedical perspective has prevailed and still prevails in the treatment of patients.

However, our concept of health is expanding and has come a long way towards a wide understanding of physical and psychological well-being. The conventional treatment perspective is expanded with a stronger focus on prevention of diseases and social, mental and spiritual well-being. The focus centres more on the quality of life for all age groups than ever before.

The widened perspective on health introduces an extensive mentality concept focusing on emotional state, self-esteem, self-control, motivation, confidence and perception of the self. In addition, the social aspect of the individual, such as status, role, social network and relations are deemed important influencing factors on the health of the individual. This increased focus is reflected in the emergence of new offers of treatment, health service providers, training offers, literature, etc., focusing on holistic thinking.

are developed, based on national and international good clinical practice, thus making advance planning of episodes of care and patient treatment possible. It seems only natural that these standard clinical pathways are supported by IT systems that are able to guide clinicians and patients as well as ensure that the logistics in the episode of care are working.

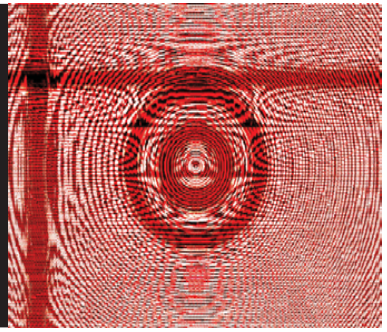
Today data is collected, processed and forwarded partly manually. This entails a risk of misinformation, and lack of or delayed information. However, the growing use of electronic communication between healthcare professionals (for example MedCom in Denmark) reduces the possibility of errors. Still, much redundant information can be found within healthcare.

A natural comparison would be to look at healthcare as an archipelago with a ferry connecting the main islands, whereas several islands remain without formal contact with the outside world. If high-speed connections were built between all the islands new opportunities would arise, but also new questions. Which bridges will be more important that others? Will the islands be populated in the future? Could other and better means of transportation possibly appear in the future?

If the predictions of the technological development hold water, integrating technology into all the types of units and environments that surround us will eventually become feasible. Technology will become pervasive, ubiquitous and invisible at the same time. It will become possible to connect different units in combinations that are unheard of today. In future, patients and healthcare personnel will be networked at all times and never give it a thought. Health will become an integral part of the society. Traditional role models and boundaries will become blurred, and healthcare providers will perceive the patient as a customer or business partner. Political trends, culture, organisational and social conditions are just some of the factors that will impact the time and speed of this development at national and Scandinavian level. However, there is no doubt that the market economy forces will affect the international technological development in that direction. The healthcare providers of the future will need marketing, cost minimisation and customer/patient relation management. Competitive parameters will comprise the patients' experience of the episode of care, the quality of treatment along with the know-how, qualifications and efficiency of their healthcare providers. In this day and age, the patient's choice of treatment is, at least to some extent, international. However, there is a need for developing uniform rules of responsibility, guarantees and treatment commitment for all healthcare providers in the market.

Patient Relation Management (PRM)

Patient Relation Management (PRM) is an IT systems architecture, just like Customer Relation Management. At local as well as national level, PRM endeavours to turn the patients' encounter with the health service into a positive experience, in addition to organising the tools used by the healthcare personnel in patient treatment. For example, planning of episodes of care and creating the necessary competences and information. This perspective is called Managed Care in various contexts.

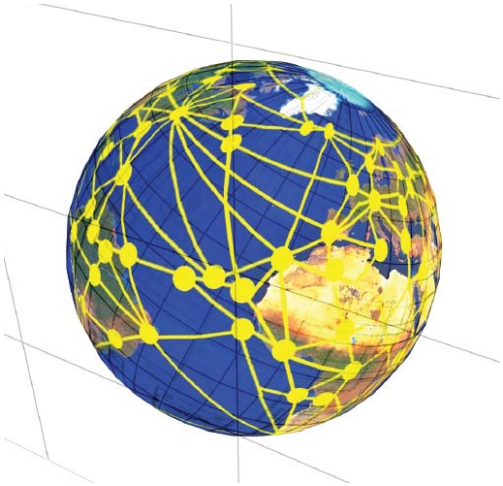


The »Front Office«

The outward image of the healthcare service provider is important to the patient. The healthcare service provider must offer correct information at the right place at the right time. The patient must be able to approach the service provider with actual problems as well as receive the most appropriate solution 24 hours a day. In modern patient treatment, the so-called "health contracts" between the patient and the healthcare service providers are gaining momentum, facilitating managed care in relation to the contract. In a PRM context this is analogous to a front office. The patient must appear in person or contact the provider by phone or electronically. Electronic inquiries must enable the patient to search for information about the organisation and treatment methods, receive personal counselling and guidance, book appointments and read the information registered about the patient. The system must be perceived as safe, that is, confidential information cannot be misused and the patient is able to check for further transfer of data. A national health portal is an important cornerstone in this context. The patient does not have to learn the entire telephone directory by heart in order to contact the healthcare service provider, but can use an entry that leads the patient to the right place or information.

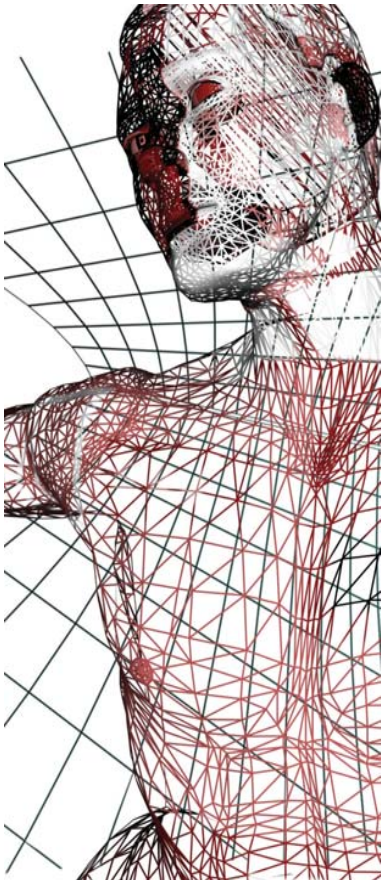
When appearing in person, the staff must be able to deliver a qualified plan for the future patient treatment and investigations and answer questions that are professionally relevant. For the healthcare professionals the IT system is a professional information portal that offers access to all underlying information and applications. The access to, for example, documentation in the electronic patient record, medicine and planning of episodes of care merges with data entered by the patient and the various decision support systems that, for example, assess the medical treatment in relation to default laboratory values.

The clinician will have access to search engines that are able to pinpoint the relevant context. If the clinician needs information about a particular disease of a patient, the search engine will assess the relevance of the data in relation to this and the information available about the patient. For example, age, sex, organisational affiliations, etc. For the clinician this is not an electronic patient record, but a patient portal containing all data about the episode of care (through the national patient index), professional guidelines, and possibility of expert assistance, for example through telemedical procedures. A central element of the front office is the electronic mail boxes and calendar (booking) that facilitate communication and planning of episodes of care and resources. Unlike the patient, the healthcare professional will be able to book appointments for treatment in other organisations, for example specialist centres at other hospitals.



The »Back Office«

The use of IT in the front office has primarily focused on supporting the primary patient encounter. The back office comprises IT systems that handle administration, finances, logistics, operations support, and quality assurance. These systems do not necessarily have the same user interface. For example, the internal mail department, kitchen, operating theatres, laboratories, image diagnostics departments, and monitoring equipment will to a great extent be operated by means of highly specialised user interfaces. The systems also feed information to the patient portal, either via direct look-up or by copying data to the central patient database. Decision makers will be able to do statistical analyses, financial simulations, data mining on data in the central databases, in addition to presenting statistics to various users via the portal.



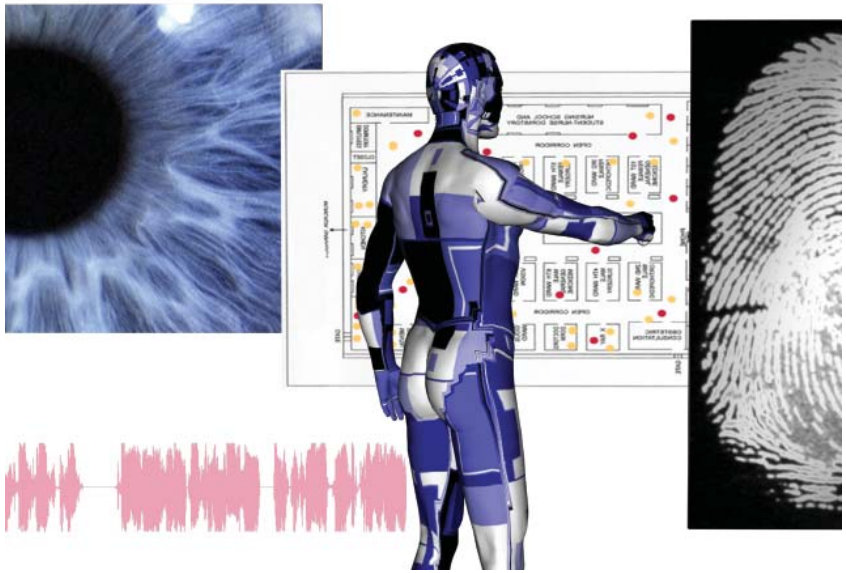
Co-ordination and Workflow

The patient's way through the healthcare service, the episode of care, the healthcare personnel's planning of the work, and scheduling are managed by means of a workflow management system. The system works like an invisible activity co-ordinator.

Central Operations and Data Storage

Interaction between different data and applications is performed in the operations department. Data is exchanged through a number of standardised communication channels, which makes it possible to replace IT components (for example various programs) without the user noticing it. The central operations organisation makes it possible to monitor systems, collect user statistics and carry out various kinds of data conversions.

The Hospital
- Safety in Treatment



It turns out that Lars suffers from renal artery stenosis, and further investigations must be made with a view to surgery at the central hospital. When Lars arrives at the hospital, he is welcomed by a friendly female voice. The voice comes from the directory map at the entrance. »Welcome to Central Hospital. Please enter your personal ID and proceed through the sluice! You can also go to the information desk if you have any questions... Welcome to Central...« Lars is not quite sure what to do and decides to ask at the information desk. The receptionist at the information desk explains that Lars has to identify himself in order to get into the hospital. He can either use his personal card or enter his personal ID if he has forgotten his card. Once in the sluice, Lars' fingerprint or iris pattern will be scanned, and he will then receive a hospital ID card. The card enables the hospital staff to locate Lars when needed. "Please take a seat in the waiting room, someone will come for you when it's your turn", the receptionist says. Lars catches a glimpse of the receptionist's computer screen. He spots a map of the hospital. "Excuse me", Lars asks enquiringly. "All those yellow and red dots moving about on the map, are they patients?" "Yes, and doctors, nurses and porters. I can also see other staff, if necessary" the receptionist replies. "In this way we always know where to find the nearest doctor!" This is a positive surprise to Lars; he takes his ID card and enters the waiting room. "Imagine, now I'm traceable...like a plane on a radar screen!" A strange, yet comforting thought.

A Password for Life

Using the data that makes us unique, biometrics automates the authentication of a person based on physiological or behavioural characteristics. Fingerprints, hand geometry, iris scans, voice recognition, handwriting are all examples of biometric identifiers. Used separately and/or combined such data provides a unique identification of any person.

ID cards, also known as smart cards, can contain various types of personal information. Anything from health information to preferences for literature, information or advertisements, etc. Another variety could be an ID card that only serves as an identifier. All data are located in the network. Various services can be tailored in accordance with the information available. Using ID cards as identification technology is expected to be a temporary solution until various biometric solutions have been established.

Security and Privacy

It is not difficult to imagine the horrors possible if sensitive information and other data are not properly secured. Data may get lost and misused, deleted or changed. The consequences would be devastating.

Critical healthcare functions must have access to secure and reliable data 24 hours a day. As organisations and individuals become increasingly interconnected through electronic networks and as more and more business and services are conducted online, the threat to information security and reliability increases. To protect data, organisations and institutions must enhance the focus on the security in their own systems and business processes.

To ensure a high level of security, the future will bring about better integration between man and the authentication process. The use of biometric analyses as authentication against IT systems is already possible, but will be much more widespread in the future. How about using fingerprint reading, iris scan or voice recognition?

A fingerprint scanner embedded in the BioLink U-Match Mouse prevents unauthorised access to the computer or network.

Source: BioLink Technologies International, Inc

Five Central Topics within Security

Authentication – Unique Identification of a Person

Authentication is the process of verifying a person's claimed identity. How do you determine the validity of a person's signature?

Authorisation – Giving the Right Person Access to the Right Data

Authorisation is about access to own data and processes. Access privileges must be checked every time a person or a system requests a service to ensure the validity of the request.

Integrity – Data Must Be Correct

Users must be able to trust that data transmitted via the digital network reaches its destination unchanged. Today this is solved by means of cryptography (PKI - Public Key Infrastructure), a sound solution that is expected to be used in the future. Integrity will then depend on the "strength" of the cryptographic solution.

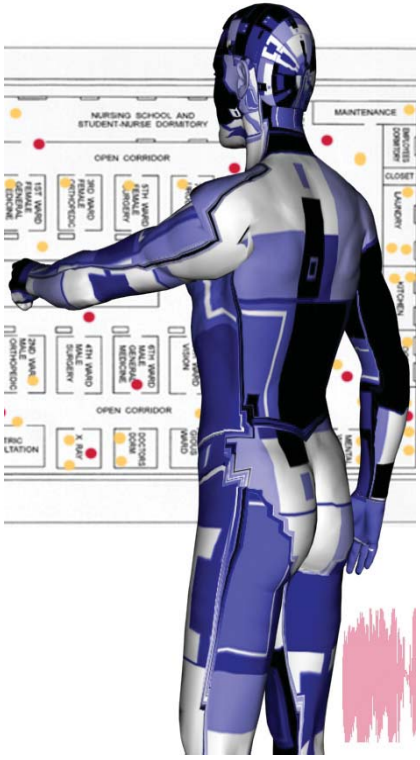
Confidentiality – Protecting and Controlling Sensitive Information

No other users must be able to access data on its way through the network. PKI solves this as well, as only sender and receiver have the required keys/passwords.

Non-repudiation – Sender Cannot Deny

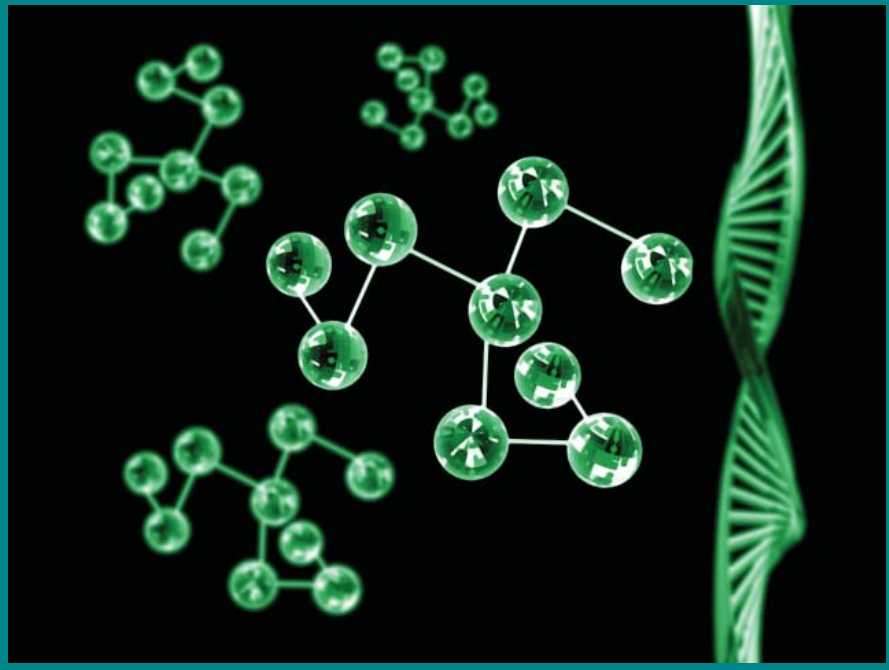
Communication The use of digital signature, rendering counterfeit impossible. This uniquely links the originator to the content of the message.

Security is as much about human judgement and human behaviour as technology. »Security solutions are 50 percent sociological and 50 percent technical,« says Ronald Knode, operations director for information assurance, Computer Sciences Corporation, USA.



Analysing Health Data – for Reliable Diagnosis

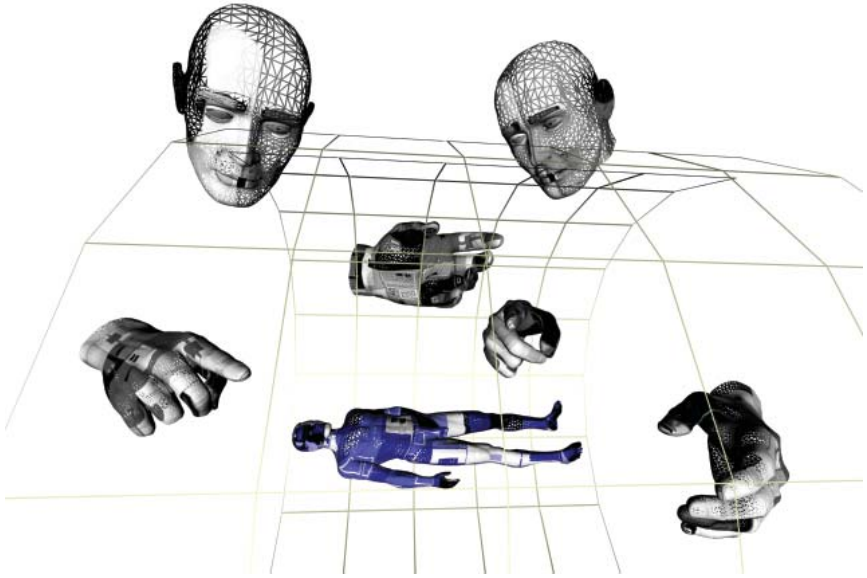
Continued increase in the number of digitalised data from various data systems as well as soaring data power presents major possibilities of performing advanced analyses and simulation of, for example, demographic trends, pathological pictures in the population, treatment of patients and adverse drug reactions. The data can be used to enhance the understanding of various health related causalities.



The Operating Theatre - Human-Computer Interaction

A while after his visit to the hosptial, Lars must be admitted for surgery. Investigations have shown that Lars suffers from severe kidney malfunction. One kidney is not functioning, while the other is functioning at 75 percent normal capacity. No wonder he's been feeling so ill. Within a week after his visit to the hospital, Lars has received a new kidney. That is, it still hasn't been transplanted, but has been made using the so-called genoplast technology. Lately, this technology has revolutionised medical transplantation. Using just one blood sample the specialists at the Genoplast Institute have created a kidney that is identical to Lars' original kidney. Now the kidney must be put into place. Lars has already read a little about the operation, seen how the kidney is made and prepared himself for the treatment plan that he has made together with the doctors.

"We better expose the arteria renalis first, don't you think?" The hand of the assisting surgeon, Henrik Amundsen, is slightly trembling. "Yes, you have a go at it too!" "While you do that, I'll prepare the laser". Suddenly there is a massive bleed from the surgical area. "The wall is simply too thin here. I think we better try closer to the aorta". The senior surgeon repeats the operating procedure. The surgeons prepare for the operation. The two surgeons are now standing in the virtual operating theatre with a copy of Lars in front of them. Using modern 3D visualisation and combining data from various scans, it is possible to perform an exact rehearsal of the operation. The simulation is so close to reality that the error rate of these relatively complicated operations has declined dramatically.



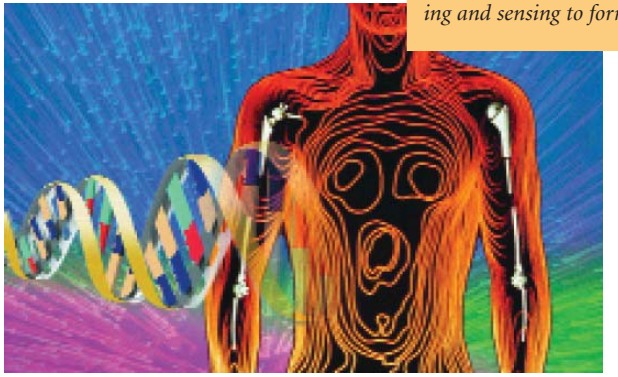
After half an hour of rehearsal the senior surgeon feels confident. »Now the entire operation is encoded in the computer. The patient will be able to walk away from here with no signs of the renal disorder that would otherwise have meant life-long dialysis or a high-risk transplantation«. Henrik relaxes again. Maybe he should run the training program again and rehearse the operation once more. Just then he receives a message that there has been a major road accident with multiple injured. One of the injured is known at the ward, and the paramedics ask for a clinical assessment. On the screen Henrik sees one of the injured and his vital data that are sent direct from the ambulance to the hospital system. The man is seriously injured and has suffered a major injury in the abdominal region. There is no doubt that the patient needs immediate surgery. Henrik prepares the trauma team for abdominal surgery so they are ready to receive the patient on arrival. »Make sure to hold the pressure« Per tells the paramedics. Although he knows that's exactly what they are trying to do. "You may start the cooling procedure". Henrik stays in contact with the ambulance until it arrives and then resumes the operation program for Lars.

10 percent of the US population already meets the definition of »cyborgs« in the technical sense as »part man, part machine.« This includes people with pacemakers, artificial hips, hearing aids, drug implant systems, etc.

The rapid advances in technology will bring about new and revolutionary ways of man-machine interaction. Today researchers are trying to restore some level of vision to blind persons by implanting small data chips. Similar advances have been made in hearing, restoring some of the hearing in deaf people by means of implanting electronic chips in the ear.

»There is no reason why technology can't be used to help everyone obtain what might be considered super-human abilities such as seeing further or hearing better".

"As computers become cheap, plentiful and wearable - or even embeddable - they will provide the knowledge, reasoning and sensing to form "sixth sense"".



Picture adapted from the U.S. Department of Energy, Human Genome Project.

Co-operating to Get Smarter

Professional competence is the pillar of healthcare. Diagnostics and treatment are all about using available knowledge, experience and competences in the best way possible for the benefit of the patient and the society as a whole.

Making information available when needed is a challenge. The competences available to the clinician in a specific decision-making context not only depend on the individual, professional, and personal ballast, but also on the knowledge and experience of others, which are made available through information sources such as the Internet, colleagues, works of reference, and last, but not least, the actual patient.

The aim of healthcare is to provide optimum consistent and operational terms of reference for decision-making. However, our knowledge about a given subject keeps changing. What we perceive as right this year may be totally wrong next year. Thus our terms of reference will change and expand as we gain new knowledge by combining existing knowledge with new information. IT-based tools that are used in healthcare today must be prepared for this constant change and the fact that knowledge is global, local, individual and social.

The quality of competences plays a central part within healthcare. Authorised healthcare providers base their practise on professionally accepted (clinically documented) terms of reference. These terms of reference must ensure healthcare personnel and the patients, but the ever-growing volume of information makes it difficult to maintain a homogenous basis for decision-making.

Knowledge as Shared Resources

Basically, knowledge is something that is found in the individual doctor, healthcare personnel, etc. This has triggered various problems:

- Can the knowledge accumulated during the clinical decision-making process be made visible?

- How do you document the use of actual information elements from the various information sources as a term of reference for a specific decision?

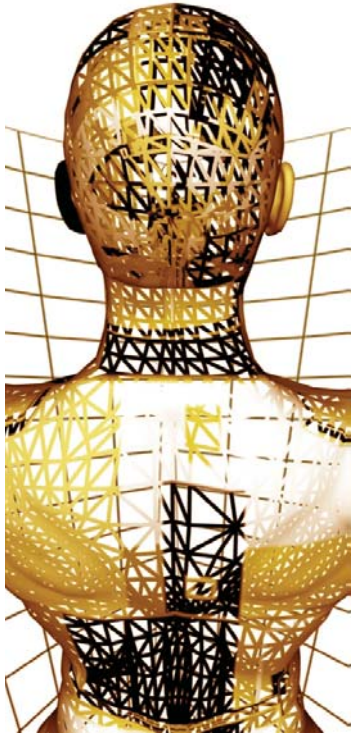
Traditionally, doctors have documented their decisions in record notes that are either private (the primary doctor) or team oriented (hospital). This is an essential part of the clinical process.

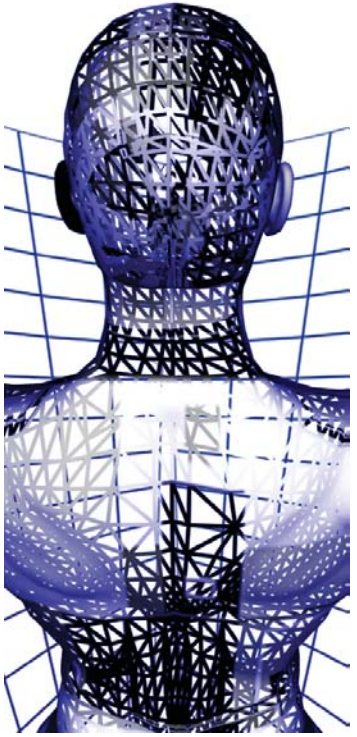
The introduction of information technology (for example, electronic patient record (EPR)) enables healthcare personnel to distribute the clinical reasoning through the network and, if desired, to the patient in question. Such possibilities also may also lead to more structured information, allowing data to be linked and become elements in the generation of new information, for example statistics and quality assurance.

The healthcare IT systems of the future will support this kind of information management and organisation. The question remains, will the individual doctor? So far experience shows that if the individual doctor reaps no benefits from this new information model, the doctor will continue work as usual. Thus the challenge is to make the values that are created by sharing healthcare information visible while at the same time preventing unauthorised access.

Growing information volumes in turn increase the need for sorting and locating relevant information. Tools for active and passive decision support for healthcare personnel and patients will thus become a central feature of the Health Service of the future.

Decision support can be performed in various ways. Active decision support comprises anything from alerts, pre-defined standard clinical pathways that indicate and perform automatic transactions (for example booking time slots for examinations) as well as guide the clinician through a chain of decision points capable of reducing the number of error sources. Passive decision support could be an overview of a patient's clinical status, in addition to access to search tools displaying certified (with clinical professional/political/financial acceptance) information in relation to the current situation (patient, disease, etc.). The basic technology for this already exists, but today it is only used within healthcare to a small degree.





A Traditional Conference - Merged with Innovation

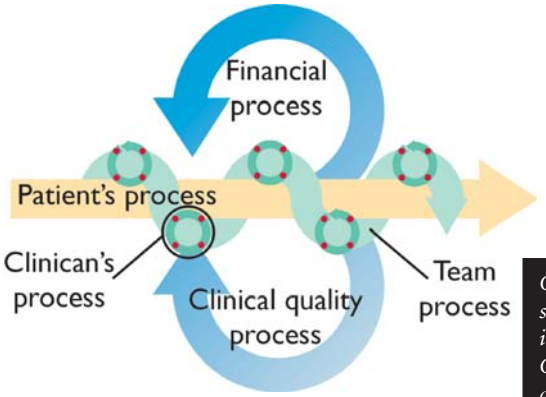
It is morning; in the conference room at the department of medicine Jacob Mortensen, the Senior House Officer on duty, is preparing to present the new patients to his colleagues. The wall at the far end of the room is almost completely covered by a giant flatscreen monitor displaying a panel from the hospital's new PRM system. Jacob is confidently browsing his shift activity log by means of a light pen and views the status of the activities he has initiated during his shift. He ascertains that he has encountered 38 patients and admitted seven new patients since eight o'clock yesterday morning. He selects the patients to be presented at the conference and checks for results of the tests he has prescribed. Everything seems to be in order, and the patient who was admitted with suspected AMI has also been transferred to the coronary ward.

One by one the doctors of the department turn up, and Jacob decides to enter the system into conference mode.

The system now registers that the doctors are present (by means of their ID cards) and displays a list of the doctors present in the room. The persons identified will subsequently be logged as present during the presentation of the patients, which is displayed on the conference monitor.

The conference starts and Jacob goes through the new patients on the conference list. The first patient on the list is a young man who has been admitted with diarrhoea after a long-term stay in the East. Referring to the patient's medical history, the current problems, the current plans, goals and the test results received, among others a dramatically elevated sedimentation rate, Jacob concludes: "I recommend performing an ultrasound scan on suspicion of liver abscess". As Jacob has followed the department's standard plan for that type of patients, he does not expect any lengthy discussion, and it is generally agreed that on the basis of the patient's symptoms and medical history this is indeed relevant and therefore Jacob can order the scan right away as a conference decision. The system automatically adds the activity "Requisition of USS" to the department's worklist.

The doctors go through the other patients in the same way, adjust plans, prescribe medication, care and plan the work of the day.



CSC Clinical Suite supports clinical decision-making and offers process support in five different dimensions: Patient-, Clinician-, Financial-, Clinical quality- and Tema process.

CSC Clinical Suite

Next Generation of the Electronic Patient Record

The future requirements of data volumes, performance, modularity, user-friendliness and openness call for a systems architecture based on a modern and scalable platform with built-in basic clinical understanding. CSC Scandihealth has opted to enter into a co-operation with Oracle Corporation and use the so-called Healthcare Transaction Base (HTB) as a platform for CSC Clinical Suite.

Process – Quality and Team Support

The work of the clinician comprises mental, team-oriented as well as logistic processes. So far systems for the healthcare sector have primarily supported the logistic or patient administrative processes, but in the new generation of clinical systems the focus will concentrate much more on the clinical decision-making process, or rather the part of the clinician's work that comprises diagnostic reasoning, planning and evaluation of outcomes. The intention is that data is captured by the persons making the decisions and that these persons must have access to all relevant information – presented in a way which is appropriate in the context. CSC Clinical Suite supports clinical decision-making and offers process support in five different dimensions: Patient-, Clinician-, Financial-, Clinical quality- and Tema process.

To facilitate the clinicians' tasks, CSC Clinical Suite will offer a dedicated workflow that is crafted by the system's very own users. It will be possible to combine the know-how of the clinical team with standard plans and programmes for good clinical practice. Processes that follow the plans can be more or less automated, whereas deviations immediately trigger the necessary attention and requirement of mandatory documentation.

CSC Clinical Suite allows multidisciplinary teams to co-operate and exchange data with partners across the health service.

Architecture

The CSC Clinical Suite architecture is based on the following objectives:

- Integration. Data is collected in a consistent, standardised data model and it will thus be possible to reuse it in various contexts.
- Flexibility. CSC Clinical Suite links the processes by means of events that may enable configuration of a subsequent sequence of events by means of a workflow-based tool.

Thanks to the built-in flexibility it is possible to describe how the clinical work flows between the different persons and professional groups in the hospital. Thus CSC Clinical Suite comprises facilities for introducing individual persons to the very information and functionality that suit their needs in relation to the task at hand.

Standards

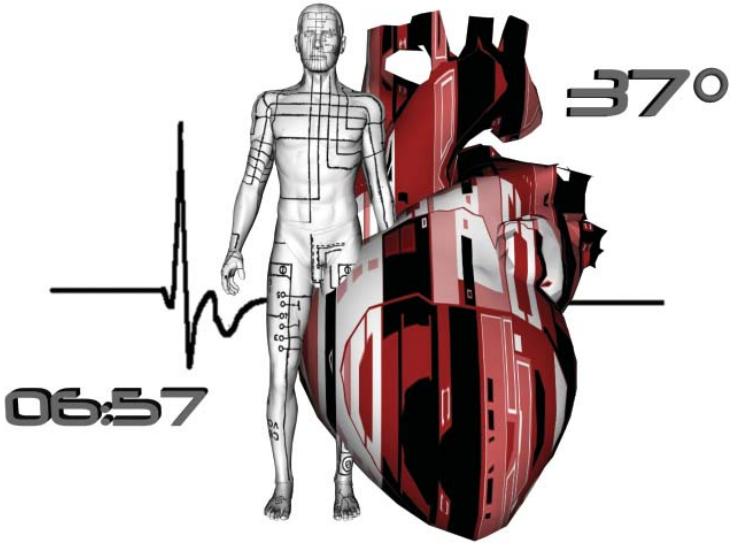
CSC Clinical Suite is based on the Oracle HTB and the international HL7 version 3.0 IT standard. This standard, which originates from the US, is currently the most popular standard worldwide, and a number of activities have been launched with a view to harmonising this standard and the European CEN standards within this area. The process-oriented model, on which the CSC Clinical Suite clinical process support is based, is based on the Danish generic basic EHR structure.

The Recovery Room
- Smart Environments

The operation went as planned. Lars is now getting warmed in the recovery room and all his vital functions are automatically monitored. Elisabeth Antonsen, ICU nurse, is sitting in the recovery room, looking at the control panel. All indicators emit a pleasant green light for the three patients she is responsible for. The time is 06:57. A picture of Lars suddenly appears on the screen. »Good morning Lars«, says Elisabeth. »Are you awake?« Lars does not respond. The motion sensors have not registered anything. Lars should be awake now, according to the calculations made by the system. Elisabeth decides to go to Lars to wake him up. As Elisabeth enters the recovery room, the screen at Lars' bed changes to monitoring mode instead of patient control mode. Elisabeth gently calls his name and is met with a muffled sound. Lars is waking up and everything seems to be all right. As she stands next to Lars, the screen starts to flicker ominously for another patient. It's Mrs. Petersen who has had a complicated heart and lung transplant. Elisabeth points at the screen and immediately Mrs. Pettersen's screen image appears.

The bed is empty because Mrs. Pettersen has got out bed – which she is absolutely not allowed to do! The indicator shows that Mrs. Petersen has gone to the rest room. "I hope she hasn't fallen!" Elisabeth hurries into the adjoining room and finds, as expected, Mrs. Pettersen in the rest room. "Dearest Mrs Pettersen, you are supposed to stay in bed!" Elisabeth sees that the patient is all right. "I had to go to the toilet, and I didn't know which button to press!" Mrs Pettersen is 69, has great mental capacity, and you hardly notice that she has undergone major surgery. Elisabeth helps the patient back to bed. "Mrs Pettersen, just talk to the monitor, then it will respond. Unfortunately it doesn't know what you are thinking, but that'll probably be possible before too long".

When Elisabeth returns to Lars, he is wide-awake. He has located his personal page on the portal and is reading about his operation. "Well, everything has worked out as planned," says Lars. "Yes, we are expecting to discharge you tomorrow".



A Smarter Web

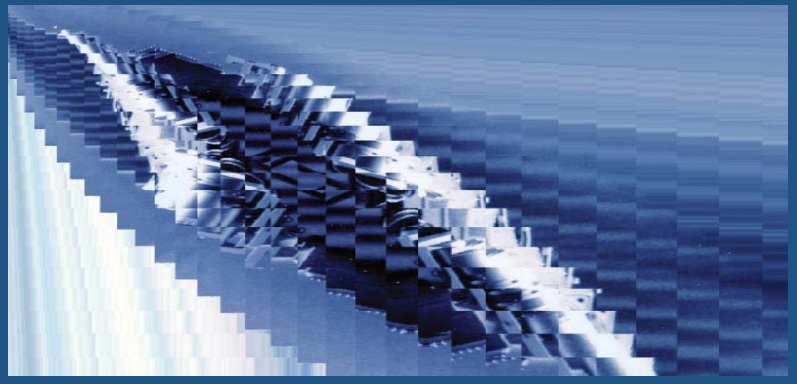
Today's Web is passive and unstructured, and filled with text and graphics only comprehensible to humans. The Web was never designed for the use of software agents, that is, personified systems that learn your preferences and can act on your behalf.

"Semantic Web" is the name of a smarter Web where information is stored in a way both humans and agents can understand. Agents can be active and constantly on the lookout for information, filtering and processing information, analysing the results and performing actions, just to fulfil your needs. Agents that know our needs and desires can also represent us on various occasions, for example buying and selling.

The semantic Web will expand the possibilities of the Web and enable communication between all parties. Consequently, agents can communicate with each other. Today this is made possible through the increasing use of XML (eXtensible Markup Language). The vision is to create a seamless system of agents coordinated in relation to each other and performing complex tasks. For example, your agent can co-operate with your GP's agent and schedule an appointment that suits you both, or agents can monitor and report errors and defects in various units, such as printers or other electronic equipment.

XML is a data format for structured document interchange on the Web and is becoming the preferred communications standard for Internet-based message interchange. The XML format structures transactions and describes products and services in a way that facilitates simple electronic exchange of information between different actors. XML will become the standard for exchange of information between e-commerce solutions.

One of the problems has been different variants of the XML format. For the purpose of handling this and the future use of XML, the Ontology.Org (www.ontology.org), founded by a group of people in CSC in 1998, working together with CommerceNet, has identified a technique for addressing the semantic discrepancies across families of XML.



Smart Environments

Smart environments already exist. Doors open automatically, taps start running when you put your hands under, sensors register movement, heat or sound – all examples of everyday objects that are part of our daily lives. In the future just about everything around us, in our homes and offices, will have computers and sensors in them and will be interconnected. This will mean enormous opportunities and services for consumers and patients. Technology will become a natural part of our environment, just like today's refrigerators, microwave ovens and mobile phones.

Smart environments can do anything from identifying you to your surroundings and offer services dependent on place and context, to monitoring a specific condition (cold, warm?) A sensor on your body, in your clothes or other equipment can measure your blood pressure and heart rate, and pass on the information to your GP.

How about a medicine cabinet that recognises the patient who is to receive its content? Such a cabinet will be able to communicate with the patient's digital identification, for example bracelet or ID card, in addition to tracking its own location in the house or the hospital. The medicine cabinet can change display, colours and sound, indicating whether it is empty or not, is close to a real patient, etc. During the actual administration of medication to the patient, whether it is dispensing the entire dose or is empty, the medicine cabinet can change the display accordingly as well as pass on information about medication doses, the patient, etc., to others.

Interview

Everyday Life Made Simpler with IT

Interview with Thomas Geisner, MD, specialising in thoracic surgery

– We need a whole range of solutions within my specialty at today's hospitals. For example, it really would make a difference if the daily surgical schedule had been prepared electronically before we arrived at work. All information about the patient, in addition to admission history, x-rays, result of blood test and investigations, could have been organised electronically in some kind of a "preoperative report". Using a PDA (Personal Digital Assistant) or something like that the doctor would be able access this data anytime and anywhere at the hospital.

– At the ward the doctor could do his rounds and have access to all the necessary data, including information from his own EPR system and other hospitals, either via his own PDA or computers that are integrated into the environment. The doctor should be able to dictate medical notes, referrals and service orders directly to the system where they are automatically translated into text.

– All prescriptions of medicine and service orders (blood tests, x-ray, referrals to and from other specialists at the hospital) made during ward rounds should automatically be transferred to the receivers and the patient's record. The system should also contain recommendations for investigations in relation to the pathological picture in the patient. In that way the doctor will be able to receive guidelines and concrete recommendations for the standard investigations that must be performed before the patient is referred for, say, surgery.

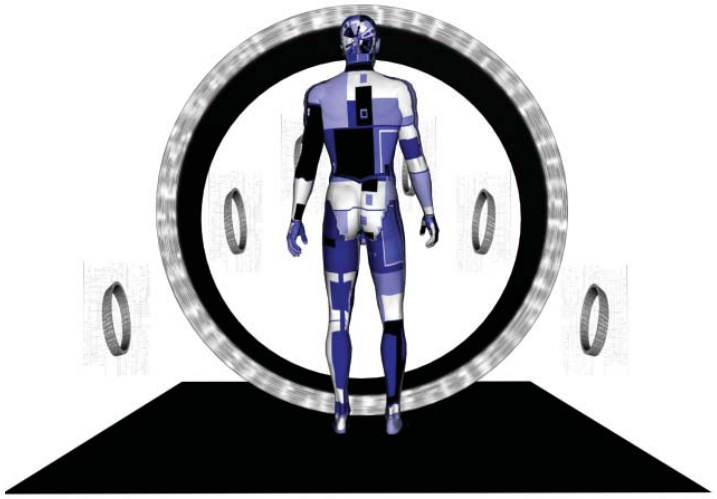
– During surgery, the surgeon should have electronic access to all data about the patient, for example x-rays and the patient record. Then the surgeon won't have to find and bring papers or pictures to the operating theatre. Diagnosis codes from the investigation, the description of the operation and the post-operative rounds should be generated in the medical discharge summary on the basis of the admission record, investigation, descriptions of operations and post-operative ward round notes. The patient's GP could also automatically get access to the medical discharge summary. At discharge, the system should suggest standard drugs on the basis of diagnoses and operation codes, and the patient's pharmacy could get electronic access to the prescription from the hospital's system. If the patient's own data is stored on a small electronic tag that he/she is carrying, healthcare personnel can get easy access to this information if an accident or another acute disease should occur.

– A whole host of electronic solutions are emerging within healthcare, and I think that systems with voice recognition and speech-to-text translation capabilities will prove very useful indeed. I also hope that the use of hand-held PCs during ward rounds will be available over time. The focus will probably centre on information; availability of all information to the doctor who will be treating the patient, communication of the doctor's decision to other doctors and auxiliary health personnel, converting reports to patients from "medic speak" to "patient speak".

– The technological opportunities will make a great impact on my specialty in the time to come. I mainly think we will witness more standardised guidelines on management and communication of information related to investigation, treatment, and follow-up. That can reduce the risk of complications, improve the logistics in the department, enhance the follow-up facilities for the GP, and take the top off waiting lists. In addition, the patient is to a greater extent assured of receiving the right treatment at the right time. Complications are also very time-consuming, and improving the access to information makes them easier to avoid. I also think that a higher degree of automated work processes, in addition to various kinds of technological aids, can make administrative routines less time consuming and give surgeons more time in the operating theatre.

– Today, various kinds of image diagnostics are emerging within thoracic surgery; the result is reduced risk of complications and more reliable test results (greater accuracy and precision in cardiac ultrasound measurements, MR angiography, ultrasound guided diagnosing of thoracic tumours, etc.). I also think that, during surgery, access to patient information will improve; this can directly affect the decisions made by the surgeon during the process.

At the Ward
- the Remote Patient



Lars is transferred from the recovery room to the ward that almost looks like a hotel. There is a minibar and an advanced television set that doubles as pc and telephone. Via the screen, Lars can select a menu from the diet that is related to his current condition, watch videos, TV and read books, magazines and newspapers. He is also able to communicate with his family at home by means of a web-camera, telephone or e-mail. His calendar lets him keep track of the planned treatment. When the nurse brings him his medicine, the screen changes to medication administration mode. The ID card has been replaced with a bracelet around Lars' wrist. As the nurse approaches, the field for Lars' medicine is highlighted. "Well, you are going to be discharged tomorrow", the nurse says. "Do you have any questions?" Lars feels fairly well informed. "No, not really! But I was just wondering...what medicine do I have to take when I get home?"
"The hospital will provide you with medicine for the first two weeks, and of course you can see what it is and what it costs, etc., on your personal page", the nurse tells him. "What happens to you next depends on how your new kidney works, but so far everything looks fine!" Lars' kidney transmits signals at regular intervals, indicating how it is working. "It will continue to send signals so that we can keep track. I also think that your own GP would like to see you in a couple of weeks to discuss if it is necessary to continue with the check-ups here at the hospital. Of course, we'll always be happy to answer any questions you may have. We really appreciate receiving your data for our quality control. But the choice is yours!" Lars feels fortunate to live in this day and age. Despite a feeling of surveillance, he sees a personal benefit in this. After all, he is free to opt out. If he does not want his measurements to be passed on to the hospital, he can choose between a physical or an electronic counsellor that will give him counselling without anybody else interfering.

Increased Focus on Resource Consumption

The ever-increasing health costs are driven by a number of different elements and have brought about more focus on healthcare spending in general. Attention has centred on cost reduction, cost effectiveness, and "more health for money". In 1999, Norway spent 8.5 percent of its Gross Domestic Product on healthcare and the percentage is rising. The same year Denmark spent 8.4 percent whereas Sweden spent 7.9 percent of its GDP. In Norway, annual growth of costs totalled 8 percent from 1992 to 1999. Growth in expenditure totals an average of some 4.4 percent in real terms for these years.

The never-ending focus on cost effectiveness is also closely related to changes in the perception of the welfare state. Thanks to the increasing attention on privatisation, market and freedom of competition, as well as the shift from the welfare state to the welfare society, the focus concentrates on cost effectiveness more than ever. Putting out services to tender is an important means of cost effectiveness. In that case the price can be decisive and often turns the scales when a supplier is selected.

With the coming age wave special attention is given to the organisation of resources for better use, where distribution of resources and not just cost effectiveness is emphasised. As the proportion of senior citizens is soaring, financing will be under siege for various reasons. Especially three factors have been emphasised (www.gp-forschungsgruppe.com):

- Increased life expectancy and thus prolonged old age enhances the risk of diseases such as cancer and osteoporosis.
- Old people enjoying good health will have no more need of care than today, but will be able to undergo major and costly surgery at an advanced age. In addition, the risk of complications is higher in aging patients, no matter what state of health they are in.
- Patients suffering from severe chronic diseases live longer too. In 1970 the average life expectancy of dialysis patients was 45, now it is 60.

Experts believe that the increasing longevity will result in more age-related and chronic diseases, which in turn mean a growing demand for appropriate treatment programmes. It may also lead to pressure to change the financing of healthcare towards more private financing, for example insurance schemes and more cost effective treatment.

However, it is important to remember that reduction of costs is not about reducing the number of health services offered or the quality of healthcare, but to organise the health services more cost effectively. Automating and/or streamlining the health processes for efficient utilisation of resources and information for the good of the patient could be one way of achieving this. Technology and organisational changes play a central role in this work. The interaction between technology and process is the key to utilising the benefits obtainable for the good of the patient.

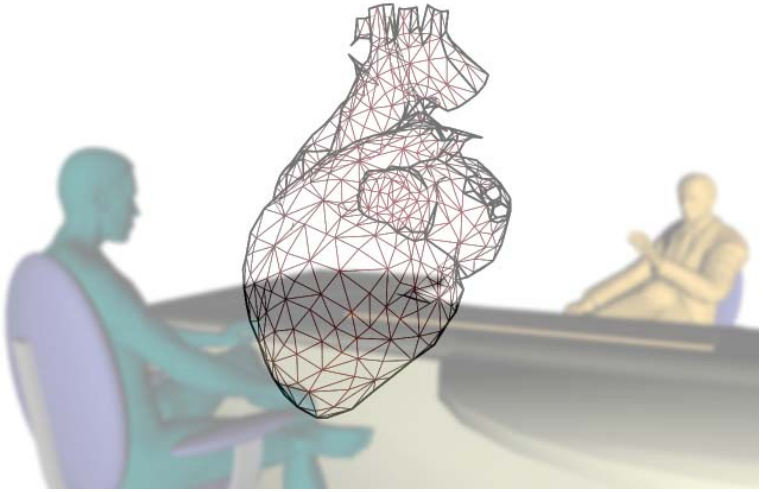
Interview

Telemedicine – an Enabler in the Future World of Healthcare

Steinar Pedersen, manager at the Norwegian Centre for Telemedicine (NST).

– In view of the pace at which IT solutions are introduced and developed within, for example, banking, commerce, mobile phone technology, expectations are that the healthcare industry will undergo the very same IT revolution in the years to come. Groundbreaking development is taking place within telecommunications technology. It is now possible to send medical information and images via the existing telecommunications network, and integrate medical investigation equipment with video conferencing equipment and thus transfer images and sound from patient examinations from GPs to the hospital, or between hospitals. We believe that new IT solutions will dramatically change how healthcare workers meet and treat patients in the future, but that the major challenge we are facing is the organisation of the health services.

– The diagnostic reliability of telemedical investigations equals that of ordinary investigations. The method is used for providing access to necessary medical expertise in the patient's home environment within radiology, pathology, otorhino-laryngology, dermatology, cardiology, gastroenterology and psychiatry. Some of the benefits are improved access to health services from the patient's home, enhanced efficiency such as faster feed-back, as well as increased cost effectiveness by way of saving patient transportation costs. Network-based training will also be used within more and more medical specialties.



– We believe that today's physical encounter between patient and healthcare personnel to a great extent will be replaced by virtual reality encounters. It will become possible to transmit audio, colours, three-dimensional images, tactile stimuli and probably even smell. The individual patient's information will be compared with global material as a support system for diagnosis and treatment, and all information will be available at any time. For individual groups of patients there will be service offers that allow the patient to stay at home, with the home doubling as a room in a virtual hospital. For dying cancer patients this kind of services would be the obvious choice.

– Waiting lists, patient databases, support systems for diagnostics, etc., will become shared resources for the entire public health service. Consequently, today's specialist health services must reorganise, from spending time on direct patient contact to increased presence in the virtual reality clinic. Patients live at home, but are monitored by the hospital. Only highly specialised hospital departments will continue to exist. As a result, the individual hospitals will to an increasing degree be characterised by highly specialised treatment.

– The age wave will benefit immensely from the telemedical solutions of the future, because it will be possible to substitute some of the current and many of the future needs for institutions by home-based services and telemonitored nursing homes.

- Telemedicine will also contribute to transfer of medical competences from specialists to GPs and on to nurses and paramedics. Hands-on medical training will take place in small healthcare institutions, whereas theoretical training will take place in virtual reality.

– I'm convinced that in general information technology will lead to an increased privatisation of today's public health service and turn health services into a commercial commodity. Information technology enables industrialisation of medical diagnostics, and if people are willing to pay, the health service will be developing its own services for those who can afford to use the network access to the most prestigious medical environments. In addition to increased access to medical experts, the demand for second opinion will grow. This way of privatising the public health service will lead to a market driven demand determined by availability, quality and, to some degree, price.

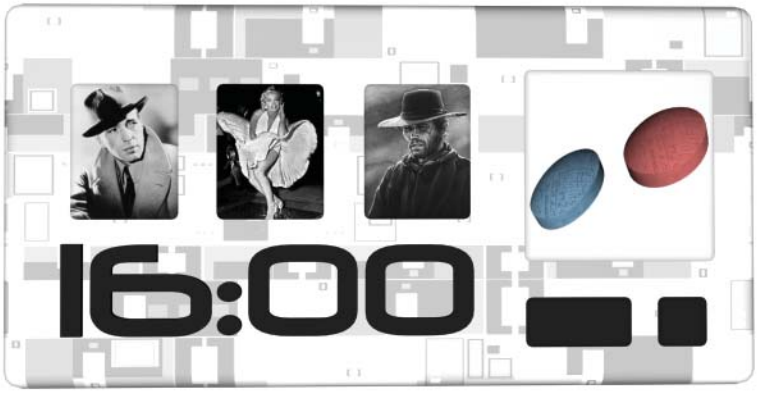
– In addition, network-based health services will enable the same kind of economy of scale in healthcare administration as seen within banking and other financial services. The consequence is centralisation of the public health services in the individual countries at the administrative level; possibly carried through at regional and international levels as well. As for highly specialised medicine and commercial networks, a major part of the services will also be organised at global level. Or in other words: The fusion and globalisation trends seen in today's telecommunications and financial markets will rub off on the development trend within the organisation of the public health service.

This interview was based on an article published by Steinar Pedersen and Per Hasvold in the Journal of the Norwegian Medical Association.

Home Again
- New Health Services

Two weeks after her operation Mrs Pettersen is home again. »Here you are, Mrs Pettersen«, says the community nurse who is showing Mrs Pettersen around in her »new« home. »We've also installed a new telly for you". Mrs Pettersen looks suspiciously at the flat screen on the wall. "With that one you can contact us at the Community Nursing Services any time you want, and you can also watch the old American films you're so fond of". The nurse shows Mrs Pettersen how the television set works. "You can use the remote, but you can also speak to the telly". "Oh, you know I'm not too keen on that", smiles Mrs Pettersen, "but I suppose I can get used to it". Mrs Pettersen's home has been transformed into a "smart" home. Technological aids such as the web-based television set with built-in web-cam enable Mrs Pettersen to communicate with the outside world, her family, and other contact persons.

If necessary, she can do her shopping and access her own health data via the web-based television. Built-in sensors in the carpet, the bed and other aids make it possible for the Community Nursing Services to monitor her without being physically present. The technology does not replace personal contact, but makes optimum use of limited resources easier. Mrs Pettersen can see when a visit is scheduled and what is on the agenda. If the community nurse is delayed or has moved, she gets an overview of this and can order additional help if needed. When someone is at the door, she can see who is outside, and when it is time to take her medication she will be reminded of if. Not all of these functions impress Mrs Pettersen, but she agrees with the community nurse that they will evaluate the need as they go along.



»Anything else you need?« The community nurse has taken out her little handheld computer. When she turns it on, it immediately senses that she is at Mrs Pettersen's and displays Mrs Pettersen's treatment plan. "Right, I can see that you must take your medication at four this afternoon". The community nurse has access to Mrs Pettersen's medical history and medical record. "Look here", says the community nurse and transfers the screen image from the PDA to the web-based television. "You must take these red pills at four and then this little blue one before you go to sleep". The web-based television shows when to take them. "Look", says the community nurse and points at the bedside table, "you have already received the box of pills from the pharmacy". Mrs Pettersen is pleased. "Does that mean that you already know what I have to take?" Mrs Pettersen asks. "The last time I was in hospital, some ten years ago, it took them more than a week to tell me. That wasn't a pleasant experience".

When the community nurse has left, Mrs Pettersen looks at the web-based television. "I wonder if I can call my son with this monster?" At that very moment it rings. "Hello Mum!" She hears the familiar voice of her son. "Welcome home!"

Standardisation Making Co-operation Simpler

The introduction of standards is essential for fast and efficient communication between different systems. International standards for interchange of medical data between different systems (ISO, CEN, HL7) are available today. In Norway, standardisation work is performed by the Norwegian Centre for Medical Informatics.

The field of diagnostic medical imaging (communication to radiology, MR, CT, ultrasound equipment, picture archiving systems, etc.) has witnessed a global standardisation as the market is dominated by major international equipment providers. The most popular international standard within diagnostic medical imaging today is DICOM.

Despite international standardisation efforts, several national standards are in use. National needs and interests have cultivated various standards as well as various systems. Increasing use of component-based systems (the system consists of various modules) and various integrated solutions, makes standardisation of communication between components all the more important. For the last decade there has thus been a strong international focus on standardisation.

New Communication
- New Opportunities

Most of us know a computer when we see one. Most of us are also communicating with the computer via the screen and the keyboard. By creating new ways of communicating with computers and other devices, we can interact with them differently and perhaps much simpler. How about a computer that just simply understands you?

Our ancestors spent millions of years developing efficient and effective human communication as we know it today. Until now, the computer has set the agenda for human/computer interaction, but we are developing communication solutions that will simplify this interaction. Voice recognition systems enabling computers to understand what we are saying are being developed. For example, in the future doctors may dictate symptoms and diagnoses to the system; the system then enters these into the patient record with the proper medical and Latin terminology. In addition, it can retrieve relevant information, standard treatment procedures and contribute to reliable diagnoses.

In the near future, the ubiquitous digital network may give you the greatest feeling of proximity to your computer, although we will never get rid of all »artificial« communication methods. Anyway, we will experience cheaper, thinner and more flexible monitors. This paves the way for improved information to some healthcare professional groups. During computer-assisted surgery, for example, large low-cost monitors in the operating theatre may display various different measurements and information about the patient. Or it may be possible to develop measurement devices such as small stickers that are attached to the patient's arm and dynamically display various data.

Mankind has used handwriting as a means of communication for thousands of years. It is a skill that feels natural to us. Solutions are emerging that can read your handwriting from the paper, either by means of your movements as you write, the trail on the paper, or by using a camera that "reads" your handwriting. Such solutions make note-taking simple, for example for the patient record or other purposes while you work. A text-based solution combined with voice recognition could be handy in environments with strict hygiene requirements. This technology will improve as it gets cheaper.

Yet another combination is the use of vision and data graphics. By means of special goggles, x-ray, CT or MR images can be displayed in the surgeon's field of vision, showing details that are hidden inside the body as if the surgeon had "x-ray vision". This technology is already being tested today.

Actual technical errors in medical instruments are unusual in this day and age. User errors, on the other hand, may occur because so may different devices are used, partly due to insufficient training, partly due to lack of intuitive interfaces. Therefore automated instrument set-up is desirable.

Technology in the Home Means New Healthcare Services

More powerful computers, low network costs and small high-tech sensors allow people to be monitored in their homes rather than in the hospital. An option ideally suited for people suffering from a chronic disease. Miniature devices or sensors can be surgically placed into the body and send biological data to, for example, the hospital or GP.

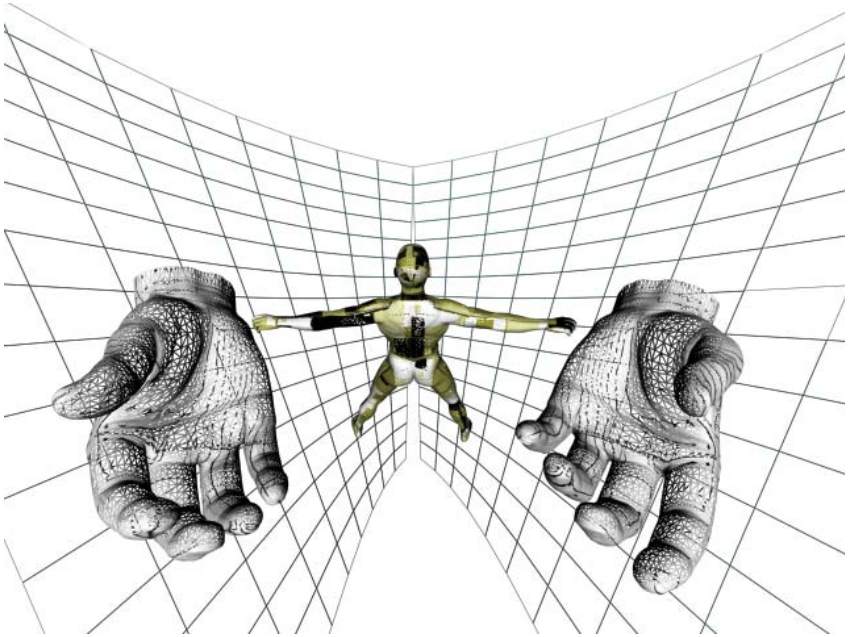
As opposed to the broad bandwidth that is often required in an emergency situation, some telemedical devices will be using relatively limited bandwidth. Given the price/performance ratio in future computers as well as miniaturisation, we will get small, cheap, but advanced multi-purpose sensors. These will be ideal for monitoring various non-emergency physiological conditions in the home.

In any case, small implants and autonomous devices are emerging that measure and report on your condition as well as dispense medication doses at the right time. An alternative is devices with wireless connection to the hospital network and your own electronic agent that controls the activities and operations of the device. These devices will be ready for clinical trials in a few years' time.

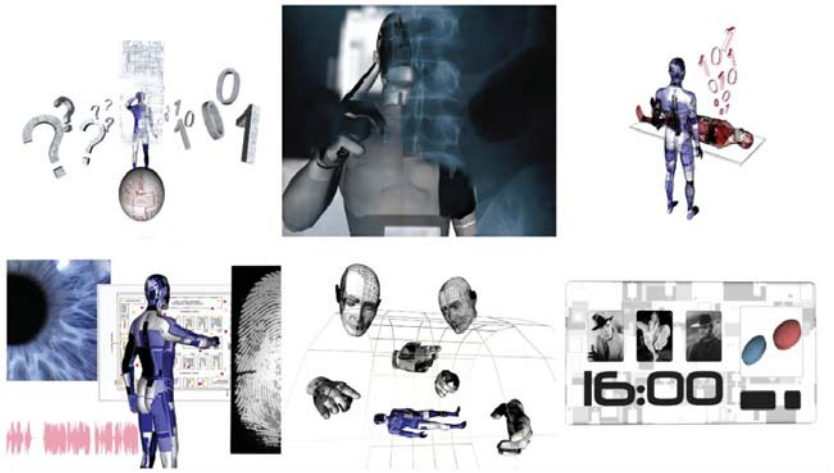
A Talking Toilet

Versatile Interactive Pan (VIP) is the name of a toilet that has built-in sensors that can register the level and balance of various hormones and substances in urine, and communicate health information to users accordingly. Information can also be sent to the user's GP via e-mail. The toilet, produced by the British company, Twyford Bathrooms, uses voice recognition to distinguish the different users. The toilet may be ready for the market in five years.

Source: Twyford bathrooms
http://www.twyfordbathrooms.com/



Epilogue



»The first manned space journey to Mars is at an end! A great chapter in the history of space travel has been written, and with international participation. The astronauts have been away for three years, and in the meantime the world has changed. Thanks to the extensive research that made this successful journey possible, the world has witnessed the emergence of new technology that would have been considered pure science fiction just a few years ago! Before the astronauts can enjoy their freedom, they have to endure six months of isolation and be examined for unknown life forms....« Lars is presented with the latest news. »Imagine – only ten years ago my operation would have been inconceivable, and now we are travelling to Mars. I wonder what we'll be doing ten years from now?"

Relevant Reports Published by CSC

CSC reports published by CSC Leading Edge Forum:

»The Era of Digital Disruptions: Exploring the Next Technology Wave«

»On the Edge - Exploring Next-Generation Digital Disruptions"

»Get Smart - How Intelligent Technology Will Enhance Our World«

All the reports can be downloaded from our Web site at:
http://www.csc.com/aboutus/content/publications.shtml

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