NATIONAL IT STRATEGY 2003-2007
for the Danish Health Care Service

National IT Strategy for the Danish Health Care Service 2003–2007

Preface

A targeted and efficient use of modern information technology in the Danish health care service is essential in order to meet society's increasing demands as well as the political objectives of high quality, information, influence and participation in the health care service. There will also be a demand for coherence and coordination among individuals and institutions which increasingly collaborate on the episode of care of any particular patient.

The purpose of the *National IT Strategy for the Danish Health Care Service* is to establish a common framework for the full digitization of the health care service during the period 2003–2007. It replaces the former *National Strategy for IT in the Danish Hospital System 2000-2002*.

The National Strategy Group has been in charge of developing the new IT strategy. The task was to monitor, disseminate and develop the *National Strategy for IT in the Danish Hospital System 2000-2002*. It consists of representatives of the Ministry of Inferior and Health, The National Board of Health, the Association of County Councils, the Copenhagen Hospital Corporation and the National Association of Local Authorities in Denmark. During the summer of 2002, the national IT strategy was subjected to widely conducted hearings. Subsequent revision has resulted in the present definitive strategy for the period.

The new strategy outlines a range of visions and specific initiatives, all of which will, in future years, help reap the important benefits of applying modern information technology in Danish health care.

This IT strategy is based on the needs of the citizen.

Thus, the initiatives of the strategy aim to provide the citizen and patient with better coherence and higher quality of care. It is also a clear objective to improve the individual's ability to influence and to actively participate in his personal care.

The implementation of electronic health records in the Danish hospital system is among the areas of focus, as are initiatives designed to create coherence across sector- and disciplinary boundaries in health care service. Thus, the way is paved for providing the individual patient with the best coherent care.

Lars Løkke Rasmussen
Minister for the Interior and Health

Summary

In order to meet the patient's health care needs it is necessary to acquire, analyze and communicate patient-related information. A central aspect of examination, treatment and care is to answer the questions of what the patient's disorder is and what treatment and care the patient needs. It is of the utmost importance to handle these answers in a rational way.

With the growing degree of specialization and distribution of work tasks between public and private stakeholders in the health care service, it is of increasing importance to the coherence of health care delivery that they are able to share and reuse data. This task can only be dealt with by using digital technology in a comprehensive manner.

It is essential to the application of information technology in the health care service that correct information is available at the right time and place to health care professionals, citizens and authorities alike.

This applies to information concerning the individual patient as well as to professional knowledge. The purpose is to ensure the highest possible quality of examination, treatment, care and rehabilitation.

In addition, the use of IT in the health care service will entail a number of secondary effects through better use of the available resources.

This strategy succeeds the former *National Strategy for IT in the Hospital System 2000-2002*. Its purpose is to identify the initiatives which are necessary to ensure that the application of IT in the entire health care service contributes to the realization of the strategic political goals for the period 2003-2007, comprising: high professional quality of health care, straight answers, shorter waiting time, a high level of user satisfaction, better information about service and quality, efficient use of resources and freedom of choice.

The strategy must support the order of priority for the use of IT in the health care service, i.e.:
- Contribute directly to the improvement of quality, service and coherence in patient care.
- Ensure better communication between all parties in the health care service.
- Contribute to the fast and safe access of the individual citizen and/or patient to his own health record as well as to information concerning service and quality of health care.
- Be instrumental to better administration and management of the health care service.
- Ensure coordination with the political goals concerning digitization of the public sector in Denmark.

The national strategy group carried out the elaboration of the new IT strategy. Its task was to monitor, disseminate and develop the *National strategy for IT in the Danish Hospital System 2000-2000*.

The members of the national IT strategy group are:
John Erik Pedersen, Head of Division, Ministry of the Interior and Health (chairman)
Arne Kverneland, Head of Division, National Board of Health
Lars Hagerup, Head of Division, Association of County Councils
Henning Bruun-Schmidt, Director of Health Services, Viborg County
Vera Ibsen, Head of Division, Vejle County
Sten Christophersen, Director of Health Informatics, Copenhagen Hospital Corporation
Vibeke Høeg, Senior Adviser, Copenhagen Hospital Corporation
Søren Lippert, Staff Specialist, M.D., National Board of Health
Claus Nielsen, Adviser, National Association of Local Authorities in Denmark
Lisbeth Nielsen, Adviser, Association of County Councils
Anders Lundbergh, Head of Section, Ministry of the Interior and Health

Visions and goals

In chapter 2 of the IT strategy, the visions and goals for the use of information in the health care service are presented.

IT has the potential to forward the interests of the citizens, of health care professionals and of society in general.

It is a goal for the development of IT in health care to improve interaction between citizens and the health care service and to support, to the utmost degree, the individual in attending to his own health and in gaining influence on his care.

IT must ensure that the citizen and patient experiences one continuous flow of events[1] even when in contact with several parts of the health care service. The exchange of patient data therefore has to be seamless. Finally, IT presents a series of opportunities for the citizen and patient to influence and to be engaged in his own care.

To health care professionals, IT is primarily a tool for the registration and retrieval of information of relevance to their planning and to decisions which must be made concerning patients. At the same time, IT must also be an instrument to facilitate and to supplement communication with other health care professionals internally in an institution and between different institutions and sectors. Improved communication will also bring about better quality of therapy for the individual patient.

As viewed from the higher level of perspective of society, IT must also contribute to optimizing the use of the resources allocated to health care service. IT leverages the modernization of procedures and distribution of work tasks across sector- and disciplinary boundaries. Through the use of IT there are a number of benefits to be gained with regard to improved professional quality and better work management and organization.

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[1] This will be referred to as an "episode of care"

Status and premises

Today, all parts of the health care sector make use of IT to a certain extent. Denmark ranks among the countries with the most widespread use of electronic communication between different actors of the health care service.[2]

Chapter 3 briefly reviews the present state of utilization of IT in the Danish health care service. It also treats the most important prerequisites for the realization of the benefits of applying IT in the health care service and for achieving the outlined visions.

It is essential that the users achieve the necessary skills to operate the IT systems which are at their disposal, that relevant organizational changes are carried out and that cooperation relations are established as a consequence of the emerging possibilities. Also, it is clearly a precondition for cooperation across professional and sector boundaries that health information is documented in a common informational structure so that it may be retrieved by all relevant parties. Moreover, the necessary resources must be allocated in order to meet this challenge. Finally, it is important, concurrently with the new possibilities for exchanging information etc. presented by IT, to find a uniform and manageable solution to the problem of ensuring the civil rights of the patients.

The initiatives of the IT strategy

The strategy describes the initiatives that should be dealt with on a national level during the period 2003-2007. The initiatives of the strategy are to enhance the coordination of the IT effort at a governmental level, with the concurrent aim to create the necessary conditions for the efficient application of IT to the health care service, i.e.: hospitals, general practices and community health care.

One of the goals is to exploit the possibilities of sharing data among the many IT solutions presently in use in the Danish health care service, thus enabling the implementation of the strategic goals and the vision for citizens, health care professionals and society in general.

The path towards integrated informational systems will be large-scale development and implementation of electronic health records based on common standards.

The majority of initiatives concerning the first period of the IT strategy (January 1st 2003– December 31st 2005) therefore relate to the development and implementation of electronic health records (EHRs). The focus is on initiatives aiming at the development of common standards, concepts, classifications etc., as well as on ini-

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[2] **The Danish health care system in brief:**
- The National Health Service covers all 5.3 million citizens
- 3.500 GPs have 90% of all patient contacts
- More than 90% of GPs use some kind of EHR
- GPs are largely publicly funded
- 65 hospitals are owned by 14 counties and the Copenhagen Hospital Corporation (no major private hospitals)
- 4.6 million outpatient visits per year
- 22.000 hospital beds
- 1.3 million annual discharges
- 13% of hospital beds are served by EHR (by mid-2003)

tiatives ensuring good integration between EHRs and the other IT systems available in the health care service.

The fiscal agreement for 2003 between the government and the counties (i.e. the hospital owners[3]) states as a common goal that electronic health records based on shared standards are to be implemented in all Danish hospitals by the end of 2005.

The development of shared standards and concepts for health records and IT systems must help ensuring that data can be shared and that they can efficiently support interdisciplinary high quality care. The purpose is also to enable communication of data between EHRs and other IT systems without forcing the concerned parties in the health care service to utilize systems from the same vendor. In this way the market will be able to maintain free competition as well as the desired degree of specialization.

A particularly important initiative of standardization is the national project "Basic Structure for Electronic Health Records". Based on standards elaborated by the National Board of Health, this project creates the foundation for a coordinated formation of concepts in EHRs in the hospital sector.

By tying the application of IT in health care to a common architecture, it will be possible to outline a distribution of tasks between national and local levels, making it possible to utilize a number of common services. For example, the authorization of users, security etc.

Apart from initiatives related to the development of the EHR, the strategy includes a number of initiatives intended to further both the application of IT at other levels of health care and the communication internally and across sector boundaries, including general practice and community health care.

The common public health portal represents a national initiative intended to be the common frame for communication and information in a cooperating health care service. At the same time, it is meant to be the electronic access for the citizens to the health care service.

Follow-up on the IT strategy

In order to follow up on the IT strategy, a national strategy group for IT in the health care service was established with the participation of the Ministry of the Interior and Health, The National Board of Health, the Association of County Councils, the Copenhagen Hospital Corporation and the National Association of Local Authorities in Denmark. The strategy group carries the responsibility for following up on the initiatives, for mediating their implementation and for the development of the strategy.

For a number of the initiatives of the IT strategy, steering committees or project organizations will be established to provide for the specific follow-up on one or more of the initiatives.

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[3] In Denmark, hospitals are almost exclusively funded and run by the regional authorities (the counties), and in Copenhagen by the Copenhagen Hospital Corporation formed by the two large municipalities of the capital. The counties and the Copenhagen Hospital Corporation are collectively referred to as the '**hospital owners**'.

1 Introduction

1.1 Health policy goals

A central aspect of examination, treatment and care consists of the acquisition, analysis and communication of information about the patient and of professional knowledge. Tasks in the health care service are more and more often performed through the cooperation of individuals and institutions. This is due to increasing degrees of specialization and to the fact that coherence of health care delivery and of episodes of care is important to ensure the quality of the citizens' encounter with the health care service.

The efficient utilization of information in health care service therefore entails increasing demands for communication and coordination between persons and institutions. These demands can only be met by consistent use of digital information technology.

An increase in the use of IT is not a goal per se. IT should be a means to further the strategic goals for the health care service, comprising:

- High professional quality of health care
- Straight answers and shorter waiting time
- A high level of user satisfaction
- Better information about service and quality
- Efficient use of resources
- Freedom of choice.

High professional quality of health care is of paramount importance to the citizens. Examinations, treatment and care must be of optimum quality. That is why it has been decided that a new common Danish model for quality in health care service must be introduced before the end of 2006. The aim for this model is to ensure and make visible the continued improvement of quality of health care delivery in Danish hospitals and, in the long term, also in the remainder of the health care service. Quality must be assessed on the basis of shared standards and associated indicators for professional quality and for organizational processes. Quality assessment must focus on episodes of care across sector borders.

Electronic health records and clinical quality registries are efficient tools to support and document systemized quality assurance of health care delivery. EHRs have been shown to result in actual improvements of quality, e.g. in fewer errors of medication. Furthermore, they will provide for improved information to the patient about service and quality. In the longer term, clinical decision support systems may be integrated. This will improve quality by guiding staff members on a basis of reference programs and standards for episodes of care.

High quality is also a question of ensuring fast and reliable exchange of data between the different parties involved with the patient. A common public health portal is intended to become the platform for cooperation across disciplinary and sector boundaries, thereby supporting the coherence of episodes of care when transferring patients between different parts of the health care system. Moreover, the portal will contribute to improve the quality of clinical decision-making by facilitating access to information on patient history in previous episodes of care.

Straight answers and shorter waiting time are two intimately connected aspects of health care service. A central aspiration for the Danish health care service is to achieve shorter waiting times.

Making better use of IT can shorten waiting times and contribute to the patients receiving reliable information about when to expect therapy. Electronic booking, notification and detailed registration of the actual examination or treatment to which the patient is referred have been shown to entail advantages such as quick and precise information to patients about when to expect admission as well as shorter waiting times through better use of the existing capacity.

A number of other IT systems, like EHRs and digital radiological systems, will also speed up the availability of information; specialists will be able to assess results regardless of physical distance; and patients and staff will have shorter waiting times, also when they are in hospital or at the GP's office.

The health care system is a service organization. **A high level of user satisfaction** is an essential goal. It is a strategic goal that Denmark should remain among those countries in the European Union whose population is the most satisfied with the health care service. A high level of user satisfaction will depend on the ability of the health care service to fulfill the strategic goals of high quality of service and care and of involving the patients in their own episode of care.

Through better information about quality and service, the health care service will provide the means for citizens to become informed, critical and resourceful users of the health care service.

With the national strategy for quality development (May 2002) as a start-off point, the health care service now follows a course towards more openness about quality and patients' freedom of choice. The two central themes in the strategy are: 1) patient security and the development of a quality structure in health care which will point towards more openness about errors and near errors, and 2) the question of publication of information on the quality of health care delivery.

The national government and the counties have agreed that together they will publish information on quality, service objectives, waiting times and patient satisfaction for the individual hospitals. It has also been agreed with the general practitioners that they will publish more information about each doctor's qualifications and range of services offered. A common health portal is going to provide the common access to this information, thus supporting the citizen's freedom of choice and his active participation in his personal treatment and care.

The health care service must inform the citizens about the best ways to attend to their health. This, of course, already takes place during contacts with the health care service, but IT and the Internet in particular present new opportunities that should be taken up.

The **efficient use of resources** is essential because citizens are entitled to health care delivery of high quality at the lowest possible cost. The health care service will always have to manage the task within restricted financial and staff limits.

A targeted and appropriate application of IT requires investments. It can, however, contribute to a more efficient use of resources. In this way, resources can be released and thus enhance quality and service in health care.

Legislation governing **freedom of choice** has been extended to encompass private hospitals etc. in situations where the public hospitals cannot offer treatment within a specified time limit, and freedom of choice in the health care service in general is increasingly available. This means that there will be a pressing need to ensure quick access to patient-related information among the different parties of the health care service.

Furthermore, patients and health care professionals alike will increasingly experience the need for fast and easy access to information on waiting times for examination and treatment.

1.1   The purpose of the IT strategy

This strategy succeeds the former National Strategy for IT in the Hospital System 2000-2002. Its purpose is to identify the necessary initiatives to ensure that the application of IT in the **entire** health care service helps achieve the strategic political goals.

The *National Strategy for IT in the Hospital System 2000-2002* was published in December 1999. The strategy was created in cooperation between the Ministry of the Interior and Health, The National Board of Health, the Association of County Councils and the Copenhagen Hospital Corporation. The strategy encompassed specific initiatives within three main areas directly concerning the development and application of IT systems. Crucial points in the strategy were initiatives concerning the development and implementation of electronic health records in the hospital system. Furthermore, the strategy comprised initiatives concerning communication between different parties in the health care service (patient index, MedCom, telemedicine, booking and health portal) as well as initiatives concerning the organizational, technical and economical prerequisites for the application of IT such as: education, security, integration and investment.

The present strategy describes the initiatives which should be taken jointly on a national level in the 2003–2007. The initiatives must strengthen the coordination of the IT effort at a central level. The strategy also aims at creating the necessary conditions for the efficient application of IT in the health care service, i.e.: hospitals, general practices and community health care.

> The strategy must support the order of priority for the use of IT in the health care service, i.e.:
> - Contribute directly to the improvement of quality, service and coherence in patient care.
> - Ensure better communication between all parties in the health care service.
> - Contribute to the fast and safe access of the individual citizen and/or patient to his own health record as well as to information concerning service and quality of health care.
> - Be instrumental to better administration and management of health care service.
> - Ensure coordination with the political goals concerning digitization of the public sector in Denmark.

One of the goals is to exploit the possibilities of sharing data between the many IT solutions presently in use in the Danish health care service, thus enabling the implementation of the strategic goals and the vision for citizens, for health care professionals and for society in general.

The path towards integrated information systems will be large-scale development and implementation of electronic health records based on shared standards.

The creation of a common public health portal represents a central initiative. The portal is intended to become the common frame for communication and information in a cooperating health care service. At the same time, it is meant to be the electronic access for the citizens to the health care service.

The majority of initiatives concerning the first period of the IT strategy (January 1st 2003– December 31st 2005) bear on the development and implementation of electronic health records (EHRs). The focus is on initiatives aiming at the development of common standards, concepts, classifications etc., as well as on initiatives ensuring good integration between EHRs and the other IT systems available in the health care service.

The fiscal agreement for 2003 between the government and the hospital owners states as a common goal that electronic health records based on common standards must be implemented in all Danish hospitals by the end of 2005.

The development of shared standards and concepts for health records and IT systems must help ensuring that these can efficiently support interdisciplinary high quality care and the sharing of data. The purpose is also to enable communication of data between EHRs and other IT systems without forcing the concerned parties in the health care service to utilize systems from the same vendor. In this way the market will be able to maintain free competition as well as the desired degree of specialization.

A particularly important standardization initiative is the national project Basic Structure for Electronic Health Records, henceforth called Basic EHR (BEHR)[4]. Based on standards elaborated by the National Board of Health, it must establish a foundation for a coordinated formation of concepts for EHRs in the hospital sector.

By tying the application of IT in health care to a common architecture, it will be possible to outline a distribution of tasks between national and local levels, making it possible to utilize a number of common services, like the authorization of users or security services.

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[4] The "Basic Structure for Electronic Health Records" (BEHR, in Danish: Grundstruktur for Elektronisk Patientjournal') is a generic information model for clinical information systems published by the National Board of Health. This model sets the national standard for EHRs. It is characterized by using the clinical problem solving process as the structural backbone for all clinical information and it is designed to directly support continuity of multiprofessional health care across all environments of the entire health care service. The original documentation for version 1.0 and 2.0 (in Danish only) may be found at URL: http://www.sst.dk/

Apart from the initiatives related to the development of the EHR, the strategy includes a number of initiatives intended to further the application of IT at other levels of the health care service, as well as communication internally and across sector boundaries, including general practice and community health care.

In recognition of the fact that evolution in the field of information technology continuously requires adjustments, the initiatives of the action- oriented part of the strategy (chapter 4) are divided into two phases (January 1st 2003 – December 31st 2005 and January 1st 2006 – December 31st 2007). Certain initiatives will span both phases while the majority of the proposed specific initiatives will need to be revised after a while.

By mid-2005, the Ministry of the Interior and Health will conclude a revision of the part of the strategy that relates to the initiatives so that it will be ready for part two of the strategy.

2 Visions and goals for the application of IT in the health care service

2.1 Visions

The central vision for the use of IT in the health care services is that citizens, health care professionals, authorities and administrators have access to updated information through channels perceived to be free of any undue obstructions. In this respect, IT is a means to boost the efficiency of access to information, to communication and to quality assurance. This can be achieved by gathering information intended for documentation on the level of the individual and information for follow-up based on aggregated data.

Three sets of interests can be taken into account when applying IT solutions:
- The interests of the citizens
- The interests of health care professionals
- Considerations of general interest to society

The vision is to take into account the interests of all groups while it is evident that they are not always coinciding, nor are they equally relevant at the same point in time. An example could be the desire of the professionals for easy access to the largest possible amount of data concerning a patient as opposed to his/her request for confidentiality. Or it could be a managerial need for detailed data as opposed to the professionals' desire for simplicity of registration.

2.2 The Citizens

In their role as patients, the citizens have some legitimate expectations of the health care service:
- A high degree of quality and service
- Coherent episodes of care
- Information
- Freedom of choice
- Influence

The pivotal point is the patient's influence on his own treatment and his involvement in self-care. This could be by tackling specific health problems or by preventing them. The professional quality of an episode of care is enhanced when the interaction between patient and staff is satisfactory. To achieve this objective, it is of decisive importance that the citizen must be able to receive and to give relevant and personally customized information. The use of IT is a means to address the citizens directly and to make better use of any information that the citizens may provide.

In recent years, the Internet has offered increasing possibilities for seeking information on issues of health and prevention in general. This includes information on waiting times, available care etc., thus helping the citizens to be informed and self-reliant users of health care.

Most contacts between the health care service and the patient are concluded in the GP's office. However, a number of contacts take place as a part of an episode of care which involves one or several hospitals or hospital departments. An episode of care can also be viewed in a broader context to encompass episodes involving several actors such as GPs, hospitals, community health care, practicing specialists

etc. To the patient, however, it is still a matter of a single episode and should be experienced as such. Therefore, seamless data exchange among parties in the health care service is of vital importance.

It is also of fundamental importance that relevant information is reused across sector limits of the health care service. It must not be necessary to give the same information each time you encounter a new instance of care, be it internally in a hospital, in case of transfer to a specialized department or discharge from hospital and subsequent referral to community health care. Likewise, analyses and examinations should not be repeated unnecessarily.

This requires that information is updated and credible and, especially, that the citizen and patient authorizes relevant information to be relayed. Naturally, it also requires that the patient can have access to the same information. This will provide the necessary prerequisites for the coordination of treatment, rehabilitation and care between sectors like district home care, specialist, physiotherapist, general practitioner, hospital and social institutions.

However, the perspectives reach beyond these aspects.

While reinforcing the citizens' general access to health related information, IT also presents citizens and/or patients with a number of possibilities to obtain more influence and to be more actively engaged in their own care.

The application of IT will give the citizen and/or patient a number of possibilities at home: He will be able to make appointments with the doctor and dentist, to request prescriptions, to ask health-related questions (e.g. e-mail consultations with his general practitioner or communication with the district nurse) etc.

The implementation of EHRs in hospitals, in the general practice sector and in district nursing will, along with the dissemination of the digital signature, enable the individual citizen to have safe access to personal health-related information. Certain patients can already record personal data (e.g. patients with chronic illnesses). Experience gained in this field will support the physicians' professional assessments and his counseling of the patient. Likewise, it will help the patient engage himself more actively in his own care.

The public health portal will be an integral element in complying with the desires and goals that citizens and patients envision for the health care service.

The health portal will not only be a communication tool for health care professionals. The vision is that it should also ensure the citizens a common informatical access to the entire health care service. The vision for the health portal is to provide the citizens with an overview of the organization of the health care system as well as with information on how to make use of its services. The portal should also support the patient in attending to his own care and state of health.

In order for visions to become realities, communication between hospitals, general practices and local authorities must become an important area of focus in the forthcoming period.

Scenarios for future possibilities for the citizens and patients:
Through the health portal, citizens will be able to acquire personalized, relevant information about the modalities of care that are available in the public health care system, about the free choice of care provider and about waiting times. They can acquire information about when to seek the general practitioners' emergency service, the casualty ward or the day-time GP, as well as counseling concerning disease control or prevention.

For all citizens the portal gives access to a personal health profile, including:
- The possibility to book appointments, to request prescriptions, to consult with the GP by e-mail, to contact the emergency medical service, the casualty ward, the district nurse or district pediatric nurse etc.
- An overview of prescribed medication
- A personal health calendar with previous and future appointments with the health care service
- The possibility to receive e-mail and SMS-reminders
- Plans for prevention, therapy or rehabilitation.

With the digital signature the citizen is given the possibility to access personal health-related information in the electronic health records.

Through an Internet-based E-learning program, the citizens will be informed about a scheduled operation, the necessary preparation (e.g. pre-operative fast) and about rehabilitation.

Diabetics will receive suggestions on diet. They will be able to enter data, like blood glucose, that are monitored by the GP or the outpatient department; or a clinical dietician could suggest a change in diet.

Through the health portal, the citizen is given the possibility to prepare for a planned diagnostic procedure by seeking information on that specific type of care. Likewise, the patient can enter basic information as well as specific information about lifestyle and health prior to a visit to the GP or to hospital.

The patient only needs to describe his medical history once. The different health care professionals involved in an episode of care keep updated on previous events and episodes and on existing plans and appointments.

Patients are not unnecessarily exposed to repeated examinations, analyses and procedures as they can grant access for the health care professionals to view previous parts of their health records, which will be electronically available.

Patients experience a smooth transition, e.g. when they are admitted to hospital or discharged from hospital to their home, so that medication, rehabilitation, personal aids and diet remain unchanged.

Health care professionals

To the health care professionals, IT is primarily a tool for recording and retrieving information of relevance to their work. IT is, however, also a tool which can facilitate and supplement communication with other health care professionals internally in an institution or between institutions and sectors.

It is a goal to present the health care professionals with:
- User-friendly and integrated IT systems
- Valid and complete (coherent) information
- Information independent of time and place
- Once-only data entry
- Easier work flows
- Better access to knowledge and support for decision-making
- Communication with other health care professionals

The common heading for the use of IT by the health care professionals is the clinical workstation. EHRs shall be the health care professionals' access to relevant information in the specific situation. Intelligent tools will provide optimal overview and reuse of already existing information originating from different sources. One important challenge will be to sort data and choose which information is to be targeted and dispatched right away and which is to be stored for later retrieval in order to avoid information overload.

IT is intended to help create attractive jobs in the health care service. The vision is that IT is easy to use for the staff, gives access to necessary information and facilitates recording and documentation of delivered professional health care. This applies to specific systems like EHRs, home care IT systems and special systems as well as to tools like PCs, mobile units and medicotechnical equipment. The aim is that health care professionals view IT as a natural part of their daily work and that they expect IT based solutions.

Implementation and penetration of IT in the health care service carry a vast potential for enhancing the professional quality in health care. This is related to the fact that health care is a very knowledge-intensive sector. Information concerning patients and plans for care, treatment etc. are often shared by a large number of persons with different levels of professional knowledge and expertise, working in different physical locations. Furthermore, information is often changed or added along the way. Access to the correct - i.e. valid and adequate – information about a patient is therefore decisive for well-founded decision-making during an episode of care.

One characteristic of paper-borne documentation is that it has traditionally been uni-disciplinary: Physicians, nurses and physiotherapists all write and read separate records. The vision is that documentation is cross-disciplinary and that the point of origin is the patient and his problems rather than the health care professional.

A cross-disciplinary health record will enhance the professionals' knowledge of the total episode of care to the benefit of the patient. It could also help blur disciplinary boundaries.

Focus on the utilization of data is important to the users. In particular, the possibilities of finding, reusing and regrouping data can be profitable in everyday work. It will be possible to avoid double entries of information, to gain access to data immediately after entry, to regroup data regardless of chronology and to regroup patient data for quality development, research and planning.

To some extent, physicians, patients and pharmacies all lack an overview of what medication is prescribed and actually taken by the individual patient. One way to generate such an overview is to provide safe access to the personal electronic me-

dicine profile through the public health portal. The portal will host information concerning prescribed medicine, dosage, indication, delivery, etc. This will lead to better utilization of drugs with subsequent consequences for the entire health care system and the public finances.

Consequently, it is important that information and data may also be used across sector borders – electronically and with a common understanding of the contents. One of the main challenges is to continue the development of conceptual as well as technical solutions that can tie together today's different IT solutions in integrated informational systems. An obvious example is the possibility to refer a patient, to order laboratory analyses and medication and to book examinations directly. This will simplify workflows for the professionals considerably and reduce errors due to transmission of information.

Scenarios for the professionals' use of IT:
IT systems are fast, intuitively and easily accessible and users require a minimum of training when changing between different systems.

Logon to the systems is quick and easy. A logon automatically gives access to all relevant data and functions.

Information is fully documented as soon as it is generated. E.g., relevant data from ECGs and monitoring equipment is transmitted directly into the record.

Complicated operations can be simulated in a computer program by using patient scans.

Through clinical information systems and the public health portal, health care professionals have access to a national patient index containing an overview of the episodes of care experienced by a person as well as to references to specific information in the health record.

Through the patient index, GPs, the medical emergency service, district nurses and hospitals can also access to the updated personal medicine profile, showing which drugs have been prescribed and delivered to a citizen.

In a similar way, a citizen can grant access to his care plans in other sectors of the health care service, so as to ensure a well-coordinated, coherent and professionally optimal episode of care.

It is possible for the health care professional to book electronically directly in the planning systems of hospitals, diagnostic laboratories, etc.

There is a possibility for queries across sector borders and in systems with expert knowledge. The application of telemedicine solutions including electronic transmission of X-rays and ECGs will permit consultations with specialists in other geographical locations.

Through the public portal, the GP will receive information on available options for therapy and referrals. Moreover, it is possible to ensure upgrading and sharing of professional skills through specialized E-learning programs.

It is possible to communicate electronically and safely with the patient, for instance about rehabilitation plans, changes in medication or the acquisition of preliminary information that can reduce the duration of a later direct contact, or add to its quality.

The electronic health report system generates reminders to patients about planned examinations or appointments with other disciplines, e.g. social workers, district nursing and physiotherapy.

Reports can be made directly and automatically from the health record to clinical quality registries and administrative systems.

Society

In addition to meeting the desires of patients and health care professionals for how to apply information technology to the health care service, IT must help optimizing the use of available resources on a national level. IT leverages the modernization of procedures and the division of work tasks. It can help achieve a number of benefits such as improved professional quality and better management and organization of work.

It is essential that managements and decision-makers engage in, acknowledge and give priority to the huge challenge it represents to part with established ways of organizing and distributing labor. It is just as important that the required resources be allocated to organizational development and cooperation and to the acquisition, maintenance and development of IT systems and equipment.

Management of the health care service is already widely based on IT. In the hospitals, this applies to patient administrative systems and economy systems, which provide managements with information concerning waiting times, performance, output volume, costs, amount of staff required etc.

The vision is that better access to clinical data, like analyses of episodes of care, can enhance the quality of data used for management purposes. They are also necessary for quality development, e.g. by targeting efforts towards patients who are frequently readmitted, as well as for organizing the planning of work shifts and for minimizing possible bottlenecks within the units. With increased emphasis on freedom of choice and activity-related allocation of funds, knowledge of the costs of different episodes of care and activities will also be essential for the control of budgets and economy.

Scenarios for the value of IT for society in general

Knowledge of patterns of prescription can be used to influence these - and thereby drug consumption - qualitatively as well as economically.

Access to queries in laboratory systems and health records can prevent multiple requisitions of the same analyses, e.g. by the GP and in hospital.

Ability to systematically assess outcome and quality of delivered care.

More efficient workflows for planning and delivering treatment and care may be introduced.

It will be possible to consult expertise beyond one's own discipline by transferring ECGs, X-rays etc., thus minimizing the need for specialists on call or on the staff.

3 Status and premises

3.1 Current state of IT application in health care service

Today, all parties in the health care sector use IT as an aid to some extent. Denmark actually ranks among the leading countries in electronic communication across the different parts of the health care service. This can partly be ascribed to the cooperation between the national health authorities and the counties (including the Copenhagen Hospital Corporation) on establishing the Danish health care data network for the communication of the most frequent clinical messages in and between the health care sectors. For instance, the prescription from the GP to the pharmacy, hospital referral from the GP, etc.

By the end of 2002, approximately 2.4 million of these messages were exchanged every month between more than 2500 parties including hospitals, pharmacies, laboratories, general practices etc.

IT has also been widely introduced in the individual sectors of the health care service. For example, by 2002 more than 87 % of GPs were using EHRs.

During the last three years more than 125 local authorities have introduced electronic care systems for managing logistics and planning in district home care. This means that about one half of the local authorities in Denmark now have an electronic care solution to support tasks like the keeping of health records, administration of drugs, documentation and planning.

Currently, within the hospital system, you will find a considerable number of IT systems which record data concerning patients. This includes EHRs, patient administrative systems, laboratory systems, systems for diagnostic imaging, booking and medicotechnical equipment, as well as a number of specialized professional systems.

Patient administrative systems are extensively used in the entire health care service. They provide data to a number of central registries that are unique in an international context, e.g. the National Patient Registry, the statement of activities in the hospital system and settlements of accounts between hospitals.

However, paper based communication is still prevalent in clinical practice. The IT systems are rarely inter-connected, in which case they could be sharing data, internally in hospitals as well as across sectors in the health care service. It is a task of vast proportions and extreme difficulty to enable them to reuse data from other systems. The Danish EHR Observatory, whose task it is to follow the development of EHRs in the Danish hospital system, estimates that 7 % of beds in Danish hospitals were covered by EHRs as of April 2002 (EPJ Observatoriet, Statusrapport 2002).

3.2 Prerequisites for the application of IT

There are several important prerequisites for gaining the benefits of IT in the health care service and for realizing the outlined visions. User friendly and fast systems, which the users are trained to use in a competent way, are essential. Another important prerequisite is that relevant organizational changes are implemented as a consequence of the emerging possibilities. The aim is, as previously mentioned, that IT becomes an integral part of the clinical workplace.

3.2.1 The qualifications of IT users

The vision is to lift all users to a level of understanding and familiarity with IT so that they expect, demand and choose the IT supported solution. This will necessitate important investments and continuous support, but it is also a prerequisite for the full realization of the benefits of IT. Before the goal is reached, an educational task is to be embraced.

There will be a need for training in the following areas:
- Fundamental IT qualifications and skills in using a PC
- Processing and retrieval of information in the health care service
- Use of specific systems and products

Part of the educational effort will be integrated into continued professional education and clinical training of the actual users, i.e. the staff. In the context of the government's strategic goals concerning digital administration, it must be endeavored over a period of time to ensure that the general IT qualifications are incorporated in the health care education. Eventually it will represent a smaller proportion of continued education. Training in the use of specific systems will still be a local task.

Continued clinical education and clinical training of the users normally takes place in connection with the implementation of EHRs or other IT systems. This draws resources from the organization, as the staff is not always able to participate in everyday tasks while participating in training and introduction to the new systems. There will be a period of adaptation with a considerable need for support.

3.2.2 Organizational changes
– professional handling and management

Complex organizational relations and many actors are characteristics of the health care service. This is especially true in hospitals. The interaction between hospitals, GPs and local authorities also involves the need for dedicated exchange of information and for reasonable workflows. Cooperation and communication between district nursing, GPs and hospitals, for instance, must have high priority and must be incorporated from the very beginning.

Support from the management is necessary if restructuring of workflows and distribution of labor are to be realized. There is a need for professional guidance in the complex task of introducing and developing new IT solutions. It is also important to acknowledge the fact that that IT is not just implemented once and for all. Rather, it is the beginning of an ongoing process of development and change of documentation methods and workflows.

One of the most important effects of the digitization of the health care service is the potential to alter organization and workflows into more rational processes, which will be to the benefit the patients and optimize the use of resources. It is now standard practice to analyze workflows whenever IT systems are introduced in the hospital system. Planning and managing tools, like booking systems, are often integral parts of IT applications in the health care service.

The exchange of experience and the application of recognized methods of analysis, project management and evaluation are necessary. This serves the dual purposes of building on the experience of others rather than to repeat their mistakes and to propagate good solutions as widely as possible.

3.3 Informatical prerequisites - steps on the way to the vision

Electronic communication in the Danish health care service is currently based on standardized messages in a number of typical clinical situations. The content of the messages cannot be read at machine level. This means that in a large number of cases it cannot be reused directly (cf. ill. 1). With the prospect of more IT systems being introduced there is a genuine risk that informational "islands" will arise, where information has to be copied manually, or is organized in such a disparate manner that it cannot be regrouped for analysis etc. The consequence may well be that the health care service cannot even remotely realize the benefits that could be expected from intensive use of IT.

The vision comprises general electronic availability of all relevant information. At first, this availability might lead to an information overload, which could become critical in case of a more liberal use of messages. If, on the other hand, the exchange of data is based on queries in external IT systems, it becomes increasingly difficult to ensure that all relevant information is found. In both cases there will be a risk of misunderstandings, and information cannot be reused for clinical decision support or quality development as long as both parties use different or undocumented informational structures and concept models.

Figure 1.

Digital access to pooled information
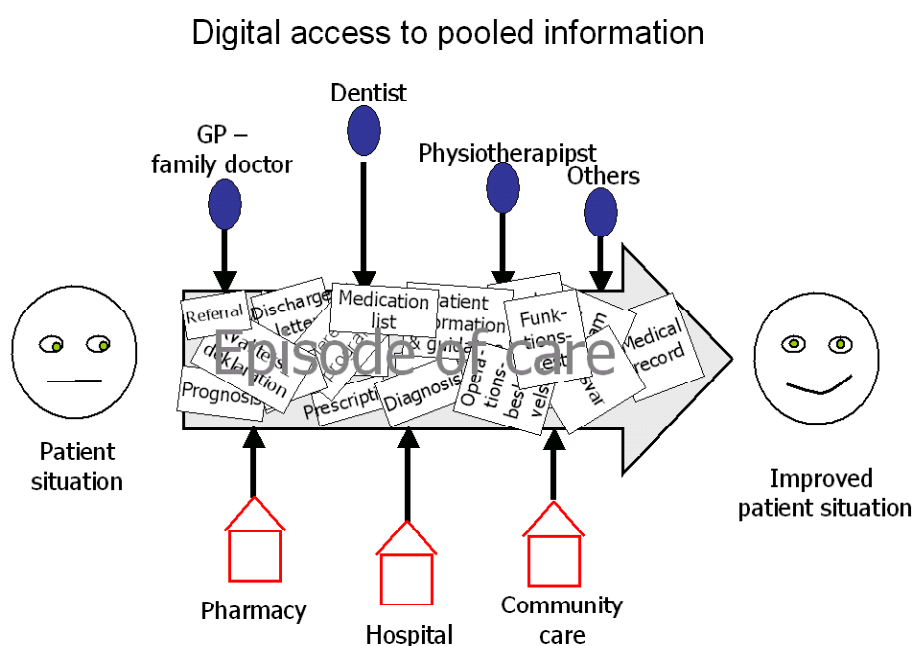
In other words, it will be difficult to find your way around in large amounts of information presented in various ways not known in advance.

It is, however, possible to ensure that health care professionals and their IT systems can find precisely the relevant information. This requires that all parties use a common and well-documented way to structure information (cf. ill. 2). Thus, users can exclude information that isn't relevant in the given situation and concentrate on what is needed here and now.

To the extent that information is also based on some sort of classification, it can be reused by different IT systems for overviews of episodes of care, for automatic booking, interactive decision support, efficient quality development with short feed-back time and for numerous other purposes.

Figure 2.

A shared structure for clinical information
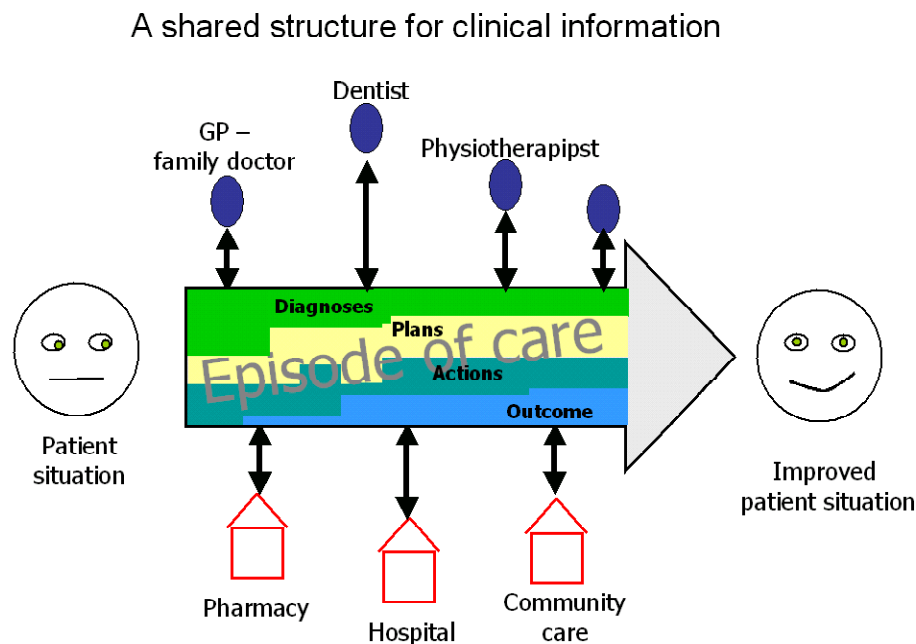
The necessary evolution from a situation with totally isolated informational systems to the optimally flexible use of information and communication as sketched in the vision may be described by a number of prerequisites that can be fulfilled one step at a time. A higher level of integration is reached for each step in this evolution.

This can be attained by methods which are also used at the following evolutionary steps where they will be complemented by further initiatives leading towards the vision. For instance, it will always be appropriate to notify the district nurses when a citizen receiving district care is admitted to hospital.

On each step of this evolution, you have to evaluate where to concentrate the effort. On the basis of cost-benefit estimates, integration will be implemented first in the most profitable areas.

There are basically only three factors concerning the IT systems that are of consequence for this stepwise evolution towards the vision, namely:
- Shared forms of communication
- The degree of structuring of information (i.e. machine-readability)
- The degree of consensus on the concept model

If the benefits at a given evolutionary level are to be achieved, it is important that the majority of the communicating systems have reached the same level. However,

evolution elsewhere may well have attained a higher level. In a complex health care service it is natural that the informational systems in use will have reached different degrees of evolution.

Steps towards full integration

Step no. (integration)	Type of communication	Structuring of data	Conceptual model
4 (All data digitally reuseable)	Queries & flexible messages (push & pull)	Highly structured data (little text)	Common for all data
3 (Important data digitally reuseable)	Previously agreed queries and messages (push & pull)	Highly structured data (little text)	Common for certain data
2 (Few data digitally reuseable)	Previously agreed queries and messages (push & pull)	Highly structured data (little text)	Proprietary concept models
1 (No digitally reuseable data)	Previously agreed messages (push)	Few structured data (mainly text)	Proprietary concept models
0	None	No structured data (text only)	Proprietary concept models

Step 1
In 2002, we had partly reached step one. Pushed messages (EDI messages – standards for transport originating from MedCom and the National Board of Health) were extensively used in the primary sector, although they still covered only some parts of communication. Every hospital can communicate patient administrative information with other hospitals to a limited extent. In certain systems (e.g. in clinical chemistry), data are highly structured. In a large proportion of primary sector systems and the few hospital EHR systems, data are poorly structured. So query programs can only to a limited extent contribute to integration through communication of clinical data. The systems in use are typically based on proprietary (different) standards, which are not always documented.

Step 2
A prerequisite for reaching step 2 is to reshape the clinical systems so that they process data with a considerably higher degree of structure than today's EHR systems and general practice systems. Concurrently, retrieval programs like the SUP-method will increasingly be able to present information from external systems, although they will not ensure electronic reuse of data without a risk of significant misunderstandings. Naturally, the other vital requirement is that most of the clinical work must be supported by IT systems. This means, in practical terms, that instead of covering 7 % of hospital beds, EHRs must cover 90 % or more.

Step 3

For the health care system to be able to reach step three, shared concept models for important clinical information must implemented. It is also necessary that queries on clinical data and modular messages (e.g. an XML medication message based on the EHR's medication module) become available on a broader scale. For this to be realistic, clinicians must have access to a functional national patient registry. A degree of consensus about a concept model can probably be reached by using "middleware". On step 2, middleware can also be useful when exploiting highly structured information. Probably steps two and three will be reached almost simultaneously.

Step 4

Step four is reached if all informational systems (not only EHRs) containing clinical data are based on the same fundamental concept model, if data are highly structured and if it is possible in a flexible and probably modular way to assemble messages and queries.

3.4   Integration between IT systems and work situations

Wherever different IT systems are used, the need arises for integrating information. Health care professionals must be able to retrieve necessary and relevant data, view them and use them in meaningful contexts. These data can be stored within the system currently in use or externally. The electronic use of data from external IT systems is important in this integration process.

IT systems integration is closely correlated with the standardization of IT systems. In order to integrate two systems they must observe the same standards within the field that is to be integrated. This is why it is necessary to identify the needs for and the scope of this standardization. There is no doubt that this standardization must be defined and carried out in all of the phases or steps, as the nature and proportion of what must be registered and communicated are in perpetual change - and so is the level for what needs to be standardized.

3.5   Financial prerequisites

One prerequisite for realizing the IT strategy and making use of the results of the national initiatives is allocation of the required resources for networks, IT workstations, software licences and user training.

Once the initiatives of the national IT strategy are fulfilled, a larger proportion of health care personnel will be working with documentation and planning which is only stored on electronic media. This means that very high standards will be imposed in the areas of operational stability, uptime and speed. Therefore, it is imperative that investments be made at all levels of the health care system, aimed at:

- Networks and network connections with sufficient capacity and extreme stability. Networks must never "crash" - this applies to networks within hospitals as well as to those connecting hospitals, the general practice sector and local authorities. This means that resources must also be allocated to the operation, monitoring and upgrading of network structure. Network design must allow for existing security regulations governing the transmission of confidential data to be observed.

- IT workstations with sufficient capacity to run the different IT applications at an acceptable speed. In the future, a large proportion of the health care staff will need access to IT workstations. At all levels, investments in more IT workstations will be imperative.

- The creation of management organizations responsible for installation, maintenance, monitoring and operation of IT workstations and servers etc. The vast majority of IT programs, like EHRs, must be available on a 24-hour basis. Necessary backup facilities and procedures must be established and all systems must be monitored round the clock.

- The creation of an education and support organization to take care of training in connection with the implementation of new systems and the instruction of new staff.

In the longer run, some of these expenses can expectedly be earned back through higher production, higher efficiency and better documentation. In a phase of construction and distribution, extra resources are required for the installation of workstations and networks as well as for the linking of different informational systems. In an operational phase, resources are also necessary for further development, for licenses and for the operational organization.

Thus, in order to fulfill the visions and aims for the national IT strategy, all levels of the health care service must be ready to allocate extra resources to the IT sector during the construction phase.

3.6 Legal prerequisites

The Law on Patients' Legal Status regulates the way patient related information must be handled in the Danish health care service. The ruling principle is that health information can only be communicated with the patient's approval. There is an exception, though, which ensures that health care professionals involved in an actual episode of care will normally have access to pertinent information. This means that information residing in department A may only be passed on to department B or to district health care when the information is to be used in an ongoing episode of care. In all other cases, the explicit approval of the patient must first be obtained. One of the most important objectives underlying this principle is to protect the patient from unintentional accessibility of health information to the outside world, like the place of work or social authorities. In 2002, the National Board of Health issued a practical guide to IT security for hospitals, including regulations on how to protect patient data in IT systems.

With the ambition of widespread reuse and sharing of data as described in the present strategy, it is natural to consider how the fundamental principle of protecting the patient can remain safeguarded alongside with the widest possible application of the increasing possibilities to achieve coherent episodes of care and better quality and safety of care.

Especially for patients unable to fully comprehend their episode of care, the fact that communication within the health care service is not functioning well enough is a problem. If different care providers have prescribed many different drugs, it can be extremely difficult to get a correct and updated list of medication, which could have prevented mistakes and misunderstandings.

A number of initiatives in the strategy will over a very short period of time challenge some of the regulations in the Law on Patients' Legal Status. For instance, it will be imperative to clarify whether the existing legislation presents any barriers to displaying information originating from various registries, with the purpose of giving the health care professional a more holistic view of a patient's state of health. An example of this could be the juxtaposition of data from the future personal electronic medicine profile and patient history data from the national patient registry of the National Board of Health.

It is of crucial importance that a consistent and manageable solution is found to the problem of how to secure patients' rights in practical life. It is equally important that the initiatives, which are implemented during the strategy period, give careful consideration to the patients' ability to control who is able to obtain - or who has already had - access to sensitive personal information.

The national government and the Association of County Councils have agreed to revise regulations concerning patients' rights during the course of 2003.

4 Initiatives

In the present chapter, the initiatives that should be dealt with on a national level in the period 2003-2007 are described and prioritized. The initiatives of the strategy must strengthen coordination of the IT effort on a national level, and they aim at creating conditions on the local levels for the efficient use of IT in the health care service, especially the hospital system, general practice and community health care.

The dependencies between the execution of the initiatives are described at the end of this chapter. Appendix A describes the goals for phase 1 of the strategy (2003-2005) and the goals that are expected to be realized only in phase 2 (2005-2007). For the sake of clarity the initiatives are divided into three categories according to what purpose they are intended to fulfill:

1. Clinical workplaces in the health services

2. National registries and databases

3. Coherent access to information

4.1 Clinical workplaces in the health care service

A major prerequisite for realizing the ambitions of a coherent health care service is that EHRs are widely implemented in hospitals, in community health care and in general practice. The major purpose of the systems is to support everyday clinical workflows through planning, documentation and communication between health care professionals.

These functions must be supported by IT in order to achieve full-scale digitization of planning, documentation and communication. To a considerable extent this is already the case today. The challenge, for the time to come, is to integrate these IT systems or data feeding systems and create well coordinated IT supported workplaces.

4.1.1 Hospitals

Naturally, the electronic health care records in the classical sense of the term - i.e.: the daily records concerning the patient - will become an integral part of the future use of IT in hospitals. However, hospitals are complex organizations that accommodate a variety of functions such as diagnostic laboratories, blood banks and diagnostic imaging.

4.1.1.1 Electronic health records

The EHRs presently in use are practically all so-called first generation solutions with varying degrees of integration with other IT solutions in the hospitals. Within the next two to three years, the first second-generation EHR systems will be implemented with a far higher proportion of structured information, in which the integration between records and data feeding systems is tied to an IT architecture with several layers. Consequently, there will be an interim period when different technological solutions will be operating concurrently, and there will be a need to pass from one technology to another.

The hospital owners and the national government have agreed that EHRs must be based on common professional and technical standards, ensuring that information can be exchanged among systems. The electronic health records must utilize the professional standards that are under elaboration by the National Board of Health.

These are tested and specified in collaboration with the counties and the Copenhagen Hospital Corporation.

It has been agreed that before the end of 2005 EHRs based on common standards must be implemented in all hospitals. There is also a common understanding that when EHRs have been widely introduced, an important task remains in consolidating and developing EHRs into proper clinical workplaces which are increasingly integrated with data feeding systems, informational systems, clinical guidelines, etc. If national registries and the public health portal are to become the common entrance for citizens and the health care system alike, EHRs must be widely implemented.

> **Initiative 1:**
> Electronic health records based on common standards must be implemented in all Danish hospitals before the end of 2005.
> Responsibility: The counties and the Copenhagen Hospital Corporation.

The implementation of EHRs in all hospitals within a three-year period is an ambitious goal that requires close cooperation between the counties and the Copenhagen Hospital Corporation. A particular challenge will be to ensure at an early stage the availability of tested shared standards which can constitute the basis for the solutions that will be demanded by hospital owners.

In order to meet this challenge, the Ministry of Internal Affairs and Health, The National Board of Health, the Association of County Councils and the Copenhagen Hospital Corporation have established a national BEHR project (cf. initiative 2). The project will create the foundation for the coordinated development and implementation of EHRs based on the national standard (BEHR). The purpose of BEHR is to ensure a common structure for communication among EHR systems and between EHR systems and other informational systems in the health care service.

With the objective of fulfilling the goal that all hospitals must use electronic health records based on shared standards by the end of 2005, the Association of County Councils has furthermore taken the initiative to organize the task of ensuring coherence when the counties and the Copenhagen Hospital Corporation implement EHRs. A project organization managed by the Association of County Councils will be in charge of the project. The aim is to cooperate as much as possible on specifications of requirements, technical standards and practical solutions concerning implementation. This project organization is cooperating closely with the national BEHR project.

4.1.1.2   BEHR compliant health record systems – a national BEHR project
In December 2002, the National Board of Health issued the *Basic Structure for EHRs* (BEHR). This is to become the foundation for a common structure and application of concepts in EHRs, which in turn can be the take-off point for cross-sectorial use of information in health records.

BEHR consists of a concept model for the clinical process and a reference information model specifying the requirements to the IT system which will ensure searchability and exchangeability of data. BEHR is based on structured, cross-disciplinary, process- and problem oriented documentation, which differentiates it from the mainly chronological, source oriented and uni-disciplinary documentation of paper records and of most existing EHR systems. Widespread use of BEHR will

records and of most existing EHR systems. Widespread use of BEHR will thus constitute a paradigm shift relative to an important part of the existing documentation in the health care service.

In the attempt to validate the theoretical model elaboration in connection with the development of BEHR, clinicians will be involved in different stages of the analysis process. One clinical test has already been conducted based on a previous version of BEHR.

The implementation of the standard for the electronic health record (BEHR) is an extensive and demanding process. The complex task of managing and executing the vast number of necessary activities will demand a high degree of coordination and close cooperation between the parties involved. It is therefore deemed appropriate to gather these activities in a national project.

Consequently, the Ministry of the Interior and Health, The National Board of Health, the Association of County Councils and the Copenhagen Hospital Corporation have established a national BEHR project with an associated project organization.

Initiative 2:
The Ministry of the Interior and Health, The National Board of Health, the Association of County Councils and the Copenhagen Hospital Corporation have established a national BEHR project with an associated project organization. It will provide the foundation for a coordinated development and implementation of EHRs in the hospital system.
Time horizon: Has already been launched.

An important aspect of the implementation is to ensure that vendors of EHR systems get involved in testing and further development of BEHR in order that they use the common concept model in their solutions. In this way the systems can support cross-sectorial process oriented documentation. At the same time, it is important to establish joint ownership through broad involvement of the health care professions.

The National BEHR project comprises the five following initiatives (3-8).

The challenge will then be for the hospital owners to implement EHRs based on BEHR. This important and extensive task will be a common project for the National Board of Health and the hospital owners. The task consists primarily of implement the concept model in clinical practice and later of developing it further on the basis of this specific implementation.

One of the tools to ensure a high degree of consistency when implementing BEHR - and at the same time ensure the potential for data exchange - is a reference implementation (i.e. a detailed reference information model aiming at the development of a prototype system). This will make possible the elaboration of XML forms defining which messages and what data content should be exchanged in specific situations. This should be done in cooperation among the relevant parties. It should include the experience drawn from the MedCom XML communication pro-

ject and ensure linkage to the general work on XML standards in the Ministry of Science, Technology and Development.

Initiative 3:
A reference implementation of BEHR and a data model are established and put at the disposal of the hospital owners.
Time horizon: The project is already initiated and will run until the end of 2003.
Responsibility: The National Board of Health.

Initiative 4:
Elaboration of XML forms for communication based on reference implementation of BEHR.
Time horizon: Is already initiated, on-going development.
Responsibility: The National Board of Health.

This evolution represents a paradigm shift as compared to the bulk of documentation in the health care service today. It is therefore agreed that extensive clinical testing is necessary. This can help validate the clinical application of BEHR and it will illustrate how the concept model for clinical practice, as described in BEHR, can be implemented in EHRs.

The clinical trial must also be viewed from the perspective of the new common public health portal in which BEHR is meant to be the basic semantic reference in the internal domain model of the portal. This means that the development of the health portal will require that BEHR is made increasingly operational relative to well-developed proprietary formats. The portal will, however, contribute to the continued development of BEHR through specific solutions.

Initiative 5:
Clinical validation of BEHR will be carried out concurrently with the reference implementation.
Time horizon: Start: early 2003. Conclusion: early 2004.
Responsibility: The National Board of Health.

Experience drawn from the clinical trial of BEHR (and similar EHR projects based on structured and problem oriented documentation) can help create a common understanding of how to design a process bearing towards increased structuring of data and problem oriented documentation in health care. This includes elaboration of workflow analyses, change management planning and training of users.

Initiative 6:
As a facet of the implementation of BEHR by hospital owners, a tool will be developed which can collect and identify the clinical and organizational consequences of BEHR and problem oriented documentation.
Time horizon: Will be launched when the clinical validation of BEHR is concluded, early 2004.
Responsibility: The Association of County Councils.

Finally, there is a need to determine a shared model for how to store, update and communicate information in health records in the longer run, when BEHR is expected to be widely implemented. This will bear on issues concerning legislation, technical aspects, IT security and economics.

It will be possible and relevant to benefit from experience gained from the ongoing construction of the public health portal and the related common infrastructure.

Initiative 7:
A project will be initiated to clarify issues concerning legislation, technical aspects, IT security and economics, as well as ways to store, update and communicate information in health records.
Time horizon: Start: early 2003. Conclusion: end of 2003.
Responsibility: The Ministry of the Interior and Health.

4.1.1.3 A market with several vendors

It is the common intention of all public stakeholders in the health care service to ensure competition and avoid monopolies. The technical evolution will probably move away from standard systems from a single vendor towards stratified and modular systems based on so-called integration platforms, where a number of vendors would typically be involved in the same solution. The disadvantage of the actual market situation has been that it is impossible or very costly to replace parts of a system with modules from other vendors. This situation will in effect tie the hospital owners to one vendor and his products for a long period of time.

The advantage of integration platforms is that single modules and parts can gradually be replaced without the consequences and costs known in the past. Expressed in a popular way, the aim is "plug and play", meaning that products from different vendors can function together. This requires that vendors agree on relevant interfaces and specifications. The objective is to shift competition from models to functionality, to the benefit of the users.

No EHR systems based on integration platforms have yet been in full-scale operation with all relevant modules. A number of lessons remain to be learned concerning the relevance of different interfaces: Should services like access control be applied on a general level or should they be module specific? It is preferable that this kind of experience be shared among the vendors in an iterative process.

Initiative 8:
Cooperation on integration platforms will be established among vendors in such a way that common interfaces and specifications are developed in an iterative process.
Time horizon: Start by mid-2003.
Responsibility: The Association of County Councils.

The common public health portal is intended to become a platform for extensive and constructive cooperation among vendors. Different vendors must be able to develop and provide components or services for the portal. It must be possible for vendors to contribute to continued integration of other IT systems. Moreover, a common architecture based on open standards and common ownership of interfa-

ces must be ensured, thus permitting relevant components to be made available for reuse in other IT systems, including the EHR.

4.1.1.4 Sharing of experience and development of methods related to the EHR
Experience concerning the implementation and operation of EHRs must be exchanged in a structured way among the counties and the Copenhagen Hospital Corporation. This is especially true for organizational experience with EHRs. The purpose is to avoid situations where everyone starts from scratch when gaining experience with EHRs. A number of areas can be pointed out:

- Preparation and management of projects.

- Actual implementation in a few departments.

- Typical problem areas and the way to handle them.

- Current operation and development of EHR systems.

- Systematic evaluation of EHRs.

- Integration between EHRs and other IT systems.

- Learning related to the long-term use of EHRs.

The process of developing EHRs has a radical impact on a hospital department. Staff will always need to gain experience locally. Therefore, the focus will be on the exchange of general experience - positive as well as negative - and on the development and distribution of general methods for organizational change which can be applied locally.

For specified project periods the EHR Observatory has had the task of monitoring the development of EHRs in Denmark, including organizational aspects. This monitoring task should persist and result in specific recommendations of initiatives to be realized by the EHR Observatory itself, the counties, the Copenhagen Hospital Corporation, or collectively. Moreover, the counties and the Copenhagen Hospital Corporation should cooperate on the exchange of experience on the basis of desires and needs voiced by the hospital owners.

Initiative 9:
During specified project periods, the Danish EHR Observatory continues to develop methods and to gather experience concerning the application of EHRs in the Danish health care service.
Time horizon: The next project period is launched in the beginning of 2003.
Responsibility: The steering committee of the EHR Observatory.

Initiative 10:
The hospital owners establish an experience bank in relation to the introduction of EHRs. This will constitute a framework for the active exchange of experience and create networks between the counties and the Copenhagen Hospital Corporation.
Time horizon: Is running and under further development.
Responsibility: The Association of County Councils and the Copenhagen Hospital Corporation.

4.1.1.5 Education of hospital employees

In order to realize the benefits of applying IT, including EHRs, it is required that health care professionals become competent users of the IT systems that are already in use and of systems that are being implemented.

Good user education should be founded on a more general knowledge of health informatics among health care professionals. This knowledge should ideally derive from the basic curricula of health care educations. E.g., health informatics is now a compulsory part of the curriculum in nursing education. To a certain extent, the educational effort will consist of clinical training and continued professional education of the staff and/or users.

In the context of the general strategy of the government for the digitization of the public sector, the government and the hospital owners have set the specific goal that general IT qualifications will be included in the basic educations. Special health care aspects should be included in the health care educations. Training in the use of specific systems will still be a local task.

> **Initiative 11:**
> The government and the hospital owners will endeavor to provide a wide range of continued education in health care informatics and ensure that knowledge of the application of IT is included in the health care educations.
> Responsibility: The Ministry of the Interior and Health, the Association of County Councils and the Copenhagen Hospital Corporation.

4.1.2 The practice sector

In the practice sector, focus has been on penetration of IT and on connecting as many practitioners (e.g. family physicians, physiotherapists and dentists) as possible to the health care data network. In the fiscal agreement for 2000 the goal was stated that all practices and relevant hospital departments must be connected to the health care data network by the end of 2002.

The counties and the National Health Service Negotiating Committee are working towards this goal through contract negotiations and local agreements. In the contracts with general practitioners and practicing specialists effective from 2002 and 2003 it is agreed that within a definite period of time all providers must connect to the health care data network, use the MedCom standards for communication and have access to the Internet. As contracts with other groups of providers are renewed, these will be faced with the same demands.

The contract with the GPs also includes electronic communication between doctor and patient. This enables the GP to offer e-mail consultations, communicate results of tests by e-mail, make appointments and renew prescriptions via the Internet. To this effect, the common public health portal will provide a safe infrastructure based on the digital signature so that these services can be accessed through the GP's personal profile site on the portal. These profile sites must also display relevant information concerning address, telephone hours, links to the clinic home page, profiles of the staff etc. It is also agreed in the contracts with GPs and practising specialists that the counties must support the penetration and the qualified use of IT through data advisor programs in each county. Advisor programs are known in six counties where they have contributed to the dissemination of IT in the quality

where they have contributed to the dissemination of IT in the quality development of general practice.

Both contracts provide for joint funding of the economical support of IT projects which can enhance the use of IT in the practice sector and communication between general practice and the remainder of the health care service as well as between general practice and the patients.

The projects that are to be supported should primarily be managed by the currently existing bodies for standardization and communication in the health care service, e.g. MedCom, the National Board of Health and the common public health portal.

4.1.3 The community health care

Today, the local authorities are in charge of tasks that were formerly the responsibility of hospitals, especially in the fields of rehabilitation and care in the home of terminally ill patients, patients with dementia or handicaps etc. The remainder of the tasks consists of lighter or more complex care and support like occupational therapy, physiotherapy, nutrition, wound care, examinations and therapy etc. In several ways the general scope of care provided in the communities resembles that of the hospitals.

A number of patients experience episodes of care that reach beyond the hospital and the GP, with massive involvement of the community care sector. Electronic communication between the GP, the hospital, the pharmacy and the local authority is essential if the episodes of care are to be based on the needs of the citizens.

Almost half the local authorities are now equipped with electronic home care records. In spite of this, only a few of the local authorities are part of the information axis which is established as a health data network between hospitals, GPs, practising specialists, pharmacies and local authorities.

Consequently, there is a vast potential for strengthening the collaboration between hospitals and the practice sector on one side and the community health care sector on the other, through increased use of electronic communication.

Aside from the routine electronic message stating that a recipient of home care is admitted to or discharged from hospital, there is a potential for enhancing communication between hospitals and home care by including information of a professional nature. Standards now exist for certain parts of professional communication such as admission reports, notice of the conclusion of hospital treatment and hospital discharge reports. However, experience and distribution are limited.

Within the "Project Digital Administration", which is a joint venture between the national government, the counties and the local authorities aiming at ensuring progress in the adjustment to digital administration in the entire public sector, the "Project Digital Coherence Between Local Authorities and Hospitals" is aiming to promote electronic communication between local authorities and hospitals. The project will entail that more local authorities communicate through the existing MedCom standards and that more extensive communication will be developed even further.

As far as electronic communication between the practice sector and community health care is concerned, a number of initiatives has been started - in connection

with "Project IT Lighthouse in Northern Jutland" and in cooperation with MedCom - towards the strengthening of electronic communication across sector borders.

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Initiative 12:
The national health authorities, the National Association of Local Authorities in Denmark, the Association of County Councils, the Copenhagen Hospital Corporation and others will - in part in collaboration with MedCom - launch coordinated projects to further and support projects of development, testing and distribution of electronic communication between hospitals, practice sector and community home care.
Time horizon: Running evaluation.
Responsibility: MedCom and the Ministry of the Interior and Health.

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4.2 National registries and databases

4.2.1 The National Patient Registry

The National Patient Registry has served as a registry of hospital contacts since 1977. From an international point of view this is a unique registry featuring long-term comprehensive documentation, on the level of the individual, of this aspect of hospital activities.

The National Patient Registry is used for statistical purposes, for specifications of activities and waiting times and for a number of research or professional purposes. In 2002, the hospital owners were given direct access to aggregated data from the National Patient Registry on http://eSundhed.sst.dk. The National Patient Registry hosts information on the citizens' previous contacts with the hospital system that can be of use for health care professionals in subsequent episodes of care - for instance by avoiding that the patient has to repeat his medical history at each contact with the health care service.

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Initiative 13:
The existing National Patient Registry will become accessible online for clinical users and it will be updated on a daily basis. When the health portal is launched it will provide access to the National Patient Registry.
Time horizon: Will be effective in 2003.
Responsibility: The National Board of Health.

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The existing registry is based on the patients' contacts with the hospital system. However, registration based on reporting of contacts gives a fragmented picture of a patient's episode(s) of hospital care. This kind of duplicate registration also entails an unnecessary workload, which is inappropriate from an administrative and clinical point of view.

With the introduction of EHRs based on BEHR, automatically generated reporting based on health issue threads will be possible. This will simplify the compulsory registrations and reportings. The new way of reporting will transform the National Patient Registry into a registry based on health issue threads, thus displaying the continuity of clinical care. This new *National Patient Registry of Clinical Continuity* (NPR) is a prerequisite if all parties involved are to be given the possibility of finding the relevant information among the vast amount of data concerning each episode of care. The NPR will be better suited as a basis for health care statistics

and for reimbursement based on Diagnosis Related Groups (DRG). In order to maintain the basis for health care statistics and the calculation of DRGs in a period of transition during which not all hospital owners file reports based on health issue threads, the National Board of Health is elaborating a method for the conversion of continuity oriented data into contact oriented data with a known loss of information. Conversion in the opposite direction is not possible.

Attempts must be made for the NPR to meet as many needs as possible in order to avoid the present situation with a number of concomitant central or national registries.

In 2003, health issue thread oriented registration will be tested in pilot trials. These will provide the basis for the development of a National Patient Registry which can receive reports from hospitals as of 2005. Implementation in the counties will take place over a span of years. In some counties it will happen only in connection with the implementation of a new EHR or hospital information system.

> **Initiative 14:**
> The National Board of Health creates a National Patient Registry based on health issue threads, called the National Patient Registry of Clinical Continuity (NPR).
> Time horizon: Open for regular reports form hospitals by the beginning of 2005.

4.2.2 National Patient Index
The NPR must be accessible online to all hospitals through the common public health portal. In this way, the NPR can be the basis for a "national patient index".

National Patient Index
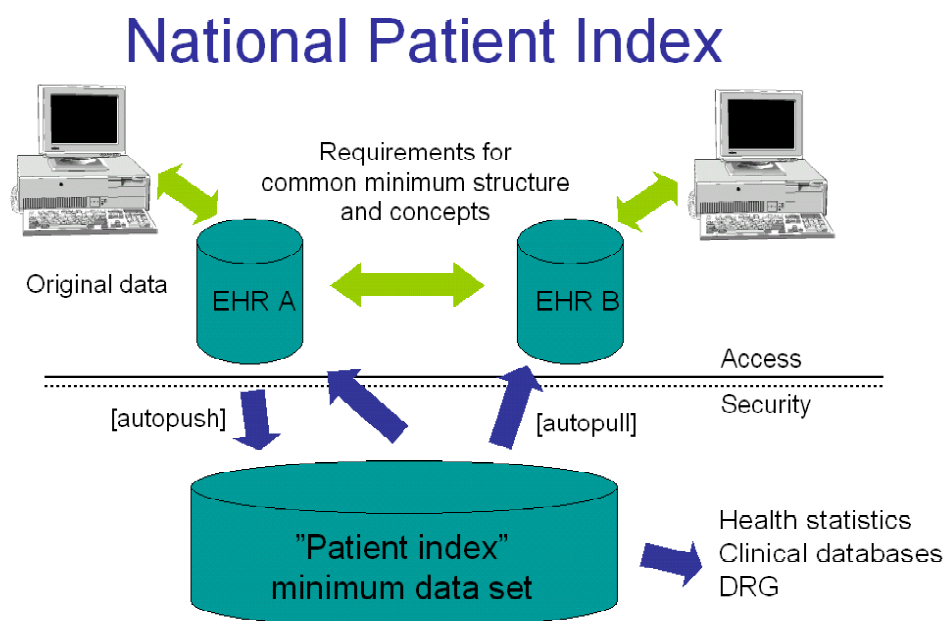
By means of reports from the hospitals' information systems, basic information will be collected concerning previous and ongoing episodes of care, declarations of consent, basic clinical information like discharge information, vital medical information and updated information on medication.

Consequently, the data basis to be used for the purpose of care must consist of automatically reported sets of data concerning basic information and an index stating the location of supplementary information. The data bank must be applicable as a data feeding registry for quality development, for purposes of analysis and research and for diagnosis related grouping.

An important advantage of the index is that it can be developed in separate phases, starting out with the NPR, through the simple index containing basic information, into a "virtual health record" with coherent presentation of information stemming from a number of different sources.

A number of preconditions and technical solutions for such a virtual health record are not yet fully analyzed. The concept of ownership of data and the principles governing the availability of data must be evaluated.

Concurrently with the expansion of the common public health portal, an index will have to be created specifying the location of data available for access via the portal. The index must include references to all relevant data sources and thus administrate the access to several sets of data as the health portal is progressively integrated with more data feeding systems.

One of the vital questions to be analyzed and described is the security aspect. One part of the solution could be the establishment of a common authorization center for health care professionals. In this way it would be a task of reasonable proportions to ensure that access to the index can only be granted to the relevant personnel. The aim is, in part by using a digital signature, to create a safe barrier against unauthorized access and the abuse of data. The national patient registry can also provide access for the individual patient to his own health information. In this situation, confidentiality can also be ensured by use of a digital signature.

> **Initiative 15:**
> The National Board of Health develops a national patient index for the exchange of clinical data on the basis of the National Patient Registry of Clinical Continuity (NPR).
> Time horizon: Preconditions and technical solutions concerning security must be ready for the system to be implemented from the beginning of 2005, at which time hospitals will be reporting on a general scale to the NPR.
> Responsibility: The National Board of Health.

4.2.3 Personal Electronic Medicine Profile

The national government and the counties have agreed (cf. the fiscal agreement for 2003) on the fastest possible implementation of personal electronic medicine profiles through the common public health portal. The purpose is to ensure that prescribing doctors have an optimal overview of the drugs a patient is taking. At the same time, the electronic personal medicine profile will become the "virtual medicine cabinet" of the citizen. Here, any person can obtain a comprehensive overview

of the medical drugs he has purchased from the pharmacy and seek further information on prescribed drugs, including side effects etc. Moreover, the patient will always have an updated account of the total expenses for medical drugs and of reimbursements.

All purchases of drugs warranting reimbursement are reported on a running basis to the central registry for reimbursement. By incorporating data from the registry in the personal medicine profile, real-time updates are ensured as the information is updated the instant the drug is delivered from the pharmacy. As quickly as possible, data from hospitals will also be incorporated in the medicine profile.

Thus, the medicine profile must necessarily be based on the concepts and information structures that are being developed for the electronic health records (BEHR) by the National Board of Health. In such an information structure it will be realistic to start by using data from the primary health care sector.

> **Initiative 16:**
> A cross-sectorial personal electronic medicine profile is established in succeeding phases. All prescribing doctors and the citizens concerned will have access through the common public health portal.
> Time horizon: The system can be implemented during the first phase of the health portal, in the beginning of 2004.
> Responsibility: The Danish Medicines Agency in collaboration with the National Board of Health.

4.2.4 Quality registration and service information

High professional quality of health care is essential to the citizens, and optimal quality of examinations and tests, therapy and care is mandatory. Quality assessment in The Danish Quality Model must focus on episodes of care across sector borders. EHRs and clinical quality databases are tools that are well suited for the collection and processing of data, which in turn will supply the required information concerning quality of service and of delivery of care. A number of projects have been launched to this effect, including:

- **The Good Department of Internal Medicine**
  This nationwide project elaborates generic standards for the function of hospital departments as clinical entities of care. Support to observe standards (and monitoring if desired) may be built into EHR systems if these store essential information in a structured form.

- **The National Indicator Project**
  The data basis for health care quality indicators is collected nationwide covering six disease areas. Data are collected electronically in systems that are prepared for integration with health records based on BEHR. In this way six nationwide databases are created covering areas of special priority.

- **Clinical quality databases**
  Clinical quality databases are an important factor in quality development in the health care service. It has, however, proven difficult to attain the required quality of data, and duplicate registration of data is extremely frequent. It has been a problem for many databases to conclude analyses and

deliver feedback reports to the hospitals within acceptable delays (few months). It represents an important incentive that reports to the databases be an integral part of daily documentation, i.e. by way of EHRs, and that quick access to the reported data be available, so that the a department can compare its results with similar departments.

The National Board of Health has taken the initiative to establish the project "Integrated Health Care Quality Registries" with the purpose of developing a set of general specifications for clinical quality databases. The purpose of the project is to boost efficiency when developing new databases, to make future integration with other patient oriented IT systems possible and to allow quick reporting of results.

As of 2002, the counties and the Copenhagen Hospital Corporation have pooled the funding of the clinical databases. They have specified common guidelines and requirements for the operation and IT support of the databases in order that the output of the databases may become more uniform in structure, the professional results derived from the databases may be enhanced and improved and finally that the results may be secured and communicated to the respective target groups. Furthermore, the Copenhagen Hospital Corporation and the counties have created three National Centers for Clinical Databases in Aarhus, Odense and Copenhagen, respectively, aiming at enhancing the development of databases.

The development of databases must be linked to the BEHR model as far as the central concepts are concerned. This allows for monitoring of the quality of provided health care, which is important for clinical management and further clinical quality development. In preparation for this linkage, shared specifications for clinical databases will be elaborated.

> **Initiative 17:**
> Completion of the project "Integrated Health Care Quality Registries" with the purpose of developing a set of shared specifications for clinical quality databases that are to be integrated with EHRs.
> Responsibility: National Board of Health.

4.3   Coherent access to information

4.3.1 The common public health portal
In the spring of 2001, the board of directors of the Association of County Councils decided on the initiative of establishing a common public health portal in collaboration with the other public stakeholders of health care: The Ministry of Internal Affairs and Health, The National Board of Health, the Copenhagen Hospital Corporation, the municipalities of Copenhagen and Frederiksberg and the National Association of Local Authorities in Denmark.

The purpose of the health portal is to bring together present and future information and communication in the field of health care. It is the intention to create a common electronic main entrance to the health care service, which can improve insight and better dialogue between the citizen and the health care service as well as support electronic communication and sharing of knowledge internally in the health care service.

The overall goal of the health portal is:

- To bring together future electronic communication between patients and the health care service.
- To function as a communication tool for the stakeholders of the health care service.
- To give citizens and/or patients an overview of the organization of the health care service and information related to the use of the health care service; and support the patient in attending to his own health and his health care situation.
- To put expert information at the disposal of health care professionals.

The health portal will be established one step at a time. During the first phase emphasis will be on the need for overview and for targeted information as well as on communication, thus supporting the encounter between the general practitioner and the patient. During the following phases the scope of the health care portal will gradually be widened towards increasing degrees of integration, communication and process support for the entire health care service.

During the first phases the health portal will present all citizens with the opportunity to create their personal health home page on the Internet. The page is intended to be the citizen's "virtual health folder", a safe platform for communication with the health care service. From there it will be possible to book appointments electronically, to renew prescriptions and to have e-mail consultations with the general practitioner.

The personal health home page will also present targeted information about the services provided by the health care system. This will provide a better overview of available options and the individual's care situation. It will also give access to personal data registered in the health care service, including medication and, in the longer term, to data in the EHR.

To the health care professional, the purpose of the health portal is to support the clinical IT workplace and the IT tools already in use. The portal must ensure easy and personal access to targeted professional information, clinical guidelines and decision support systems. This will help improve quality, coordination and cross-disciplinary cooperation in the health care service.

The health portal must also enhance the quality level and the efficiency of the clinical decision process by ensuring better access to updated information on the health status of patients. It must be possible to obtain information on present and previous episodes of care through safe access to the individual's electronic medicine profile, medical history data in the National Patient Registry, diagnostic laboratory systems, existing EHR systems etc.

In particular, the portal must support coherence of episodes of care where several actors of the health care service are involved and thus minimize loss of information in situations where a patient is referred from one health care provider to another. During the first phases of the health care portal, special focus will be directed at health care in pregnancy and the implementation of the electronic shared patient record. In due course more features will be added to the portal.

4.3.2 The SUP project (Standardized Pull of Patient Data)

The counties, the Copenhagen Hospital Corporation, the Ministry of Internal Af-
fairs and Health and The National Board of Health have agreed to follow a strategy
in several stages in order to ensure the coherent development of EHRs in Denmark.
This strategy comprises short-term as well as long-term goals and efforts.

In the short term it will become possible to exchange information between existing
EHR systems by following the SUP method. This takes into account the fact that
the counties have reached different levels of EHR implementation.

The EHR systems which are marketed today and implemented in a few counties
are not based on the "Basic Structure for Electronic Health Records".

The so-called SUP project is launched as a transitional solution to this problem.
The purpose is to enable web queries in health records and patient related data re-
gardless of county, in the primary health sector and among hospital departments in
the same county. It is the aim for the participating counties to be able to retrieve
patient data in the SUP format (XML) from an "SUP database"; and that other par-
ticipating counties are granted access - through the health portal - to relevant health
records and patient-related information in the database.

Concurrently with the development of EHR-standards and concepts, these will be
integrated with the EHR systems. Subsequently the SUP method will be phased
out. This will ensure that experience gathered by the counties with the SUP method
will be incorporated in the further development of a basic structure for EHRs.

4.3.3 Common Concepts in the Health Care Service

The need for a uniform way of applying concepts and terms is increasingly coming
into focus. In order to solve this problem in a rational manner the need also arises
for authoritative definitions of concepts and terms. The National Board of Health is
elaborating these in collaboration with the relevant professional groups. The Natio-
nal Board of Health will establish a database system which can collect terms and
concepts. In the beginning it will be an internal tool for the elaboration of concepts
in the National Board of Health, but within a year it will be available to all activi-
ties pertaining to analysis and development in the entire health care service. The

concept database will be continuously updated and functionality will be further developed.

> **Initiative 20:**
> The National Board of Health is in charge of establishing a widely anchored organization whose purpose it is to evaluate and develop concepts in the health care service. Through a database, these will be made available to all activities relating to analysis and development in the health care service.
> Time horizon: Open for general use at the end of 2003.
> Responsibility: The National Board of Health.

4.3.4 The connection between electronic home care records and electronic health care records

In order to create the basis for better and safer electronic exchange of data between the district home care records and other IT systems (patient administrative system, EHR, health portal etc.) in the health care service, the National Association of Local Authorities in Denmark has - in collaboration with many related parties (the Association of County Councils, the Ministry of Social Affairs, the Ministry of Interior and Health, MedCom, local authorities, IT vendors, user organizations and others) - initiated a project aiming at the further development of the home care records into a version 2. This will enhance the possibilities for cross sectorial communication.

The project does not, however, include the development of an authorized linking of home care record systems (Shared Language I & II)[5] and EHRs. There is, however, a widespread desire for this work to be initiated. In the municipalities of Århus and Aalborg this is being done on a local level by defining communication reports for the home care and health care records in local communities and hospitals. This will affect only those citizens who have chosen hospitals within their own county.

This is the foundation on which common communication standards for the local community home care records and the EHR systems of the hospitals will be developed. They will be based on Shared Language I, BEHR and SKS (the health care service classification system, cf. footnote 6). MedCom will be in charge of this effort in cooperation with the National Board of Health. An XML standard must be worked out and made accessible on the public info-structure database, in such a way that it can be communicated safely on the Internet. The goal is to enable local authorities and counties to exchange electronic action plans concerning citizens who need rehabilitation or care in the home.

> **Initiative 21:**
> Standards for communication between community home care record systems (Shared Language I & II) and EHRs are being elaborated in collaboration with the National Board of Health, the National Association of Local Authorities in Denmark, the Association of County Councils and MedCom.
> Time horizon: Will be launched in mid-2003. Must be concluded by the 30th of June 2005 at the latest. At that time it must be possible to send the first message.
> Responsibility: MedCom.

[5] Shared Language I & II: A Danish assessment and classification system for IT in home care for the elderly and disabled.

4.3.5 Classifications

4.3.5.1 Hospital Department Classification

Due to changes in the structural organization of the hospital system over the past decades, the current classification of hospitals and departments does not reflect the way the hospital system is organized at present. With the increasing need for communication, for settling of financial accounts and for planning, it becomes increasingly important to enhance systematization of hospitals and their subunits. A registry of communicating parties already exists as far as the health data network is concerned (called the "Partnership Table"). In order to facilitate cross-sectorial communication, a comprehensive systematic registry of all services in the health care system should be elaborated.

> **Initiative 22:**
> The Partnership Table will be developed further and combined with the classifications for hospitals and hospital departments, thus forming a new classification of locations. The National Board of Health is responsible for the project in cooperation with the hospital owners and the Ministry of the Interior and Health.
> Time Horizon: To be concluded before the end of 2003.
> Responsibility: The National Board of Health.

4.3.5.2 The Health Care Service Classification System (SKS)

A wider use of EHRs and of highly structured data will make heavier demands on classifications and coding tools. These will provide the shared terms that will be used to feed information into the EHR systems. This requires more user-friendly coding tools and the development of improved transparency of the classification structure.

Common cross-disciplinary use of the Danish SKS classification system will first of all require clarification and definition of concepts related to the health care professions. The classifications must be available in a structure that is suited for documentation, thus facilitating the communication of clinical information across sectors and professions in the health care service. Today, the SKS classification is being used for reports to the National Patient Registry, for the settlement of accounts of delivered care through DRG (Diagnosis Related Groups) and - increasingly - in clinical quality databases.

The National Board of Health has initiated the development of a new indexing system (PAXIS), which will permit cross-disciplinary access and the use of SKS codes for documentation purposes in EHRs. This tool generates an indexation of the existing classifications and makes it possible to find the necessary codes in a given work situation. The combined classification system must be continuously refined and rendered more efficient as the indexing system (PAXIS) reaches a higher level of development.

Efforts have been made in the practice sector to convert the ICPC classification to ICD-10. In order to ensure the validity of the exchange of information between the practice sector and the hospitals, the elaboration of a common classification tool that covers relevant needs should be analyzed in cooperation between the relevant parties.

4.3.6 The further development of BEHR

The Basic Structure for EHR describes the fundamental concepts of the electronic
health care record. This structure will provide the basis on which the National
Board of Health will elaborate specialized sections, each of which describes impor-
tant subsections relevant to the EHR. This will be done on the basis of the general
elaboration of concepts by the National Board of Health (cf. initiative 20).

During the strategy period, the National Board of Health is responsible for plan-
ning the elaboration of specifications of the parts which are relevant to the records
of the majority of patients. This includes specifications for diagnostic imaging, cli-
nical chemistry and booking. When practical experience is gained in these areas,
and as the need arises, it will probably be appropriate to create shared specifica-
tions for basic concepts for decision support. These will be published continuously
so that they can be incorporated as quickly as possible in the future development of
the IT systems in the health care service.

In the section concerning medication, a specific medication message in XML-
format has been proposed and tested. In order for the prescription of medicine to be
safe for the patient, the doctor must have an overview of the patient's current me-
dication, and preferably of previous medication as well - be it when the patient
changes doctors, seeks emergency services, is admitted urgently to hospital or
when he is discharged to home care. Consequently, it is important that all sectors of
the health care service be able to safely exchange information on medication. This
can be attained if all parties involved in the personal medicine profile make use of
relevant concepts and of a relevant information structure in accordance with the
BEHR standard (cf. initiative 16).

4.3.7 Information Security

The question of security has always been of major importance to the hospitals
when dealing with information concerning patient care:
  - Certainty that correct and complete patient information is at the disposal -
    at the right time and place - of the persons needing it.
  - Certainty against inappropriate disclosure of patient information.

The question is becoming increasingly important. The nature of security issues re-
lated to electronic information processing differs markedly from what applies to
paper borne information. The use of IT makes it easier to meet the security requi-
rements of legislation while maintaining improved access to information for quali-
fied persons.

In 2002 the National Board of Health published a set of IT security guidelines. Its
primary aim is to provide hospitals with guidance on how to meet specific legisla-
tive requirements on data security while ensuring a satisfactory overall level of se-
curity concerning patient information contained in the IT systems. The guidelines
are directed at all Danish hospitals. Issues relating to IT security in other health ca-

re sectors are not addressed. However, some of the instructions will probably be applicable to the remainder of the health care service also.

With a new strategy for the entire health care service, a need will also arise for a closer look at ways to ensure that legislative requirements on confidentiality and on the integrity of data are met while the accessibility of patient data hosted in the IT systems is maintained.

Initiative 24:
In order to assist the entire health care service in meeting legislative requirements on information security and the general level of security of patient data hosted in IT systems, the National Board of Health will publish information and guidelines on the special problems and conditions that apply to all actors of health care.
Responsibility: The National Board of Health.

4.3.8 Communication Standards

For a number of years to come, there will be a need for communication among EHR systems that are not based on BEHR, and between these and other health care IT systems - especially internally in hospitals. In order to support this type of communication, a number of XML messages should be developed and made available to hospitals and their IT vendors.

On this background a project has been initiated, the purpose of which is to take the content of MedCom standards that were developed for the EDI communication between hospitals and the practice sector, and reuse it in similar forms of communication internally in the hospital sector. Standards for referrals, discharge letters, laboratory requisitions and results may be completely or partially reused, until such a time when communication can be direct or through the sharing of data among the hospital IT systems.

MedCom has outlined three "packages" consisting of messages which meet the need for communication among hospitals and clinical services ("Hospital package"), among clinical services, diagnostic laboratories and departments of diagnostic imaging ("Clinical package") and among clinical services, general practices and community care ("Primary care package").

Experience drawn from the development and implementation of EDI-messages in the primary sector can become useful through reuse of the semantic content of the messages in such a way that only the syntax has to be changed to XML. This experience can be used to boost the efficiency of the implementation process as such. In close cooperation between MedCom and the National Board of Health it will be possible to create a set of messages enabling flexible communication between EHR systems based on the BEHR and the existing EHRs. This presents a cost-effective way to establish communication in a period of transition, until the implementation of EHR systems based on BEHR has reached a stage which allows the internal XML-messages to be used also in communication between the systems.

Initiative 25:
XML-messages must be developed and implemented to an extent that can meet the need for communication to and from those hospital EHR systems that are not yet based on BEHR.
Time horizon: The implementation will begin early 2003 and be concluded at the end of 2005.
Responsibility: MedCom.

4.3.9 Infrastrucure

The widespread use of standardized electronic messages in the Danish health care data network has brought significant advances in the quality and efficiency of work processes. It has also given the patients a better experience of continuity and coherence when confronting the different parties of the health care service. Concurrently with this evolution, the Internet has gained widespread distribution.

The public health portal is a common entrance to communication between the parties of the health care service. This communication comprises queries in external systems as well as communication by images, sound, graphics etc. The counties have now established closed health care data networks that can be linked so as to enable Internet based communication between networks through the health portal.

On this background, MedCom will gradually reorganize the existing health data network. The present VANS basis will be replaced by Internet technology in a new closed network, which is basically a linkage of the existing closed county and local community networks. This way of applying technology puts high demands on security, on certification, and on user administration in conjunction with the "partnership table" maintained by the National Board of Health.

This will, however, enable forms of communication that haven't been available with the present health data network. For instance, it will be possible to realize the pull principle, according to which the health care professional can collect the information needed from external systems. At the same time, pictures, sound, graphics etc. will become available on the network. Finally, the Internet technology allows for extending the user group of the network to include not only the health care professionals but all parties involved, including the patients. This area also needs for precise clarification of how to ensure confidentiality and other security aspects.

MedCom's activities involve not only an infrastructure project aiming to establish a safe, functional, nationwide network, but also a number of communication projects which must support intensive use of the Internet based health data network. This could be within the framework of the health portal, which will become the common entrance for relevant communication projects. Close integration between MedCom activities and the health portal must therefore be ensured.

Initiative 26:
 A safe, nationwide infrastructure and comprehensive implementation of Internet based telecommunication reaching across boundaries in the health care sector will be established.
Time horizon: Concluded at the end of 2005.
Responsibility: MedCom.

4.3.10 Telemedicine

Telemedicine is a technology in which the transfer of video, pictures, sound and test results enables experts who are not physically present to be involved in the diagnostics and care of a patient.

Telemedicine provides a number of ways to enhance the quality of care and service and thereby the level of patient satisfaction. Furthermore, telemedical solutions can help ensuring a more rational use of resources available to the Danish health care system.

Telemedical solutions may entail a number of advantages for the patient, including faster and better diagnosis, fewer extra medical investigations, no unnecessary transportation etc. In certain cases, the use of telemedical solutions will also enable relatives to remain close to the patient, to the benefit of the patient's psychological well-being.

For the health care professionals, new possibilities will emerge: consultations with experts, better decision support, less traveling etc. With telemedicine, existing physical limitations can be disregarded. The patient doesn't necessarily have to come to the expert; nor do images need to be moved physically. This can all result in better communication internally in hospitals and between hospitals, practice sector and community health care. Equipment, professional expertise and emergency alert can be put to more efficient use.

On the basis of a specific initiative in the "IT strategy for 2000-2002" and with the aim to further the application of telemedical solutions, the Ministry of Health has published a report entitled: "Telemedicine - a Report on the Application of Telemedical Solutions in the Danish Health Care Service, September 2001". The report maps the consequences of applying telemedical solutions to aspects like organization, legislation, security and resources.

It is apparent from the report that the current use of telemedicine in Denmark is quite limited. Telemedicine is primarily used in hospitals and has only to a limited extent been introduced in other areas, be it cross-sectorially, in the pre-hospital phase or in the doctor-patient relationship.

In order to further the application of telemedical solutions, the report recommends a number of projects and initiatives.

> **Initiative 27:**
> The proposed initiatives must be followed up on the basis of the recommendations of the telemedicine report.
> Time horizon: Initiated early 2003.
> Responsibility: The Ministry of the Interior and Health.

4.3.11 International standardization

International standardization follows several tracks, which are influenced by contradicting interests, including commercial interests. There is, however, a trend towards convergence. The National Board of Health, in cooperation with the Danish Standards Association, is following this extremely complex subject matter. The main activities relate to three organizational levels. One is primarily financed

by the IT vendors (the HL7-organization based in the United States), another is the European Committee for Standardization (CEN), and the third is the global organization ISO.

The Danish standards for EHRs and communication that are to be developed must to the highest possible degree conform to international standardizations. These, however, only constitute a high-level framework that require further elaboration on a national level.

Initiative 28:
The National Board of Health will, in collaboration with the participating organizations in the Danish Standards Association, monitor and seek influence on the international standardization initiative.
Time horizon: Continuous process.
Responsibility: The National Board of Health and Danish Standards Association.

4.4 Inter-dependencies and coherence among the projects of the initiatives

The National IT strategy describes many initiatives which - mostly in the form of projects - aim to provide coherence in the way the health care service utilizes information. Therefore, a visual representation of the way these projects make use of - and depend on - results from other projects would amount to a rather intricate web of mutual dependencies.

A vast proportion of the projects is based on the health care service classifications and on the BEHR standard. In spite of the complexity of all the inter-dependencies, only a smaller proportion of the projects must be entirely concluded before the ensuing projects can be launched.

5 Follow-up

The strategy identifies the initiatives required to ensure that IT can effectively contribute to reaching the goals for the health care service as described in the introduction. To actually reach these goals, it is of paramount importance to follow up on the strategy. To this effect, a firm structure for the continued work must be established, involving all relevant parties in a consensus oriented process.

Initiative 29:
The Ministry of the Interior and Health appoints a national strategy group for IT in the health care service with the participation of the National Board of Health, the hospital owners and the National Association of Local Authorities. It is the responsibility of the strategy group to follow the initiatives, help disseminate the results and further the development of the strategy.
Responsibility: The Ministry of the Interior and Health.

The national strategy group must ensure a permanent dialogue between the national health care authorities, the hospital owners and other relevant parties of the health care service concerning the implementation of the initiatives of the strategy and the general development of IT in the hospital system.

The strategy group must coordinate the work of the committees and work groups that are appointed as a consequence of the strategy or were already in existence in this field.

Concerning a number of the initiatives of the IT strategy, steering groups or project organizations already exist or will be appointed. These must specifically follow up on one or several of the initiatives. This applies to the Steering Group for Med-Com, the project organization in charge of the public health portal and the project organization for the national BEHR project. The role of the IT strategy group will thus be of a more superior and coordinating nature.

Overview of the initiatives of the strategy - Responsibility and time schedule

Initiative (Responsibility)	2003			2004			2005		
	Early	Mid	Late	Early	Mid	Late	Early	Mid	Late
Initiative 1: EHR in all Danish hospitals based on common standards before the end of 2005 (Counties and CHC)									
Initiative 2: National BEHR project (MIH, NBH, NACC, CHC)									
Initiative 3: Reference implementation of BEHR (NBH)									
Initiative 4: XML-schemas for BEHR communication (NBH)									
Initiative 5: Clinical validation of Basic EHR (NBH)									
Initiative 6: Support of implementation (NACC)									
Initiative 7: Clarification of legal, technical, security problems etc. (MIH)									
Initiative 8: Cooperation on integration platforms (NACC, CHC)									
Initiative 9: EHR Observatory (EHR Observatory steering group)									
Initiative 10: Experience bank (NACC, CHC)									

Initiative (Responsibility)	2003			2004			2005		
	Early	Mid	Late	Early	Mid	Late	Early	Mid	Late
Initiative 11: Training of hospital staff (MIH, NACC, CHC)									
Initiative 12: Coordinated communication projects (MIH)									
Initiative 13: Online access to National Patient Registry (NBH)									
Initiative 14: National Patient Registry of Clinical Continuity = NPR (NBH)									
Initiative 15: National Patient Index (NBH)									
Initiative 16: Personal Electronic Medicine Profile (DMA, NBH)									
Initiative 17: Integrated Health Care Quality Registries (NBH)									
Initiative 18: Health portal (involved participators)									
Initiative 19: SUP access to EHR-data (NACC)									
Initiative 20: Concepts database (NBH)									
Initiative 21: Linkage of electronic home care records and EHRs (MedCom)									
Initiative 22: Location classification (NBH)									

Initiative (Responsibility)	2003			2004			2005		
	Early	Mid	Late	Early	Mid	Late	Early	Mid	Late
Initiative 23: Development of shared classification tools (NBH)									
Initiative 24: Information Security Guidelines (NBH)									
Initiative 25: XML EHR communication project (MedCom)									
Initiative 26: Nationwide Internet based infrastructure (MedCom)									
Initiative 27: Telemedicine project (MIH, MedCom)									
Initiative 28: International standardization work (NBH, DSA)									
Initiative 29: Natl. strategy group for IT in health care service (MIH)									

Appendix - Forms of integration

This appendix briefly describes the different forms of integration (cf. chapter 3.4). A more detailed description of the forms of integration was presented in the discussion draft (in Danish) in March 1999 by PSO Sundhedsinformatik, on behalf of the Ministry of Health.

Wherever IT is applied, the need arises to integrate information. The health care professional must be able to retrieve the necessary and relevant data, to view them and to work with them in meaningful contexts. These data can be stored in a local or an external system.

Common definitions and minimum data sets create the basis for the exchange of information between different IT systems. Exchange of information between IT systems is one form of integration. Six different forms of integration may be defined:

- Work flow integration

- Functional integration

- User interface integration

- Semantic integration

- Data integration

- Technical integration

These forms of integration overlap. More importantly: The different forms of integration are connected and in part mutually presupposing. It is not possible to achieve data integration without technical integration. It can be seen that communication of data and integration of data are two sides of the same coin.

Work flow integration
In this context, the term work flow integration designates an IT system which is perceived by the user to be a natural and beneficial part of his daily work. Work flow integration is an organizational matter. It primarily deals with the question of how to design work processes and IT systems.

Functional integration
Functional integration refers to the possibility of accessing, from within one IT system, a function belonging in another system. As an example could be mentioned the de facto standards of Microsoft Office products.

User interface integration
The term user interface integration means that the user works with different systems through the same, uniform user interface.

Semantic integration
Semantic integration describes the situation where concepts are understood and used in the same manner in different IT systems. Semantic integration thus refers to the context to which the information is related. Semantic integration plays a crucial part in ensuring that you don't have to stick to one system from one vendor: semantic integration is one of the prerequisites for "open systems" based on standards for information structure and elements.

For a number of years, the National Board of Health has worked with semantic standards in the form of classifications (SKS) and definitions of shared concepts that are being reported to the National Patient Registry. In the last years, the National Board of Health has initiated the development of semantic standards for EHRs, thus making it possible to define and use central concepts in a consistent manner on a national level.

Data integration
Data integration means that data that are registered in one place can be used in many different places and in different contexts. Data only have to be registered once.

Technical integration
Technical integration means that it is possible from one single workstation to access different systems that can reside in the same or in different servers.

Thus, technical integration requires that infrastructure (cabling etc.) is installed. If this is the case, this form of integration does not cause serious problems, as applicable technical standards are already available.

Abbreviations

BEHR	Basic Structure for Electronic Health Records
CEN	Comité Européen de Normalisation - European Committee for Standardization
DRG	Diagnosis Related Groups (System for the evaluation of hospital productivity)
EDI	Electronic Data Interchange (standard for electronic communication)
ECG	ElectroCardioGram, Electrocardiography
EHR	Electronic Health Record
ICD-10	International Statistical Classification of Diseases and Health Related Problems
ICPC	International Classification of Primary Care
ISO	International Organization for Standardization
IT	Information Technology
NPR	National Patient Registry of Clinical Continuity
MedCom	Center for Health Telematics
NACC	National Association of County Councils (hospital owners)
PAXIS	A national PolyAXial Indexing System (a tool for using the Danish SKS classification system)
SKS	(Danish: Sundhedsvæsenets Klassifikationssystem) A classification system established by the National Board of Health. It includes several classifications, e.g. the Danish treatment classification and the Danish version of ICD-10).
SUP	Standardized pUll of Patient data
VANS	Value Added Network Services (a closed communication network).
XML	eXtensible Markup Language (syntax for electronic information)