National Scale Clinical Information Exchange in the United Kingdom:

Lessons for the United States

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Portions of this paper were presented at the 2010 American College of Medical Informatics Winter Symposium in Tucson, Arizona, February 19, 2010.
ABSTRACT

Over the last four decades the United Kingdom (UK) has made large investments in healthcare information technology. We conducted interviews and reviewed published and unpublished documents to describe national-scale clinical information exchange in England, how it was achieved, and the problems experienced that the US might avoid. Clinical information exchange in the UK was accomplished by establishing a foundation of policy, infrastructure, and systems of care, by creating and acquiring clinical computing applications, and with strong use of financial and clinical incentives. Many software and hardware vendors played a part in this effort; they participated in a national framework created by the National Health Service (NHS) in which standards for exchange are specified and their applications designed to make clinical information exchange part of practice. Great potential exists for more cost reduction, increased safety, and greater patient involvement as a result of clinical information exchange.
INTRODUCTION

Over the last four decades, the UK has invested in and achieved more electronic health information exchange than the United States. Although there are substantial differences between the healthcare systems of the two countries, the US can learn from the successes and challenges surrounding the UK NHS information systems. The purpose of this paper is to describe national-scale clinical information exchange in England, how it was achieved, and the problems experienced that the US might avoid.

Types and degrees of information exchange

There have been several scales proposed to classify health information exchange. Walker and colleagues\(^1\) use a four-point scale (Table 1), while the SemanticHEALTH project supported by the European Commission\(^2\) uses 3 levels. In this paper we focus on the exchange of information in a form that can be read by a person using the receiving electronic system, corresponding to Level 2 or 3 in the Walker scale, and Level 1 in the SemanticHEALTH scale. Alongside the technology we consider cultural and organizational issues--for example the content and organization of discharge documents can be standardized with organizational and professional leadership.

Why information exchange is important

*Safety:* Health care is likely to be safer if information such as allergies and current medications are known when new treatments are ordered. Knowledge of concurrent conditions permits consideration of those conditions into decision making; if that information is not available, such as results of an echocardiogram showing aortic stenosis, then unsafe management decisions may occur. Diagnostic errors may occur if the full history is
not known, leading to programs of evaluation or treatment that are directed at the wrong condition.

*Timeliness, convenience, and patient autonomy:* Time can be saved if a consultant or emergency room physician can verify information from the primary care provider's record rather than gathering it anew. If health information is exchanged electronically it can be made available more rapidly, and can save the inconvenience to the patient and healthcare facility of gathering records, copying them, and transmitting them where they are needed. The difficulty of gathering health information from its dispersed locations is a commonly cited reason for interest in personal health records along with the ability to have oversight of their health record.

*Cost-benefit optimization:* An increasingly important reason to exchange health information is the potential to reduce healthcare costs. Most clinicians knowingly or inadvertently duplicate tests because they lack access to results of studies performed elsewhere, which may be incented by fee-for-service. The Walker analysis estimated that the savings that could accrue if Level 4 information exchange were broadly available in the United States at $77.8 billion per year.¹ Though this figure has been criticized as too high or too low, there is little doubt that with greater information exchange substantial savings may be achieved. Political leaders point to reduction in unneeded services as one strategy to reduce U.S. healthcare costs; duplication of tests may be considered among those unneeded services. Indeed, Title XIII of the enabling legislation for widespread EHR implementation in the US anticipates such an outcome; it is sub-labeled Health Information Technology for Economic and Clinical Health (HITECH).
Why study the UK

The UK has undertaken extensive initiatives in healthcare information technology on a scale far larger than past or currently planned efforts in the United States. The most recent has been described as the largest non-military IT program in history, with $32 billion appropriated in 2002. One of the goals of the most recent English health IT initiative is clinical information exchange on a national scale. As the US embarks on efforts to reform our health care system, a review of the UK experience, both for steps that are regarded as successful but also for those that are not, is useful. In our experience, most US providers and medical informaticians are not familiar with the UK healthcare IT experience.

The NHS and information technology

The UK National Health Service (NHS) has been described elsewhere. General practitioners (GPs) throughout the UK provide primary care to all citizens through agreements negotiated with the NHS and monitored using extracts from electronic medical record (EMR) systems. Emergency, outpatient and inpatient care is provided by consultants and hospitals also financed by the NHS. Most GPs are generally independent contractors though almost exclusively state-funded rather than private practice, while hospital physicians and some “salaried GPs” are employed by the NHS, though may have private practice as well.

There have been three large health information technology programs in the NHS over the past 20 years that have bearing on electronic health information exchange, as shown in Table 2. The accomplishments described in this paper occurred as a result of
all three programs, and from other initiatives such as support for electronic records in GP offices by private industry. The most recent and largest has been NHS Connecting for Health (CfH), the agency commissioned with delivering the NHS National Program for IT in 2002, formulated in “Information for Health” published in 1998, on foundations laid by successive NHS national information systems agencies. For at least thirty years, UK primary care has been an early adopter of IT with most practices computerizing prescribing and clinical record keeping over the past fifteen years. CfH has been subject of considerable debate in political and academic sectors.

METHODS

This report is based on 1-5 hour interviews with 37 individuals (Appendix) conducted between May and July 2009 by one of the authors (TP) and a review of published and unpublished documents. Interviewees were identified from published literature, by personal knowledge of their backgrounds and by referral from people previously interviewed. In most cases, a summary of what was discussed was sent to the interviewee for review and correction. Each interviewee was also asked for published and unpublished papers and electronic documents relevant to points discussed, and many provided such information. Published literature was identified using Medline to identify articles on information technology and health information exchange in the UK NHS.

RESULTS

Clinical information exchange in the UK

Requirements for clinical information exchange

We propose the following three layer model to describe requirements for electronic clinical information exchange (Figure 1). The first layer is a foundation: a legal, ethical, and
social framework in which information exchange occurs; a secure medium for information exchange; and national standards for transmission of clinical information that are broadly adopted including the ability to identify senders and recipients and the individual whose information is communicated (Table 3). The next layer is incentives: for providers to devote time and effort to send and receive information and for IT vendors to make it practical for information to be exchanged (Table 4). The third layer is applications: for entry, storage, transmission and receipt of information (Table 5). The information to be exchanged must be in digital form, and there must be a place for it to be received, viewed, and stored in digital form by the recipient.

Foundation

Policy. Many UK policy initiatives have contributed to the level of clinical information exchange that occurs today. Public interest in information exchange has arisen from incidents that have received broad press coverage. The “Victoria Climbié” incident involved the tragic case of a child who received care from multiple providers, each unaware of the full clinical history, for what was later found to be a result of child abuse.

The consequence of such cases was public interest in making a record of care available to emergency practitioners so that it is more likely that patterns would be apparent. Conversely, inadvertent disclosures of private health information have heightened concern that electronic health information be carefully protected. These concerns and others have resulted in two entities not found in the United States: Caldicott Guardians and the National Information Governance Board.
Caldicott Guardians. A Caldicott Guardian is a senior person responsible for protecting the confidentiality of patient and service-user information and enabling appropriate information-sharing, and serves as the ‘conscience’ of an organization. The Caldicott Guardian within the organization may determine what information can be disclosed and the local safeguards that need to be in place before a disclosure is made. An example of an issue in which the Caldicott Guardian may be asked to assist is when a police officer or researcher requests access to health information as part of an investigation. This role is different than the Privacy Officer and Institutional Review Boards in the United States; the former typically services the entire organization in a policy development role, while the latter focuses on research. Further, while the Caldicott Guardian seeks to enable appropriate information-sharing while protecting privacy, the enabling language of health data privacy officers in the US speaks simply to understanding of and enforcement of privacy rules.

National Information Governance Board. The National Information Governance Board (NIGB) is an independent, statutory, multidisciplinary national body charged to consider ethical issues, the interpretation and application of the law and policies, and to provide advice on information governance matters at a national level. The Board reports annually to the Secretary of State for Health and is responsible for the NHS Care Record Guarantee for England. It meets monthly to consider issues referred to it that have to do with how clinical information should be shared or not. After referral to consider an issue, it may recommend a national policy for government or the NHS to follow, may refer the issue to Parliament for possible legislation, or recommend other actions. This Board considers many difficult issues in the rapidly evolving area of protection of health
information and also monitored access to person-specific health data for legitimate social purposes such as biomedical and public health research.

Other policies and practices include the Information Governance Toolkit and the requirement that each NHS organization develop information use policies, self-monitor and send reports to the Department of Health, the Data Protection Act, and the Information Commissioner.

**Secure medium.** *NHS Net* is a network used by the NHS for clinical and administrative purposes. It has developed over a decade beginning with the Information Management Group, and exists now in its third version “N3.” It is for clinical information transfer, to access to applications used for clinical information exchange and for clinical and administrative email (through NHS Mail). Use of the NHS Net is restricted to authorized users, including treating clinicians, many of whom possess a NHS Smartcard. Connection for N3 stipulates no mixing of NHS Net and Internet outside of centrally controlled gateways.

Establishing the identity of and authenticating and granting appropriate access to users of NHS Net is accomplished using strong authentication by means of a username, password, and a token carried in a NHS Smart Card typically worn around the neck of NHS staff. Without all 3—username, password, and card (“something you know and something you have”)—authorized clinicians cannot access NHS Net or use NHS Care Records Service, Choose and Book and the Electronic Prescriptions Service. These security provisions and others have been criticized as insufficient.
National standards. Another important foundational element is the widespread use of nationally sanctioned standards within NHS computing systems. The NHS Data Dictionary, standard data sets and standard messaging are examples of use of standards within UK health information technology. The collection of standards known as the GP System of Choice (GPSoC) includes application standards such as Requirements For Accreditation (RFA) 99 version 1.1 and more recently the Common Assurance Program for GP systems. These standards first came into existence over a decade ago, and coupled with incentives for use described below, assure that EMR systems have the functionality needed for electronic exchange of health information. The electronic patient records use standard clinical terminologies extensively. The UK primary care standard has been the ‘Read Codes’ since the early 1990s and SNOMED CT is mandated to supplant this in all current deployments. The Read Codes were integrated into SNOMED CT some years ago. All shared clinical data is stored on the ‘Spine’ (described below) coded using SNOMED CT. The UK has also developed medication standards such as dm+d and others including user interface standards. The important point is that vendors who provide elements of the NHS IT framework are either contractually obligated to utilize these standards within their applications, or have strong financial incentives to do so.

Unique patient & practitioner identifiers and inter-relationships. Several aspects of the UK health care system serve as a foundation for clinical information exchange. Unique identifiers for patients, practitioners, practices, and NHS sites of care are available for use in health information exchange. The NHS Number is the national identifier assigned by the Registrar of Births used to track health records for all patients in Eng-
land. This was later combined with the NHS Number assigned by the GP during registration. The NHS Number has a long history, including the New NHS Number project, which gave new NHS numbers to all registered patients in England. It has served as an important element for financial management, and more recently, clinical information exchange. Without some process to assure that the sender and recipient are referring to the same person, information exchange could be much more difficult, time-consuming, and potentially hazardous because of the risk of misidentification. When combined with identifiers for practitioners and practices, the NHS Number is an important foundation for clinical information exchange and healthcare resource management. All UK citizens registered with the NHS have an NHS Number; there is no ‘opt out’ for assignment of a number as there is for information exchange--this reflects the importance of the NHS number in English national administration, including links to birth & death registration and social security. In Scotland, the Community Health Index (CHI) number is more widely used. There is widespread public acceptance of the unique personal identifiers both for protection of privacy and greater data accuracy through minimized misfiling of patient records.

There also exists an explicit patient registration linkage between almost every UK citizen and a GP practice that coordinates their care and primary care medical record.

Incentives for exchange of electronic information

Incentives are used extensively to encourage activities that directly or indirectly lead to exchange of clinical information. Two types of incentives were apparent: clinical and financial. These were applied to all involved in clinical information exchange: GPs,
fice staff, hospital physicians and staff, computing system vendors (referred to as suppliers), and others.

Most notable are the financial incentives and, of these, the most pivotal was the support given to GPs to use computing systems. An important contribution to the broad use of EMRs in the UK is that the NHS reimburses GPs for hardware, software and maintenance (or the Trust [an NHS administrative body] is responsible for maintenance and insurance directly). This is done only if the GP selects an EMR that is certified, or accredited, to conform to NHS-established standards for electronic exchange of clinical information systems. Since the cost for these systems and their maintenance is high, this is a powerful incentive to select one that conforms to standards in the Common Assurance Program for GP systems. The standards include details on what and how data are sent through the Spine to other GP systems when a patient moves, and how data contributes to the Summary Care Record. The standards have been adopted by the systems used by the vast majority of UK GPs. In this way, the NHS has both supported use of EMRs by nearly all UK general practitioners, and leveraging the funds used for this has brought about extremely high compliance by both vendors and GP purchasers of standards that permit clinical information exchange.

The British Medical Association lobbied for adoption of data exchange standards on behalf of its GP members, because unless electronic exchange of information was possible, GP practice staff would need to enter by hand potentially large amounts of information about new patients moving into their practice from another practice, even if that practice held the information digitally. If they did not do this, then they would need to
refer to and store a paper record along with the electronic one. More recently, an additional incentive for digital storage comes from the fact that Quality and Outcome Framework scores, on which between 30-50% of GP income is based, would decline because newly arrived patients would appear in the denominator of the score as registered to the practice, but details that might count in the numerator, such as remunerated monitoring of coronary heart disease, would not appear in the numerator of this score derived from automated report transmission from practice EMRs to a national agency.

When a patient is discharged from the hospital, if a discharge summary is not made available to the patient’s GP within 48 hours, then the hospital will incur a financial penalty at the end of the year. The discharge summary does not have to be transmitted electronically, but if it is sent using non-electronic means it may be more difficult to achieve the 48 hour requirement. When the next contract for hospital services is written, it is anticipated that this deadline will drop from 48 hours to 24 hours. This achievement would be very helpful to continuity of care through handoffs between clinicians, which is fraught with risk of under- or miscommunication of important clinical information. The association between patients and their GP makes it clear to whom the discharge summary should be sent. We have no data on adoption or clinical effect of this incentive.

In recent national contracts between GPs and the NHS, out-of-hours (evenings, nights, weekends) care for primary care patients was negotiated to be given by practitioners other than the GP. Without access to the GP record, out-of-hours practitioners may not know medications, allergies, and other basic information unless the patient keeps an
accurate record. The division between in-hours and out-of-hours care serves as a clinical incentive for information sharing. (Today, most out-of-hours care occurs without access to this information though the number of communities in which this exchange occurs is growing.xxx)

These incentives, particularly the strong financial incentives, have been associated with substantial effort to build on the foundation for clinical information exchange, and most importantly to lobby for creation and use the applications described in the next section.

Applications used to store, transmit and receive electronic clinical information

Over the last 25 years, EMRs have been adopted in nearly all GP practices (Figure 2). Along with the change in workflow from paper to electronic process that accompanied this adoption a wide variety of applications have been developed for use for clinical information exchange within the NHS.

The Spine is one of six foundational elements of the English National Program for IT. It includes extensions to projects preceding CfH. The Spine is a combination of national IT infrastructure, a set of transactions, and applications that use those transactions, including Choose & Book, Patient Demographic Service, Summary Care Record, GP2GP, and EPS. The prominence of the Spine within the large CfH program reflects the importance of clinical information exchange to the objectives of CfH. It underlies and permits much of the clinical information exchange that occurs in the NHS. Though its design and architecture have changed since the beginning of CfH, today it consists in part of NHS Net, NHS Mail, shared national services such as Central (Personal) Demographics Service as well as central security architecture and all supporting services
for the applications above and for the Secondary Uses Service. Clinicians who wish to exchange information outside the walls of their facility must authenticate using the Spine, requiring both a SmartCard placed in the keyboard, and a username and password. Once this is done, the Spine makes possible the exchange of information using the applications below.

Among the most prominent applications for exchange of clinical information is GP2GP, which permits exchange of the entire GP patient record from one GP office to another, between GP EMRs from the same or different software vendors. This exchange only happens when a patient changes GP registration, due to home relocation, a change of patient choice of GP, or (rarely) expulsion of a patient by a GP. The exchange includes encoded information and narrative text accompanying the codes, the combination of which comprises the patient’s EMR. It is transmitted according to standards permitting the received information to contribute to patient data used to derive Quality and Outcomes Framework reports. The data also permit the new GP to resume the preventive or chronic care plan begun by the former GP based on that patient’s prior EMR record. At present, GP2GP adoption in UK practices is not yet complete, but rising. In a recent year there were roughly 4.5 million UK patient record transfers between one GP practice to another; of these, over 1 million (23%) had their GP record transferred using GP2GP.

The Summary Care Record is intended to be available outside the GP office when the full record is not. In emergency care, after-hours care and more recently in end of life care, it gives access to information that is frequently required to support acute care de-
cisions. All the GPSoC compliant systems can now export this record. The summary is also being made available within the EMR software used by out-of-hours providers. There is an intention to expand the summary to cover additional data items in the future. There was debate over whether patient’s explicit consent should be sought to create a Summary Care Record for potential future use, or whether all citizens except those wishing not to have one (“opt-in” versus “opt-out”) are informed indirectly by advertising, for example via posters in GP clinics. The result of the debate was the current policy of “opt-out” for creating the record, but with the requirement for permission from the patient before the Summary Care Record is viewed unless an emergency exists. There is still discussion about the content and boundaries of Summary Care Record. A recently published evaluation of its early use showed its benefits to be “more subtle and contingent than early policy documents had predicted.”

Choose and Book is an electronic system to replace the paper and telephone process for referring a patient to a consultant or other practitioner, and for patients to request the location and sometimes provider and appointment time for consultation. It is used primarily by GPs and patients, sometimes during a clinic visit. Its purpose is to speed the referral process, to give the patient additional choice regarding who they see and when, and to attach background information to the request. Some consulting practices permit viewing of physical location of the requested consultation; others do not show appointment availability for individual practitioners but in response to pressure from the British Medical Association and GPs, increasingly named practitioners are available for booking.
One of the most enthusiastically embraced national health IT systems is the network of picture archiving and communication systems (PACS) now used in all Trusts in England. \textsuperscript{xxxiv} Regional PACS repositories permit authorized clinicians, typically consultants, to view images and radiologist’s interpretations for studies performed in that region.

\textit{NHS Mail} is an email system devoted to NHS employees, authorized by professional societies for clinical use. It uses encryption for all direct communications and prevents spoofing of email sender identity so can be used for administrative and clinical communication with reduced risk of disclosure that might occur using other email systems. \textsuperscript{xxxv}

Prescriptions are partially transmitted electronically, using a bar-coded paper form given to the patient and used by some pharmacists. Around 30%, and rising, of the nearly one million prescriptions entered in the UK each day are processed electronically. The process is as follows: Most community based prescriptions are written by GPs since they manage prescriptions other than a limited supply of discharge medications following hospitalization. A printed prescription is generated in the GP office and given to the patient, and the details of the prescription are transmitted to a central server on the Spine, tied to the GP prescription using a key. On the right border of the paper form is a bar code containing this key. When the patient delivers the paper prescription to the pharmacy, the pharmacy software reads the barcode to retrieve the Spine data and then generates the prescription label, patient information, and data for internal pharmacy purposes. This process is referred to \textit{Electronic Prescription Service 1 (EPS1)} and represents a large volume of clinical information transfer within the UK. The second version of this process, EPS2, does not require a paper prescription, but instead will
electronically transfer the electronically entered prescription to the pharmacy designated by the patient.

Some NHS agencies and regions have developed repositories used to collect information from several facilities to permit viewing of data across multiple settings of care. Examples include the Salford Integrated Record\textsuperscript{xxxvi} and the Scottish diabetes system, SCI-DC.\textsuperscript{xxxvii} Although not available nationally in England, they permit authorized practitioners to have a consistent view of the EMR from multiple settings & systems, and for longitudinal summaries and outcome models to be created to support the management of long-term conditions. These repositories are not part of the English national IT programs but add value to its infrastructure. SCI-DC is a project of the Scottish eHealth Strategy Board.

Applications to permit citizens to view their own health information include the NHS HealthSpace, some vendor EMRs and regional initiatives.\textsuperscript{xxxviii}

Protecting the privacy of health information

Because of the growth in electronic health information and plans voiced by national leaders to increase exchange of information, an active, public discussion of protection of private health information has occurred. It is a breach of policy and a disciplinary offense to view records of patients for which the individual has no responsibility, which can be detected using audit trails. There is opportunity for those who are not deterred by such sanctions to view, copy, and disseminate electronic health information.
Much of this privacy debate focused on the choice between ‘opt-in’ versus ‘opt-out’ models for consent, as mentioned above, but wider concerns about protection of personal health information continue within the UK and elsewhere. Despite coverage in the press, on the Web, and in hearings, at the moment the collection and exchange of electronic health information continues, as does the debate.

DISCUSSION
Over several decades, the UK has created a foundation of policies and infrastructure, on which it has built strong financial, clinical and other incentives, to nurture an ecosystem of applications, which together have resulted in national-scale clinical information exchange. The three layers described in this paper have each been essential. For example, standards for data exchange alone are unlikely to have resulted in the achievements the UK has experienced without policies, privacy protections and incentives to exchange information. Creating one of the three layers alone is unlikely to have resulted in success; the presence of all three, on the other hand, has been associated with remarkable achievement. An estimate of the volume of clinical information exchange is given in Table 5.

In spite of these achievements, the results of the most recent large-scale initiative, Connecting for Health, have fallen short of what political leaders expected. The complete health record is not transmitted from one city to the next at the time of need during an emergency as envisioned. Much of the success in information exchange has been on the local level, and resulting from local initiatives. The small but critical portion within the Summary Care Record that can be transmitted currently covers only a small portion
of the UK population and thus far has had limited clinical benefit.\textsuperscript{xii} In the case of elective clinical information exchange when a patient moves from one GP practice to another, a nearly complete\textsuperscript{footnote1} transfer of the record occurs but this only on roughly one fifth of the occasions when such a transfer of care occurs. Use of GP2GP and Summary Care Record is growing but not quickly enough to satisfy many. In one sector of health information transfer--imaging--the intended goal of national-scale exchange is closer to being achieved. There are financial incentives for transmission of discharge letters from hospitals to GP practices. Image transfer is also very common, and digital content of transfer of letters is growing.

Little work has been published on how clinical information exchange has benefited the UK clinically or financially.\textsuperscript{xiii}

Yet despite the shortcomings of clinical information exchange in the UK, the amount of clinical information exchange is on a much larger scale than occurs in the US. Discussions in the US focus on the need for improvements in data exchange standards, and the availability of EMRs to healthcare providers. The other layers described here receive less emphasis. The closest to a national ‘Spine’ in the US is the NHIN, which has inconsistent participation across providers—not an issue in the UK with one NHS.

LIMITATIONS

This analysis has several important limitations. It is based on interviews with 37 individuals over 2 months and review of materials available from them, and from the publicly

\textsuperscript{1} The record audit trail showing who added and deleted record entries is not transmitted by GP2GP.
accessible literature. This topic is complex, the programs described here have developed over decades, and these complexities are unlikely to be fully apparent in such a brief exposure. It is likely that those with whom we spoke have different perspectives from those who were not accessible to interview, and so an acquisition or volunteer bias is likely. In a rapidly evolving area such as healthcare IT, what may have been true when interviews were conducted or materials were written may no longer be the case even if accurate at the time of interview. Also, some of the experiences described are those of demonstrator or early adopter sites, which may be more optimistic than the majority. And finally, most of the interviews were with individuals in England, yet Scotland and Wales have had different experiences, successes, and failures than England. This paper mostly describes England’s experience rather than the entire UK.

We have reviewed the strengths and some of the limitations of UK healthcare IT initiatives, including the largest one, Connecting for Health. The National Program For IT is described by some as a failing project, and by others very positively. It is not our intention to judge whether timelines were met, budgeted funds used optimally, or whether expenses were justified by accomplishments. Deeper analyses collectively may come closer to these goals. We have not focused on problems associated with health IT programs in the UK.\textsuperscript{xliii,xliii}

LESSONS FOR THE US

The UK’s remarkable achievements in national-scale clinical information exchange are the result of establishing a foundation of policy, infrastructure, and systems of care, by creating and acquiring clinical computing applications developed over decades, and
with strong use of financial, clinical and reputational incentives. Many software and hardware vendors play a part in this effort; they participate in a national framework created by the NHS in which standards for exchange are specified and their applications are designed to make clinical information exchange part of practice. The UK has thus made enormous progress toward enabling clinical information exchange while also assuring policies to both protect data and allow regulated access for desirable social goods including research.

Examples of features which stand out from UK efforts are the use of strong financial incentives, RFA and GPSoC programs, envisioning and working to create the Spine, the broad use of EMRs in primary care, PACS implementations and the national scope of UK healthcare IT programs.

Great potential exists for cost reduction, increased safety, and greater patient involvement.

Successive UK healthcare IT initiatives have encountered substantial obstacles over 30 years. The consensus among those interviewed is that efforts should be concentrated on local and regional exchange of clinical information more than the widely cited but less common scenario where an accident befalls a citizen in a distant city. Rather than use a single suite of applications within one large region, there is preference for more flexibility to choose applications that meet local requirements while complying with national standards--a major departure from the 2003-2004 philosophy of the NHS National Programme for IT. Working to achieve engagement of clinicians in all of these initiatives is critical to success, since the IT programs in the complex domain of healthcare
benefit from the expertise of clinicians who practice within it. The UK course has been difficult, open, and creative.

As the US renews efforts to improve the quality and control costs of healthcare, development of a framework, incentives, and applications for clinical information exchange is likely to be among national goals. Studying the experience of a nation farther along the road may help.

ACKNOWLEDGEMENTS

Funding for this work is from UK grant EPSRC/RCUK Digital Economy e-HealthPlus. This work was supported, in part, by the University of Washington Center of Excellence in Public Health Informatics (CEPHI) funded by the Centers for Disease Control and Prevention (CDC) Award Number 1 P01 CD000261-01. The authors gratefully acknowledge the time, openness, and participation of those listed in the appendix for their assistance in the preparation of this report, gratefully acknowledge assistance of CEPHI in making this possible. The errors and opinions are the responsibility of the authors and not those listed in the appendix.
TABLE 1. Model for classifying level of clinical information exchange, from Walker. ¹

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<tr>
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<th>Model for classifying level of clinical information exchange</th>
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<tbody>
<tr>
<td>1</td>
<td>Non-electronic (Mail, telephone)</td>
</tr>
<tr>
<td>2</td>
<td>Machine transportable data (fax, portable document format [PDF] files)</td>
</tr>
<tr>
<td>3</td>
<td>Machine organizable data (e-mail of free text, HL-7 messages)</td>
</tr>
<tr>
<td>4</td>
<td>Machine-interpretable data (automated exchange of coded results)</td>
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TABLE 2. Large national health IT initiatives in the United Kingdom

<table>
<thead>
<tr>
<th>NHS Information Management Group</th>
<th>1992-1999</th>
<th>NHS Number, NHS Net, and other infrastructure, Read Codes, SNOMED CT</th>
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<tbody>
<tr>
<td>NHS Information Authority</td>
<td>1999-2004</td>
<td>NHS Net, NHS Number for Babies, NHS Mail, IT skills training</td>
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<tr>
<td>National Program for Information Technology</td>
<td>2002 - 2010</td>
<td>NHS Net 3 (N3), NHS Number adoption, Spine and local applications, PACS</td>
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TABLE 3. Foundations for information exchange in the UK

<table>
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<th>Level</th>
<th>Examples</th>
<th>Comment</th>
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<td>Infra-structure</td>
<td>NHS Number in England, CHI in Scotland</td>
<td>Uniquely identifies each UK citizen</td>
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<td></td>
<td>Strong authentication</td>
<td>Smartcards</td>
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<tr>
<td></td>
<td>NHS Net</td>
<td>Currently 3rd version, N3</td>
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<td></td>
<td>National primary care computing application standards</td>
<td>RFA 99 v1.1, GP System of Choice</td>
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<td></td>
<td>Coding of records</td>
<td>Part of documentation culture. Read, SNOMED, ICD10</td>
</tr>
<tr>
<td></td>
<td>Unique number for practitioners, practices, facilities</td>
<td>Regional reciprocal access</td>
</tr>
<tr>
<td>Policy</td>
<td>Public discussion of privacy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>National policies for protection of privacy</td>
<td>National Information Governance board, Caldicott Guardians</td>
</tr>
<tr>
<td></td>
<td>National service frameworks, NICE guidance</td>
<td>Minimum datasets etc.</td>
</tr>
<tr>
<td>System</td>
<td>GP coordinates care for UK citizens</td>
<td>Strong incentive to use</td>
</tr>
<tr>
<td></td>
<td>Largely single payer</td>
<td></td>
</tr>
<tr>
<td>Incentive</td>
<td>Who</td>
<td>Comment</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>--------------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>Hospital penalized if discharge letters arrive &gt; 48 h</td>
<td>Acute trusts, consultants</td>
<td>Introduced recently</td>
</tr>
<tr>
<td>GP payments linked to Quality &amp; Outcomes Framework(^1)</td>
<td>GPs</td>
<td>Used in almost all GP practices</td>
</tr>
<tr>
<td>Practices appear more professional, more likely to meet targets</td>
<td>GPs, consultants</td>
<td></td>
</tr>
<tr>
<td>GP SoC, RFA 99, Common Assurance Process</td>
<td>Suppliers</td>
<td>Suppliers have strong incentive to comply with NHS standards</td>
</tr>
<tr>
<td>Vaccination, cervical screening and other targets</td>
<td>GPs</td>
<td>Predates Quality and Outcomes Framework</td>
</tr>
<tr>
<td>Payment by results</td>
<td>Hospitals</td>
<td>Requires capture of clinical activity data and central returns via Secondary Uses Service</td>
</tr>
<tr>
<td>GMC and Royal College professional standards</td>
<td>All health professionals</td>
<td>Encourage communication of relevant data with others to facilitate safe, high quality care</td>
</tr>
</tbody>
</table>
TABLE 5. Current status of clinical information sharing in the UK. Sources:

<table>
<thead>
<tr>
<th>Application</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP2GP</td>
<td>1,022,140 uses, 23% of practice transfers.</td>
</tr>
<tr>
<td>Choose &amp; Book</td>
<td>21 million bookings; 35,000/day</td>
</tr>
<tr>
<td>PACS</td>
<td>127 PACS systems, 27 Trusts</td>
</tr>
<tr>
<td>Discharge letters</td>
<td>Broad use, strong incentive to use</td>
</tr>
<tr>
<td>Summary Care Record</td>
<td>Pilot, with 258,000 SCRs on Spine</td>
</tr>
<tr>
<td>EPSI</td>
<td>300 million prescriptions, 83% GP practices using</td>
</tr>
<tr>
<td>Regional repositories</td>
<td>≥2 regions</td>
</tr>
<tr>
<td>NHS Mail</td>
<td>983,152 messages are sent/received daily</td>
</tr>
<tr>
<td>Emergency Care Summary</td>
<td>National example in use for 3 years covering 5 million population of Scotland</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Pathology and radiology messaging</td>
<td>Pathology results messaging fully rolled out. Pathology ordering in design phase</td>
</tr>
</tbody>
</table>
FIGURE 1. The three layer model of requirements for clinical information exchange.
REFERENCES


xxxiv Peter Simpson, MD, personal communication.


xiii McGrath K, Hendy J, Klecum E, and Young T. The vision and reality of ‘Connecting for Health’: Tensions, opportunities and policy implications of the UK National Pro-
gramme. Communications of the Association for Information Systems 2008;23(33) 603-618.