Adoption of Information Technology in Primary Care Physician Offices in Alberta and Denmark, Part 2: **A Novel Comparison Methodology**

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This article follows on from part 1 on the history of medical computing in Alberta and Denmark (Protti et al. 2007). It provides background to the driving forces for automation in primary care physician offices in Denmark and Alberta. It also summarizes the functionality of electronic medical records (EMRs) in both jurisdictions and compares the status of primary care physician office computing in Alberta to that of Denmark. The scoring system used is based on data gathered from publicly available sources on the Internet, databases held by the respective jurisdictional programs (MedCom and Physician Office System Program [POSP]) and interviews with individuals involved in the deployment of systems. The article offers a novel method of scoring the adoption of computerized advances in the office setting that may be applicable to other health jurisdictions, at country, state or provincial levels.

The seminal findings indicate that both Danish and Albertan physicians engaged with computers in the early 1990s; however, in Alberta the emphasis was on the recording of diagnosis and visit date for the purpose of payment for services by the provincial government, while in Denmark the emphasis was on creating an exchange mechanism between physicians utilizing existing standard protocols. In Denmark, physicians rapidly adopted locally provided EMRs, while in Alberta physicians retained paper records until the introduction of a standard process for reimbursing the costs of extended computer capability in 2001. While many of their peers in adjacent provincial or European Union country jurisdictions have languished with respect to EMR adoption, these two trajectories have led to nearly 100% of EMR adoption by general practitioners in Denmark as early as 2000 and 60% adoption by primary care physicians in Alberta by 2006. An evaluation of the similarities and differences points to various factors that have contributed to the rate of adoption of primary care physician office computing that may be important for future evaluations in other settings

such as those of specialist offices and clinics. This comparison of the two jurisdictions is proposed fully realizing that some of the data are far from rigorous; some of the raw data on utilization are simply not available. In addition, the scoring instrument is restricted to the individual physicians' offices and their ability to communicate electronically with other sectors.

DRIVING FORCES TO AUTOMATING

As is evidenced by Tables 1 and 2, there is clearly a variety of forces that have influenced Danish and Alberta physicians to use computers in their clinical practices. The ranking in Table 2 (with 1 being the most important) is C-type data, that is, estimates based on small samplings in each jurisdiction.

Table 1. Incentives and influencing forces

Jurisdiction	Gov't Billing Mandate	Gov't Funding Support	College or Association Leadership	Peer Influence	Accreditation of Vendor Systems	Non-financial Support Received
Denmark	Yes	No*	Yes	Yes	Yes	Yes
Alberta	Yes	Yes	Yes	Yes	Yes	Yes

*Negligible assistance was provided in the mid-1980s to send claims by floppy disc instead of on paper.

Table 2. Benefits of automation in primary care physician practices

Jurisdiction	More Timely Communication with Other Clinicians	Simplified Repeat Prescription	Quicker Receipt of Results	Time Savings	Improved Patient Management*	Legibility of Records and Forms†	Data for Clinical Research
Denmark	1	2	3	4	5	6	7
Alberta	7	5	4	3	1	2	6

*Easier to find records.
†That is, who wrote what.

Reasons Why Physicians Use Computers

The use of technology by Danish physicians has historically been voluntary. It was not until the primary care physician contract of 2004 and the specialist contract of 2006 that using computers and MedCom was mandated. Apparently, as long as 10 years ago, patients would consider a primary care physician to be "second rate" if he or she did not have a computer.

The major reason Danish physicians use their computer is the communication benefits it brings them. They report a much-improved dialogue with hospitals (e.g., where they use to wait five days for test results, they now receive them almost as soon as they come off the equipment). They are automatically notified when a patient is registered in an

emergency department of most hospitals. Hospital discharge summaries now arrive within two days (as opposed to at least four weeks) due to the policies set and enforced by the counties.

In Alberta, regional health authorities (RHAs) took over responsibility for laboratory reporting in the early 1990s and did not develop systematic reporting for physician EMRs until after the Y2K computing obstacles were cleared. There are still major hurdles to overcome in seven of the nine RHAs due to proprietary mainframe restrictions on exporting laboratory data. Hospital records departments still have difficulty reporting electronic results, aside from faxed messages. Funding for the necessary electronic transformation has been subject to health authority constraints that were instituted to meet legal requirements to maintain a balanced budget. Funding for health infrastructure demands did not keep pace with the rapid expansion of the population during the past five years that resulted from the "oil boom." Thus, communication with colleagues in hospital and laboratory facilities did not proceed as rapidly as in Denmark.

Automated Medication Prescriptions

Simplified repeat medication prescribing is a major benefit to Danish physicians. A process that use to entail having to pull charts and hand write a script now takes 10 seconds – interestingly, this is a comment frequently made by British primary care physicians as well. Danish physicians say that they have much quicker access to all of their patient data, particularly recent reports and results. They are able to finish all that needs to be done while the patient is still present. These comments apply equally to Alberta physicians who also can provide repeat prescription writing for patients in the clinic without pulling charts. Repeat prescription writing is one of the vendor conformance and usability requirements (VCUR).

The data in Table 2 suggest that it is also the application that provides one of the biggest benefits to Danish primary care physicians as it addresses legibility concerns, can be a significant time saver (particularly for repeat prescriptions) and offers the potential to make use of decision support capabilities – in some cases, as part of a national pharmaceutical association database. Simplified prescribing, including access to lists of generic drugs, is often seen to be of value as well.

In Denmark, primary care physicians enter all medications themselves. They access a drug database that is maintained centrally by the national Danish Drug Agency. The agency automatically updates the physician office systems every 14 days. Physicians are required to use the lowest cost drug unless a "no substitution" order is given. Most systems provide some decision support in terms of drug-drug interaction, warnings concerning pregnant patients and so on. A major focus for 2007 is to develop national standards in terms of decision support, which all vendors will be required to introduce into their systems. The medication decision support is realized using the central medication database and the MedCom virtual private network (VPN). The development and dissemination constitute a co-project with MedCom, the Danish doctors' association, primary care physician vendors and the Danish Medicines Agency.

After the physician selects the patient's pharmacy from a pull-down menu (often a default), the prescription is sent electronically to the specific pharmacy. At this time, over 85% of prescriptions in Denmark are sent electronically to pharmacies through a national prescription database. All 321 pharmacies with three different IT systems are able to receive electronic prescriptions.

As of January 2007, pharmacies received prescriptions from the general practitioners through the prescription server. An acknowledgement from the pharmacy is automatically sent back to the physician office system. MedCom is considered more secure than normal mail (the value added network [VAN] checks the validity of the phone number calling in). The VAN (the mailbox handler) also uses a VPN technical solution whereby the Internet is used, but the VPN has hardware boxes at the sender and receiver sites, which encrypt all the data transmissions. All users have a single log-on and password, which are never changed. Apparently, there has never been a privacy issue with MedCom (which is not the case when it comes to electronic patient records in hospitals).

As of 2005, all dispensed medications are kept in the Danish Medicines Agency central database (i.e., a BC PharmaNet type of system), which is accessible via an Internet portal to those physicians and patients who have a digital signature.

Over the past 10 years, considerable effort has been made to implement a complete electronic prescribing/dispensing process in Alberta similar to that used in Denmark. However, to date, this has not been implemented except in a small number of practices. Legislative, technical and socio-cultural barriers have each played a role in delaying the widespread utilization of electronic prescribing and dispensing. For example, the majority of pharmacies in Alberta are part of national retail chains that make their technology investment decisions based on national, rather than provincial, trends. During this same period, a national standardization process building on Health Level 7 (HL7) standards has progressed, distracting pharmacy vendors from building a provincial system. Additionally, initial legislation required that patients provide informed consent to have their prescriptions given electronically. This had a severe impact on physicians' available clinical time, which was already in short supply. The original legislation was amended in 2004 to assume implicit consent unless the patient opted out.

As well, when introduced as a pilot program, many patients questioned where the data would be stored and how it would be used. Physicians too were concerned that data might be sold to national agencies that would use the information to influence prescribing habits with targeted marketing practices. Patients in Canada have expressed concerns that the pharmaceutical industry already has too much influence on prescribing patterns. Nevertheless, in Alberta, primary care physicians with an EMR can enter their prescriptions and print them locally even though they are not allowed by federal law to send electronic prescriptions. Although they can access patient drug information online, this is only for patients over the age of 65 years since only the medications for this population are currently recorded in a centralized repository. Recognizing the problems of missing data for the majority of patients, the provincial government enacted legislation that will mandate pharmacies to upload all dispensed

medications by the third quarter of 2007. This, along with an emerging synchronization of national standards for a prescribing/dispensing system, bodes well for Alberta to have a pharmaceutical information network similar to that in Denmark.

Saving Time

Though there are apparently little hard data available, some Danish physicians have said they save one hour per day of staff time. As a result, they are able to see more patients – the estimate is 10% – which they argue covers the cost of the computer system. Two surveys in 1998 found that a primary care physician saves more than 30 minutes each day as a result of receiving electronic laboratory results and discharge letters and sending electronic prescriptions.

Danish physicians also report that they have much quicker access to all of their patient data, particularly recent reports and results; they are then able to finish all that needs to be done while the patient is still present. Recent studies in Denmark have found that 50 minutes is saved per day in each primary care physician practice, telephone calls to hospitals are reduced by 66% and 2.3 € ($3.30) is saved per message, of which there are 60 million per year.

In Alberta, physicians have noted improved efficiencies in filing of laboratory results electronically, writing notes at the time of visits and managing return appointments – particularly for chronic patients who require ongoing care for diseases such as arthritis, heart failure and diabetes. Similar time savings as reported in Denmark are noted in Alberta. Alberta physicians have noticed greatly improved time savings by front-line staff answering phone queries from patients about scheduled appointments, test results and plans for further management. The majority of physicians in Alberta work in multi-doctor clinics, and now the time spent finding misplaced charts has become negligible.

Government Funding Support

The Alberta government has invested in a provincial network that facilitates transfer of laboratory and pharmacy information, and in one of nine health authorities provides discharge summaries, radiology reports and other patient-centric data. However, this network is not available across the other health authorities, at the time of this writing. Plans to develop a "health information exchange" modelled on Denmark and New Zealand are in progress.

Professional Colleges and Associations

Professional colleges and medical associations played an influencing role in both jurisdictions. In Denmark, the Danish doctors' association has always supported MedCom and the use of EMRs. Over the years, the negotiated funding for quality assurance in primary care physician clinics has been changed to quality assurance and IT support, acknowledging the critical role that IT plays in quality improvement initiatives.

The Alberta Medical Association and the College of Physicians and Surgeons played a pivotal role in the development and implementation of IT in Alberta. Alberta primary care physicians are paid on a fee-for-service basis, which traditionally has included a component for overhead fees. These fees cover the costs of liability insurance, societal

dues, space rental, staff, utilities and chart materials. The balance remaining represents the physicians' personal income for living expenses, retirement savings and taxes. In 2003, the physicians' representative organization, the Alberta Medical Association, proposed a settlement that set aside a certain amount of fee increase for the specific purpose of office computerization. This was ratified by the majority of physicians and led to a targeted automation program. Each physician, whether a primary care physician or specialist, who agrees to use a complete EMR, receives $740 per month ($8,800 per annum for a period of four years). Negotiations are under way to extend this beyond four years. Reimbursement approaches for Danish physicians are handled differently.

Peer Influence

Peer influence – collegial pressure – played a significant part in the computer movement for Danish primary care physicians. Early adopters often hosted their colleagues to show them how the computer system affected their work life. At the yearly, one-week primary care physician education seminars – referred to as primary care physician days – there were always IT workshops covering topics ranging from basic computer use to advanced use of diagnostic coding.

In Alberta, physicians were selected to provide workshops and visits to practices that were new to office automation. These early adopters were given special support materials and assistance through the POSP office and became the champions of the program. Special training sessions were also introduced so that physicians could share tips and insights on medical computing. The Alberta Medical Association provided letters of endorsement and encouragement for their membership. Its board made this a top priority of the overall program of effort.

Comparative Culture

Another contributing factor to the Danish success story is the "comparative culture" of the Danes. Since its inception, MedCom has regularly reported on which counties are leading the way in terms of various aspects of the e-health agenda. Since it is human nature to avoid being at the bottom of the list, the competition has spurred the introduction of IT in Denmark.

Other Factors

Denmark also chose to develop point-to-point messaging, which allowed physicians to pass information to each other without having to share data in a central repository. But for the next few years, the focus is moving from messaging to on-demand web services based on new MedCom web service standards.

In Alberta, several factors influence the incorporation of technology into physicians' practice. Oil-rich Alberta has the financial backing to support new developments and has created a culture where, unlike other provinces in the country, there is a push rather than a reluctance for change – a phenomenon that was apparently quite common in a number of Nordic countries in the early 1990s. Alberta is also developing its approach to the confidentiality of patient information. The competing interests of a publicly funded system that wishes to have better central control of the information against the

physicians' need to protect the information of their patient require further examination from legal, privacy and societal perspectives.

Change Management

Non-financial support was a significant influencer in both jurisdictions. Since 1992, the Denmark counties have been providing primary care physicians with a diskette of all their patients when they first start their practice. In 1998, Funen County introduced a data consultant scheme on a trial basis. The scheme, with general practice as its primary target group, had an overall aim of strengthening the use of computers for quality development. By 2001, data consultants became a permanent fixture in all 14 counties. The counties also fund practice coordinators for each specialty (e.g., general practice, psychiatry, general surgery). These physicians work two to three hours per month and coordinate the wishes of their colleagues to hospitals and vice versa. The physician IT agenda moves forward through them.

The aims of the data consultant are to strengthen the use of computers in general practice and, in particular, the use of electronic communication to attain greater coherence in patient treatment in the exchange of necessary data in the progression of a patient. They also strengthen quality development work in the individual medical practices and at the individual primary care physician level, partly by using data extraction in medical practices.

A typical data consultant working for a county regularly visits primary care physicians in their own practice at least two times a year and talks with them about the use of their EMRs. He or she also demonstrates the possibilities EMRs provide, especially about the opportunities to extract data from their systems and use the data for quality monitoring. The consultant reassures the primary care physicians, "You are not on your own – help is readily available."

A similar capability exists in Alberta, again as part of the POSP. POSP provides three levels of support, recognizing that some clinics are ready to begin switching from paper charts to EMRs, while others want to get some experience first using computers. Level 1 is for those who have little or no IT in their clinical practice and want to gain some experience using IT in a clinical context. At this level, IT supports clinical decision-making and information management. Level 1.5 is for those who have little or no IT in their clinical practice, or who have automation but it has not been used at the point of care. At this level, IT also supports clinical decision-making and information management. Level 2 is for those interested in moving toward using comprehensive EMRs as a replacement for traditional paper-based charts.

FUNCTIONALITY OF EMRS

Table 3 summarizes the extent to which electronic communications are used to send and receive clinical information. The specific percentages are based on the total primary care physician population, not just those with EMRs in their offices. It should be noted that the table involves primary care physicians only and does not reflect the degree to which specialists are communicating electronically.

Table 3. Networks and clinical electronic communications

Jurisdiction	% of Primary Care Physicians with EMRs	Health Network in Use	Organizations Connected to the Network	% of the EMR Structured and Coded	Year Technology Use Became Common*
Denmark	99	Yes	Most	~30	1994
Alberta	60	Yes	Some	~5	2001

*More than 25% of physicians using it.

Clinical Notes

Virtually all Danish primary care physicians use their EMRs to capture clinical notes either by entering the data themselves or by dictating it for later entry by office staff. In fact, most primary care physician offices are what are termed paper-light.

In Alberta, it is estimated that 30% of primary care physicians using EMRs enter their clinical notes directly into the computer, which decreases the amount of paper and provides more ease in reviewing notes. This figure is higher than that reported by Schoen et al. (2006) in the Commonwealth Fund study of the use of computers by primary care physicians in seven countries.

Electronic Communications

Virtually all Danish primary care physicians (and as of 2006, all specialists as well) use their computers to electronically send and receive clinical messages such as prescriptions, laboratory results, laboratory requests, discharge summaries, referrals and so on. Sixty standardized messages (up from 32 in 2002) – including their "one letter solution" – have been implemented in approximately 100 computer systems, including 16 physician office, nine hospital, 12 laboratory and three pharmacy systems. The Danes like to use a gas pump analogy – any automobile can be fuelled, regardless of the oil company that supplies the petroleum or the make of the car.

The national network is used by over three-quarters of the healthcare sector, altogether more than 5,000 different organizations. Around 3.5 million messages a month are exchanged, or over 85% of the total communication in the primary sector. All 65 hospitals, all 321 pharmacies, all laboratories and virtually all general practices take part. As of January 2006, all private physiotherapists (1,750 in 550 clinics) and all private dentists (2,800 in 1,600 clinics) were connected to the network. By the end of 2006, all 240 private chiropractor clinics and all 598 private psychologists were also part of the electronic network. This high level of connectivity means that most Danish primary care physicians run paper-light offices.

Physicians pull their messages (some every five minutes, others once a day). All transactions go into a mailbox and into the patients' EMRs automatically. All messages in the mailbox must be acknowledged by the physician before they can be removed from the mailbox. Until this happens, the message displays "not read."

Electronic communications in Denmark are over a secure network, which explains in part why physicians are so comfortable using it.

In Alberta, physicians are working rapidly toward increasing electronic communications. Currently, 27% of primary care physicians and 39% of specialists have an electronic interface to an external laboratory or diagnostic imaging centre. Laboratory and diagnostic imaging results are delivered to an electronic mailbox, where the physician can review and sign off on them. Newer EMR systems that are being implemented across Alberta have test results going directly into the EMRs. They allow for physicians to comment on results and give directions for follow-up action as required.

Communications Standards

Having chosen EDIFACT as their communications standard in the early 1990s, the Danes have recently decided to gradually convert to XML, as promoted by the World Wide Web Consortium (W3C; http://www.w3.org/). The use of HL7 was discussed in 2001 but rejected due to very few IT systems in the Danish health sector being based on HL7 in 2001.

MedCom is proud of its one-letter solution. Before it was introduced, there were hundreds of different paper-based forms for discharge letters, hospital referrals, laboratory results and so on. Now there is only one electronic form used for all types of letters; it is used in over 5,000 health institutions with 50 different IT providers.

Alberta is committed to using HL7 as the primary messaging standard across the province. This has allowed physicians to receive electronic laboratory data and also underpins the transfer messages for diagnostic imaging results as well as a recently developed medical summary.

Directories

MedCom provides an online "Yellow Pages," which allows primary care physicians to see who they can communicate with electronically. It has been reported that primary care physicians increasingly favour referring patients to specialists who are automated. It is expected that by mid-2007, most primary care physician offices will be paperless; currently there are still paper documents being created (e.g., consultation reports from 20% of specialists or physiotherapists who are not yet computerized). A small number of practices currently scan such documents into their system.

The situation in Alberta – though the most advanced in Canada – is somewhat less striking than in Denmark. There are not currently any online directories for electronic referrals, although this is seen as a priority for the future.

Structured Data

Though the Danes appear to be the most advanced country in the world with respect to the adoption of health IT, they trail England and Scotland in the terms of structured and coded clinical data. Though most vendor systems can support it, less than one-third of Danish primary care physicians are using the International Classification of Primary Care (ICPC) to code each visit, which makes it harder for them to use their

data for clinical audits. It also increases the difficulty for researchers to use primary care physician data to provide outcome data for clinical trials and epidemiological research, for example, in a fashion that is supported by English and Scottish EMRs. Private specialists who work outside of hospitals and who code their data use International Classification of Diseases 10 (ICD-10). Laboratory and medication data are, of course, highly structured.

Denmark has made a national commitment to the translation, distribution and health-professional validation of SNOMED Clinical Terms (SNOMED CT). Approximately 20 million DKK ($4 million) has been budgeted for the translation process, which is expected to be completed by 2008. Once ready, all vendors will able to embed the SNOMED nomenclature into their systems. At the present time, there is no contract about the timing of when this process should be finalized. It is noteworthy that the new international SNOMED standards body is headquartered in Copenhagen.

As for the use of SNOMED, the situation in Canada, and hence Alberta, is less clear. At this time, although there is no commonly accepted nomenclature for clinical terms, Alberta is examining the feasibility of SNOMED CT. All physicians are required to code diseases with the ICD-9CM for billing purposes.

ACCESS TO "SHARED" CLINICAL ELECTRONIC HEALTH RECORD DATA

Patient Access

The Danish National Health Portal was created in 2005 to provide information about the Danish National Health Service to its citizens and patients. It is also beginning to serve as a unified hub for electronic communication between patients and the health service. The new health portal permits both providers and patients to access biochemistry laboratory results online via the Internet. Additional services already available on the portal include access to medication profiles, waiting list information, online scheduling of primary care physician appointments, e-mail contact to primary care physicians and online renewal of prescriptions by patients.

The Danes have been capturing hospital discharge abstracts (as Alberta does with its Discharge Abstract Database submissions to the Canadian Institute for Health Information) for both in-patient and outpatient clinic visits since 1977. This data (the so-called events electronic health record [EHR]) is now also available to patients via the Internet using an application called LPR (National Discharge Diagnose Register). Not only are the Danes able to see the high-level data of each of their discharges, but they are able to drill down to obtain more data if they wish through the e-Journal (national e-health record). To date, only 25% of the Danish population is able to do this as not all the hospital computer systems are able to populate the website with the detailed data. Danish patients are also able to go online to see who specifically has accessed their data. Over 800,000 Danes have applied to the National Health Portal and have received a digital signature that allows them to access the above information on the Sunhed.dk portal.

In Alberta, patients wanting information on their laboratory results and history have to apply to their physician for that information as it is not yet available for them to access electronically. Patients wanting to check wait times for magnetic resonance imaging, computed tomography, surgery and cancer treatment can go online to the Alberta Waitlist Registry for detailed information by physician and region. For detailed information on the healthcare system, such as number of discharges, patients can access the Alberta Ministry of Health and Wellness or the Statistics Canada website.

Physician Access

The above-mentioned discharge abstract data (events EHR and e-Journal) to which patients have access are also accessible by hospital-based Danish physicians and primary care physicians, as are shared laboratory and medication data. It is worth noting that these data are kept in separate databases and, at the moment, there is no intention to bring them all together in some form of EHR.

Currently, about 40% of Alberta physicians only have access to shared laboratory data, though the intention is that 100% will have this in the long term. The approach is based on a philosophy that "one size does not fit all"; as a result there are a variety of ways in which physicians are accessing shared laboratory data within their regions.

It should be noted that Danish physicians have a single sign-on to both their EMRs and any nationally available data. In Alberta, the situation is rapidly evolving to a single sign-on; however, development is ongoing and is expected to take at least 12 to 18 months.

DATA PROTECTION LEGISLATION

The Danish Act on Processing of Personal Data went into force on July 1, 2000. The act implements the European Union Directive 95/46/EC on the protection of individuals with regard to the processing of personal data and on the free movement of such data. The act replaced the Public Authorities' Registers Act and the Private Registers Act.

The Danish Data Protection Agency exercises surveillance over processing of data to which the act applies. The agency mainly deals with specific cases on the basis of inquiries from public authorities or private individuals, or cases taken up by the agency on its own initiative (http://www.datatilsynet.dk/eng/index.html). In 2005, the act was amended to permit physicians to have access to medication data. Prior to the change, it was against the law to maintain a medication profile outside of a hospital.

In terms of patient consent, the current legislation is based on an opt-in model, which means that all physicians are allowed to access the medication profile (medication database) of their patients, but all other health professionals must ask for patients' consent before looking at any health information excluding medication.

Danish law forbids the interconnection of IT systems across sectors (e.g., health and taxation).

The 2003 Health Information Act (HIA) legislation in Alberta was modified in 2005 in order to remove the requirement that an informed consent was to be obtained. It is noteworthy that consent and data-sharing aspects of the legislation are expected to be opened up for review shortly.

There is sensitivity to the sharing of electronic data in Alberta, which does not appear to be the case in Denmark. One gets the sense that the issues Albertans are struggling with are issues that were dealt with by the Danes over 30 years ago. Perhaps it is because the approach in Alberta appears to be moving to a comprehensive EHR that will be shared, as opposed to Denmark's approach, which is much more oriented to point-to-point transfer (versus sharing) of clinical data. In the Danish model, the responsibility for what data are sent clearly rests with the physician, whereas in the Alberta model, it is unclear who assumes responsibility for access to shared data.

Dealing with the consent and access issue is not unique to Alberta. In Denmark, most of the regions have a repository of clinical data and the ability to have it accessed. Efforts along these lines were put on hold in 2006 because of consent problems. However, now the problems are solved and access to data is possible.

COMPARING DENMARK AND ALBERTA

It should be noted that this article is built on the premise that there are individual EMRs within each primary care physician's office. It does not take into account the situations in jurisdictions such as Sweden or the US Veterans Health Administration, where primary care physicians have access to a complete EHR and there are no separate EMRs. This article also assumes that the EMR functionality is active in terms of being real time and online – versus passive, which supports off-line activities such as printing forms that are then manually faxed or mailed.

Various models were used to identify the criteria to be scored, including the factors identified in the recent Commonwealth Fund Study (Schoen et al. 2006) and the upcoming Canadian Medical Association survey. According to Davies Award criteria, "The EMR in use must capture and manage medications, the problem list and at least one other type of patient information (e.g., laboratory test results, notes) and provide some real-time clinical decision support such as drug checking (drug duplication, drug-drug interaction, drug-allergy checking). This is the bare minimum functionality" (Healthcare Information and Management Systems Society 2006).

Any attempt to develop a scoring method by which jurisdictions can be compared is clearly a work in progress. Varying definitions, means of implementation and actual usage of technologies by primary care physician staff versus the physicians themselves are but some of the many factors that make this exercise challenging. This work is exploratory and qualitative in nature and, therefore, cannot completely tease out all the various effects. The reliability and validity of the instrument will have to be determined by having other jurisdictions apply it and provide feedback. That said, Table 4 (below) attempts to establish the "state of the nation" across 12 criteria *based on actual usage by primary care physicians versus the EMR system functionality being available.*

Though there are no empirical data available, it is reasonable to assume that Danish primary care physicians fit the classic bell curve from Roger's Diffusion of Innovation Theory, namely 2.5% of innovators, 13.5% of early adopters, 34% of early majority, 34% of late majority and 16% of laggards. Each adopter's willingness and ability to embrace innovation would depend on the adopter's awareness, interest, evaluation, trial and eventual adoption.

Roger's diffusion theory acknowledges the expectation of change over time, that is, the Gaussian distribution describes the distribution in the population by "type of innovation up-taker." To show progress, it has been deemed useful to break the adopted function score into smaller increments. This would allow jurisdictions to know whether the adoption was stalled, increasing or dropping and what impact incentives or government policies were having. On this basis, the score for each criterion is broken into five 20% slices: 1 = <20% of primary care physicians; 2 = 20–40%; 3 = 40–60%; 4 = 60–80%; and 5 = > 80%. Using this degree of granularity is important to providing details of whether jurisdictions are gaining adopters and at what rate.

Since the reliability of the data on the use of computers by primary care physicians is so variable and in some case simply not available, the authors are of the opinion that a weighting factor needs to be applied to any scoring system. The authors are sensitive to the possibility that jurisdictions may be motivated to adjust numbers to match political rhetoric and bureaucratic incentives. This is particularly true when counting is involved and where the definition of what is to be counted introduces the possibility of significant error. Hence, each criterion is given a Cochrane-like confidence factor (CF) in which the following scale is used:

- A = The jurisdiction has provided a descriptive statistic prepared and verified by an independent organization; the data is undisputable.
- B = The jurisdiction has provided an inferential statistic, repeated over a series of years, which provides great confidence as it is based on repeated properly documented, large-scale, technically representative surveys of physicians resulting in valid and reliable inferential statistics about the population of interest.
- C = The jurisdiction has provided an inferential statistic that is reasonably reliable based on recent, statistically significant, large-scale surveys.
- D = The jurisdiction has provided a report supported by statistics and expert opinion but that falls short of meeting the test of representativeness of the national population of physicians. This report is likely an estimate derived from multiple small-scale surveys and the opinions of a number of local medical and health (government or industry) experts.
- E = The jurisdiction has made simple claims and statements based on the views of a few local experts and made without sufficient evidence to scientifically support the claim.

Table 4. Use of EMR functionality as of March 2007

	Denmark	CF	Alberta	CF
Patient administration				
% who have patient appointments recorded in their computer*	5	A	4	C
% who are able to book appointments with specialists and clinics from their computer†	3	B	0	C
Medications				
% who generate printed medication prescriptions from their computer	5	A	3	D
% who receive alerts or prompts warning of potentially adverse prescribing‡	4	B	1	D
% who electronically send prescriptions to pharmacies from their computer†	5	A	0	D
% who have access to medications dispensed to their patients by other clinicians	4	A	2	D
Clinical notes				
% who record the majority of their progress or clinical notes in their computer§	5	A	3	D
Placing orders				
% who send procedure requests to laboratories from their computer†	3	A	0	C
% who send referrals or consultation requests to specialists from their computer†	3	A	0	C
Receiving results				
% who receive most of their patients' laboratory results into their computer†	5	A	3	C
% who receive specialists' (e.g., radiologist, cardiologist) reports into their computer†	5	A	2	D
% who receive hospital discharge summaries into their computer†	5	A	2	D

* The entry of the appointment need not be done by the clinician.

† This is a computer-computer electronic data interchange and does not include printing forms and sending/receiving faxes or mailing.

‡ These could be regarding drug dosage, drug-drug interaction, drug duplication, drug-allergy checking or drug-disease warnings.

§ This includes notes which are dictated by a clinician and entered by staff.

CF = Cochrane-like confidence factor.

It could be argued that the criteria being measured are incomplete, too difficult to measure reliably and not mutually exclusive – all valid arguments that will have to be subjected to the test of time. Future developments of this instrument will likely include criteria such as the following:

- % who receive alerts or prompts to provide patients with recent test results
- % who receive reminders for recommended patient care
- % who have decision aids (e.g., to evaluate treatment options)
- % who generate patient reminder notices for preventive or follow-up care
- % who generate lists of patients who are due or overdue for tests or preventive care
- % who generate lists of patients by diagnosis or health risk
- % who provide patients with electronic access to their EMR
- % who regularly access journals, guidelines and so on from their EMR
- % who receive diagnostic imaging reports into an EMR
- % who electronically transfer patient records to another clinician
- % who access their EMR from outside their office
- % who access patient test results via a portal
- % who access patient hospital records via a portal

It could also be argued that the proposed instrument does not measure the impact of the use of EMRs, and there is indeed opportunity for future research to enhance the instrument. Eventually, it will be important to know how much the EMR capabilities above have no apparent effect or value for clinically relevant outcomes.

Measures of this type are usually expected to facilitate self-evaluation through the provided power of comparison and trigger of individual action. Implicit in the title of how a jurisdiction is doing is the notion that there will be a continuum from doing poorly to doing well in terms of a jurisdiction's collective use of technology by primary care physicians. Given that this is a work in progress, the authors expect to use this tool or a variant to demonstrate adoption over time. For now, the two scales being used indicate that they collectively allow for data users to have a sense of confidence regarding the quality of the estimate based upon the methodology used to achieve the estimate. More formal weighting strategies are under investigation.

DISCUSSION

The marked increase in the use of IT in physician offices in Denmark is consistent with the growth seen in other European countries and is in sharp contrast to the stunted growth in Canada and the United States. It has been suggested that one reason for the failure of North American primary care physicians to take up EMRs is the fragmentation of the market, though the Danish experience would suggest otherwise.

The impact of IT (particularly in primary care), though difficult to show empirically, must be significant. How else could the number of visits to Danish primary care physicians be increasing over the past 10 years while the number of practising primary care physicians has been decreasing, when there is little evidence to suggest that Danish primary care physicians feel they are working too many hours and are burning out? Perhaps innovations such as payment to physicians for phone call visits with designated call-in times has helped. Gaining an hour through automation processes has no doubt also helped. Demographics and the demands of different age and gender groups on the healthcare system may also play a role. Danish patients may expect less time from physicians and be more prepared to gather health information from other healthcare providers such as pharmacists and nurses.

Alberta is only one province in 10, and it is subject to national trends in technology standards as exemplified by the pharmaceutical information systems that are currently being developed. It is also subject to federal laws such as the prohibition against electronic prescribing. Physician reimbursement schemes that have traditionally covered all costs incurred by the primary care physician have left little room for targeted computer investments. However, with a concerted effort by the Alberta Medical Association, with the support of the College of Family Physicians and the College of Physicians and Surgeons, Alberta primary care physicians have made rapid progress in adopting the EMR. Despite significant barriers to critical data such as laboratory results, hospital discharge summaries and dispensed medications, Alberta has reached an EMR penetration of 61%, well beyond other provincial and American jurisdictions.

It is clear that the diffusion of technology within the physician sector of the healthcare market is subject to historical, financial, legal, cultural and social factors. This tale of two places illustrates the issues and different ways to address them.

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Acknowledgements

The authors would like to thank Dr. Chris Corbett for his valuable help with the methodological aspects of this undertaking and Dr. Allen Ausford for assisting with the wording of the EMR Functionality criteria in the table. Numerous discussions with Mary Gibson, Vic Taylor and Dr. Fraser Armstrong guided Dr. Edworthy, who generated the Alberta data in the comparison table. The Danish scores were determined by Ib Johansen, Dr. Jens Parker, Dr. Niels Rossing and Dr. Peter McNair.

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