Advances in Electronic Health Records in Denmark: From National Strategy to Effective Healthcare System Implementation

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Professional paper
SUMMARY
Electronic health records promise to modernize and improve healthcare worldwide. A number of countries have now initiated large-scale national projects to facilitate the deployment and interconnection of this technology across hospitals, health regions and entire countries. This has proven to be a difficult objective for many governments to achieve. Internationally, many governments have encountered problems, despite large financial and human resource investments. However, there has been major progress in a few countries; most notably the country of Denmark. Denmark has achieved its objective: a high adoption rate by physicians of electronic health records. This has involved the development of interlinked health information systems and sharable patient data across the country's regions and nationally. For example, Denmark's national strategic plan has lead to the ability of physicians to obtain patient summaries throughout the country using a national Internet-based portal. This article describes both the technical achievements and the organizational considerations that have lead to a leading-edge national program for electronic health records. Advances in Denmark are discussed in the context of developments in national e-health strategies in other countries, most notably Taiwan.
Keywords: Electronic health records, national strategies, system adoption, Denmark, e-health, mega projects

1. INTRODUCTION

Information technology in healthcare is one of the most rapidly developing areas of advanced computer technology. A central component of local, regional and large-scale national efforts in bringing advanced technology to healthcare is the concept of the electronic health record (EHR). This technology will not only allow for more efficient electronic storage and retrieval of patient health data, it will also allow for integration of existing and emerging health information systems with advanced healthcare decision support, data mining capabilities, business intelligence, and other new technological innovations. Electronic health records are defined as electronic repositories of patient and health data that can be accessed from different locations, by different users (e.g. health professionals, nurses, doctors, patients) in the management of patient care and healthcare resources (1). EHRs may obtain and integrate information from many other types of systems, including electronic patient records (EPRs) housed in hospitals, electronic medical record systems (EMRs) found in clinics or physician offices, and personal health records (PHRs) located in a patient's home. The EHR provides a longitudinal view of patient data over time from these varied sources.

The effective deployment of information technology to improve healthcare has truly become an international objective, with major national and international mega projects being developed or well under way in a number of countries, including Canada, the UK, Denmark, and other countries as well as the European Econom-

ic Union (EU). The objectives of such programs include: (1) the development of highly interoperable healthcare information systems to provide up-to-date and timely health information across regions and time, (2) to provide effective direct electronic data access to a country's citizens (i.e. patients and providers). The focus of these international efforts has been the successful deployment of working and interconnected EHRs throughout entire countries and regions. The country of Denmark has been a leader in advancing electronic health records and related technologies in this area (2, 3).

In this paper we will discuss the approaches taken by Denmark in the design and implementation of advanced electronic health record systems. At the same time we will take a look at some of the basic technical and organizational aspects within that country which have formed the basis for success in electronic health record implementation and adoption. The paper will also discuss some of the current international challenges in designing and deploying advanced healthcare information technology worldwide. These include the need for consideration of new system designs and development approaches better suited to high-risk mega information technology projects, as well as the need for incremental system design and deployment for systems and projects of the massive scale being attempted in healthcare.

The objective of our work along these lines is to begin to see where approaches and solutions from different business areas, various countries and different perspectives might be applicable. The aim is to share ideas and experiences internationally and to encourage exchange of information across borders about the successes, challenges and issues encountered in the complex task of developing highly interoperable information systems.

2. CURRENT ADVANCES IN DENMARK

Before describing the relation of Denmark's national strategy for healthcare IT to actual implementation projects, we would like to delineate to date what have been the accomplishments in that country in healthcare IT. Some of the most important achievements are described below (based on a semi-structured interview the authors conducted with the Danish Minister of Health, described in (2)):

- In Denmark, secure intranets that have been established that link regions with local health authorities and other organizations through secure intranets. This has been accomplished through virtual private network (VPN) connections to create an Internet based healthcare data network. The national organization known as MedCom was created in Denmark in 1994. The organization was created with the important mandate – that of certifying systems (i.e. from different computer companies and vendors) that are able to interconnect on the national network which Medcom manages (i.e. the secure Danish Health Data Network — see (4).
- Through the efforts of insightful national strategic planning in Denmark, electronic health records are now used by virtually all general practitioners in Denmark (i.e. 100% penetration), approximately 74% by full time specialists and all pharmacies (i.e. 100% penetration). In Denmark, all General Practitioners and healthcare institutions have access to the Danish Health Data Network.
- 80% of all healthcare communications in the primary healthcare sector are being exchanged through EDI (electronic data interchange), with several million standardized medical documents being exchanged every month.
- Creation of a set of standardized EDI forms to be used to interchange and communicate patient information across the country (for prescriptions ordered, referrals to specialists, radiology reports, lab orders and results, insurance claims and home care messages).
- A variety of healthcare services delivered by the national network, including referrals, discharge summaries, prescriptions, and teleradiology. In Denmark virtually all primary care practices have the ability to electronically manage medication lists, enter clinical data, generate problem lists, use decision support software, and create electronic prescriptions that can be sent to pharmacies.
- Creation of a national e-health portal that both health professionals and citizens (i.e. both patients and lay people) of Denmark can access. An impressive advance is that citizens can log into the portal to book appointments electronically, request renewal of medications, review their own patient summary including medications, discharge summaries and laboratory results over the Internet (5).

3. ORGANIZATIONAL AND STRATEGIC CONSIDERATIONS

The successful deployment of healthcare IT in a country like Denmark can be considered a major feat. This is particularly the case given the problems encountered worldwide by national e-health programs that have goals that are similar to many of those already achieved in Denmark. The selection of an appropriate national e-health strategy, given the complex political, organizational and technical constraints present in any country, has indeed been an elusive goal for many governments in many developed countries that have attempted to do this.

To understand the successes of Denmark's National healthcare IT strategy we must first consider the key characteristics of the healthcare system in that country. Healthcare in Denmark is

based on the concept of free and equal access by citizens to healthcare. Much like other countries (e.g. Canada) doctors known as general practitioners serve as the "gatekeepers" of patients to other specialists and health professionals (i.e. they can refer patients to these specialists). In recent years a previous governmental organization of 15 counties and 271 municipalities was replaced by 5 major regions primarily focused on the healthcare sector, along with 98 municipalities. In January 2008 a new national strategy for the Digitalization of the Health Sector (2008-2012) was created. This strategy, which focuses on the goals of: (1) digitization (2) better service for citizens and (3) stronger cooperation for digital connectivity, builds on the impressive work of the following interlinked organizations created within Denmark (each addressing one or more key aspects of an integrated and rational national e-health strategy):

- Connected Digital Health in Denmark (6) has the goal of creating a coordinated health service, where different stakeholders (including doctors, health professionals and patients) have access to all necessary data. The mandate of the organization is to create an overall framework for computerization of healthcare, by creating the channels of information and communication that health data must flow. This national organization works closely with the local regions and communities to achieve its objectives. The Shared Medical Card project is one example of a project run by this organization that aims to provide online access to essential patient data.
- Sundhed.dk (5) is the institution responsible for the nationally accessible eHealth Portal – the official eHealth portal for public healthcare services. By using unique digital signatures (with different ones for citizens and for health professionals) a range of data can be accessed electronically including accessing electronic record information, such as medications, and laboratory results (i.e. citizens can use their digital signature to log on the personal web space on the WWW to review their summary data, request appointments etc.). It should be noted that access to such information is carefully controlled by the Danish Data Protection authorities.

Medcom (4) is a pioneering Danish organization that was created in 1994, with the initial goal of serving the needs of primary care physicians (i.e. general practitioners). Its accomplishments include the management of the Danish Health Data Network. It is also responsible for the communication of health data and information exchange involving the creation of over 50 standardized messages/reports (there are now over four million messages transmitted electronically per month). Medcom has certified electronic health record products (to ensure their ability to receive and dispatch documents electronically). Since 1996 MedCom has developed EDI (Electronic Data Interchange) standards based on the EDIFACT syntax and these standards have also been developed in an XML format for future hospital communications (2).

4. IMPLICATIONS AND RELATION TO PROGRESS IN OTHER COUNTRIES

It is interesting to note some similarities as well as differences between the approach taken to e-health in Denmark and the approaches taken in other countries where a high level of success has been achieved. One other country where there is also not only a high level of adoption of electronic health records, but also a nationally accessible database containing essential patient data (i.e. patient summaries) is Taiwan. In a recent investigation of that country's national strategy (based on a recent site visit to the pioneering laboratories (7,8) in Taiwan made by the authors) it was found that like Denmark, Taiwan had developed effective nation-wide approaches to making electronic health data accessible where and when it is needed. The approach taken in Taiwan has some interesting parallels to that taken in Denmark, including: (1) the development of a secure digital national health network, where health data is stored in the National Health Insurance data center, and (2) the focus on creating a patient summary record that can be assessed from anywhere in the country. The differences in the implementation of the program in Taiwan as compared to Denmark are very interesting. In Taiwan progress has been built off of the National Health Insurance program's smart card project, where there are two versions of smart cards – one for citizens and one for health professionals to carry with them (7). Access to a patient's summary health data (including for example drug allergy information, medications and procedures (8) can be made using card readers located at doctor's offices, clinics and hospitals nation-wide (using a dual card reader that requires insertion of both the patient's and the doctor's card). The patient's summary on the card, as well as the nationally stored copy of the record are updated by transactions that take place in the hospital or doctor's office, leading to an up-to-date and nation-wide accessible health record. Much like Denmark, key developments that have led to success include the following: (1) creation of a nation-wide electronically accessible patient summary record, and (2) creation of a secure national health data network. Comparisons of Denmark's approach have also been made to those of other countries, including England and Canada (e.g. see (3)). However, from the perspective of having developed an integrated as well as practical national approach that has already achieved nation-wide sharing of essential health data, the closest

country to Denmark (in terms of successes and accomplishments to date, despite differences in implementation) would appear to be Taiwan.

5. CONCLUSIONS

The development of digitally connected health information systems across regions and entire nations is a daunting goal, which as proven to be difficult to achieve. However, in Denmark, a number of impressive accomplishments have been made towards achieving this goal. In this paper we have described the overall approach and the organizations within Denmark which have been responsible for the progress to date. It is hoped that by examining successes in different countries that there will be greater global sharing and exchange of information about what organizational, strategic and technical strategies work best and under what differing regional, national and cultural contexts.

REFERENCES

1. Shortliffe E, Cimino C. Biomedical Informatics: Computer Applications in Health Care and Biomedicine. Springer-Verlag, 2006.
2. Kushniruk A, Borycki E. Health Information Technology in Denmark: Forming the Basis for an Effective Health Information Technology Strategy. Healthcare Information Management & Communications Canada, 2009; 23(4), 42-3.
3. Protti D. A comparison of how Canada, England and Denmark are managing their electronic health record journeys. In Kushniruk, A., Borycki, E. (Eds.) Human, Social and Organizational Aspects of Healthcare Information Systems. Hershey, Pennsylvania, IGI Press.
4. MedCom – the Healthcare Data Network: http://www.medcom.dk
5. Sundhend.dk – The National Health Portal: http:/www.sundhed.dk.
6. Larsen O. Connecting Digital Health in Denmark: http://www.ehtel.org/references-files/2007-10-whit-presymposium/EHTEL-EuroRec-2007-Larsen-Digital-Health-Denmark.pdf/view.
7. Hsu M. Smart health care reform. Canadian Medical Association Journal, 2010; 182(7).
8. Hsu M, Li Y, Liu C. ADRs and smart health cards, Canadian Medical Association Journal, 2006; 175(4), 385.

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