International efforts in implementing national health information infrastructure and electronic health records

DR HARRY McCONNELL FPCPC
CHIEF EXECUTIVE OFFICER, THE INTERNATIONAL EHEALTH ASSOCIATION

Abstract

Many countries are developing national strategies using information and communication technologies (ICTs) to implement health information infrastructure and electronic health records (EHR) into their medical systems. Efficiency, quality of care and medical error along with new opportunities presented by the technologies themselves have driven this process internationally. Many countries have had spectacular failures costing billions of dollars alongside some amazing successes. There has been very little dialogue internationally about what works and what doesn’t work despite the fact that many government and international agencies have placed this key priority on their agendas. The nature of the technologies used promotes cooperation and these innovations in healthcare lend themselves particularly to working together for collaboration and for communication in order to learn best practice from each other. In this paper, I look at some of the national initiatives for developing an information infrastructure for healthcare as well as some of the challenges presented by these very different approaches around the world. We also review briefly the many organizations looking at international standards relating to eHealth and to implementation of electronic health records.

Many countries are investing heavily into national information technology infrastructures for clinical care, medical education, administration and research. In the United Kingdom, Richard Granger has been recruited to head a £2.3 billion National Information Technology Infrastructure programme to modernise the National health System (NHS). The NHS is putting together what is perhaps the largest and most complex such framework in the world as the key component in modernising the NHS.

Canada has long been strong in TeleHealth projects and has established the Office for Health and the Information Highway to bring together some of the lessons from its many separate eHealth programmes into a comprehensive national structure. The US has been impeded for many years with the inability of physicians to practice medicine between states, the bureaucracy and competing interests generated from the many types of third party providers and conflicting standards. Tommy Thompson and Health and Human Services have now prioritised the National Health Information Infrastructure and this is moving rapidly to develop national standards and interoperability.

However, the leadership to date in eHealth implementation has come from areas most in need, i.e. the use of eHealth technologies has developed out of necessity rather than legislation and its implementation has been easier in part because of a ‘bottom up’ rather than a ‘top down’ approach. Norway and other Scandinavian countries, Australia and Malaysia have been using such technologies as part of the day to day clinical care for many years with success.

The policy development and implementation at a national level is often done with little or no reference to best practice or lessons learned in other countries, despite the many overlapping issues inherent in the development of national eHealth strategies. Indeed very few conferences have dealt with this important issue and it appears to us that there is much to learn from each other as we are now faced with the development of national and regional health information.
and educational strategies in many countries. Security, privacy, confidentiality, electronic health record development, quality of care and medical error, standards and interoperability, medical educational curriculum, continuous professional development, and educational and research integration into clinical systems are all critical issues that predominate in these discussions in every country.

Table 1 gives some examples of eHealth Infrastructure being implemented at the national level is select countries and their different approaches and priorities.

Table 1. Selected National Health Information Infrastructure Programmes

Country: Australia
Australia has developed the use of distance learning and telemedicine out of its own geographic need with many rural areas requiring healthcare and education. Rural health and implementation of newer eHealth technologies are two of the foci in Australia’s various eHealth initiatives. The Australian Plans for eHealth and Telehealth Implementation have included many facets:

(i) National Telehealth Plan – June 2001 – 4 priority work areas identified by HealthConnect Board
(ii) Future financing arrangements – NSW Health
(iii) Develop national data/technical standards - Standards Aust and National Health Information Management Group
(iv) Secure telco infrastructure – ANZ CIO Forum
(v) Decide national R & D priorities – Office of Rural Health, DHAC, The Commonwealth eHealth Institute

Refs: 1, 2

Country: Canada
Established in 1997, the Office of Health and the Information Highway has recently appointed a CEO, Richard Alverez, and provided an additional $1(C) 600 million to Canada Health Infoway to accelerate the development of EHRs, common information technology standards across the country, and the further development of telehealth applications, which are critical to care in rural and remote areas. Rural health is a major priority because of the vast geography of Canada.

Refs: 3, 4

Country: Korea
Korea has invested $7.5 billion over five years in laying the infrastructure needed for a mass scale broadband roll out. Nearly 95% of online households in Korea have a broadband connection. As such, home health care will be an important focus of the newly developing Korean national strategy for eHealth. Korea will cooperate on generating eHealth technology as a core technology for diseases surveillance and creating national wealth through realization and promotion of eHealth industry through international cooperation. Korea has set the following priorities:

(i) e-Health Standardization; promotion of the standard e-health technology must be set forth beforehand to induce both nations systemized technological improvement.
(ii) e-Health Human Resource Development; for the globalization of an internationally leading product, there is a prominent need for constructing a cooperative developing system of professionals.
(iii) Policy Planning; to accomplish e-Health master plan, Korea sees a need for arbitration and reformation of law and policy related with diseases information, medical information, telemedicine, telehealth and e-commerce on medical supplies.
(iv) International Cooperative Research & Development;

Refs: 5

Country: Mexico
Telemedicine has been a major focus of Mexico’s eHealth national Strategy. There are 3,200 telecentres in the e-Mexico National System. A main priority is to deliver services in rural and isolated localities.

The vast majority of telecentres are in educational units and these extend to 25 states. Internet services to the population are delivered at 128 kbps via satellite and people are able to use the internet while attending health care services.

The Mexican plan includes integration of the Health Level 7 (HL7) chapter in Mexico. Future priorities include:

(i) Establishment of the national policies for the certifications of e-health programs
(ii) Regulation for compatibility and interoperability of the systems
(iii) Implement telemedicine standards
(iv) National and international legislation
(v) Clarification of responsibility and medical ethics
(vi) Creation of platforms of integration of health, education and telecommunications, and
(vii) Evaluation of impact of telemedicine programme

Refs: 6, 7
ADVERT
Olympus UK Ltd
Country: Mozambique
Mozambique has demonstrated remarkable capacity for implementing technology in healthcare through its work in Malaria research and in its educational programme with the African Union on HIV, Malaria and TB. Prime Minister Pascoal Mocumbi and Health Minister Francisco Songane both have a vision for implementing clinical, educational and research initiatives with technology. Dr Mocumbi is also very active in European and Developing Countries Clinical Trials Partnership (EDCTP) and is interested in pan-African initiatives.

Refs: 10, 11

Country: Saudi Arabia
This is now in the planning stages and covers the first five years period of the 20 years of the Information Technology general strategy. The King Faisal Specialist Hospital and the Saudi Computing Society are working with the Kingdom to develop a comprehensive national health information infrastructure as part of the National Information Technology Plan. This is because it would be impossible to make an integrated, detailed and realistic plan for a period of twenty years as it is known in planning fundamentals and principles. The plan involves telemedicine, eLearning and eHealth from a broad perspective. Components of the information Technology Plan include:

- Specific objectives (including transitional objective for one or more years)
- Policies (Implementation Mechanisms)
- Programs
- Great/Pioneer Projects
- New/Modified Regulations
- New/Modified Establishments

Refs: 12

Country: South Africa
South Africa has made significant investments in health information infrastructure and in telemedicine and telehealth applications. The National Health Information system, Medical Research Council (with Professor Koos Louw), and WHO (with Dr Salah Mandil) have all made significant contributions to developing a nation wide effort inspired by the geo-political needs of the country. Its development followed specific priorities:

(i) Restructuring and shifting resources,
(ii) Nutrition,
(iii) Maternal and child health,
(iv) Specific diseases and conditions,
(v) Drug and technology procedures and
(vi) Information and Research.

Specific Deliverables include: (a) Functional Clinical Services to remote rural Communities of South Africa, (b) Education and training of South African rural healthcare providers, (c) Technical Task Teams for developing TeleEducation, Clinical Protocols, Legal Licensure Ethics & Infrastructure systems and guidelines, (d) Ensuring an affordable, clinically acceptable Primary Care Telemedicine, (e) Workstations suitable for the region, (f) Efficient management of the images, and (g) Using appropriate Telecommunication Infrastructure for sustainability. This is being developed over three phases: Phase I included Tele-Radiology (Free State, Mpumalanga and Northwest Province), Tele-Pathology (Eastern Cape); Tele-Ophthalmology (KwaZulu-Natal), Tele-Ultrasound and Antenatal Screening (Northern Cape and KwaZulu-Natal); and development of a Research Centre. The second phase focuses on developing an effective ‘telemedicine connection’ or connectivity between 71-sites divided into three networks. In phase 3, Additional networks of secondary and primary sites are being established.

Refs: 13, 14

Country: United States of America
The US National Health Information Infrastructure (NHII) is a voluntary initiative rather than a centralised database or government regulation that attempts to engage all stakeholders in achieving a system for the US Healthcare system that maximizes eHealth technologies. The NHII is:

(i) an initiative to improve effectiveness, efficiency and quality of health
(ii) a comprehensive knowledge-based network of interoperable systems
(iii) the set of technologies, standards, applications, systems, values, and laws that support all facets of individual health, healthcare

It involves a three-stage process over 10 years. The first stage (over 2 years) includes developing leadership within the Department of Health and Human Services (HHS) and other agencies in order to define the vision for implementation and policy. The second stage (over 5 years) focuses on building collaboration among all potential stakeholders. The third stage (over 10 years) involves implementing the plan in both the public and private sectors.

Refs: 17, 18

International Standards, Quality Assurance and Interoperability
Standards and interoperability are important factors in the planning of any eHealth Programme and become particularly important in deciding the policy of a national health information infrastructure. This is particularly important for implementing electronic health records. Part of the problem is the many standards that exist in healthcare and in technology. The ECRI Directory (45) lists over 35,000 sets of such standards relating to healthcare. In Table 2, we list some of the more important standards, systems of nomenclature, and organizations inputting into the critical issues of standards and interoperability. The most critical standard developing of these in HER specifically is HL 7 which is rapidly gaining international acceptance and is being implemented in the USA. In 2003, the HL7 Board of Directors initiated a project to develop a functional model of an electronic health record system. This is being developed with the Institute of Medicine who is looking at the patient safety features. The proposed functional HL7 model is based on two axes described by the committee as follows (48):

(i) Functions. The functional axis is a hierarchy of the
Table 2. Selected International Standards and Related Organisations Important to Implementation of Electronic Health Records

<table>
<thead>
<tr>
<th>Organization/Standard</th>
<th>Comments</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPT</td>
<td>CPT - Current Procedural Terminology - was developed by the American Medical Association and are used for the billing of medical procedures.</td>
<td>19</td>
</tr>
<tr>
<td>DICOM</td>
<td>The Digital Imaging and Communications in Medicine (DICOM) Standard was developed for the transmission of images and is used internationally for Picture Archiving and Communication Systems (PACS). This standard was developed by the joint committee of the ACR (the American College of Radiology) and NEMA (the National Electrical Manufacturers Association).</td>
<td>20</td>
</tr>
<tr>
<td>CEN</td>
<td>There is a long-standing European committee for Standardization (CEN) Technical Committee, TC251 Health Informatics, and this has produced a series of European Standards covering the electronic exchange of medical data. There is also a recently formed CEN/ISSS Focus Group in the eHealth domain, which provides new key priorities and targets within eHealth.</td>
<td>21</td>
</tr>
<tr>
<td>Health Level 7 HL7</td>
<td>HL7 is a standard organization that produces the HL7 messaging standard. This is the internationally recognized messaging standard for communicating clinical data. The HL7 mission is to provide a comprehensive framework and related standards for the exchange, integration, sharing, and retrieval of electronic health information that supports clinical practice and the management, delivery and evaluation of health services. The HL7 Reference Information Model (RIM) is an object model with a large pictorial representation of the clinical data.</td>
<td>22</td>
</tr>
<tr>
<td>HISB</td>
<td>Health Information Standards Board (HISB) is a subgroup of the American National Standards Institute (ANSI). The American National Standards Institute’s HealthCare Informatics Standards Board (ANSI HISB) provides an open, public forum for the voluntary coordination of healthcare informatics standards among all United States’ standard developing organizations.</td>
<td>23</td>
</tr>
<tr>
<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineers, Inc (IEEE) is a large standard organization that sets standards for computers and languages, many of which affect eHealth.</td>
<td>24</td>
</tr>
<tr>
<td>The IOM Committee on Patient Safety Data Standards</td>
<td>A committee of the (US) Institute of Medicine which facilitates the development of data standards applicable to the collection, coding, and classification of patient safety information.</td>
<td>25</td>
</tr>
<tr>
<td>World Health Organization (WHO) International Classification of Diseases (ICD-10)</td>
<td>The WHO International Classification of Diseases, Tenth Revision, (ICD-10) classifies morbidity data for indexing of medical records, medical case reviews, and ambulatory and other medical care programs, as well as for basic health statistics. A Clinical Modification (CM) version is being developed.</td>
<td>26</td>
</tr>
<tr>
<td>Logical Observations: Identifiers, Names, Codes (LOINC)</td>
<td>A US-based coding system generated from a consortium of federal agencies, academia, and the vendor community for the electronic exchange of laboratory test results and other observations. The LOINC model can be applied to other standards setting domains.</td>
<td>27</td>
</tr>
<tr>
<td>Systematized Nomenclature of Medicine (SNOMED)</td>
<td>Created with the National Library of Medicine (NLM) and others, SNOMED-CT (Clinical Terminology) has been created from the combination of SNOMED-RT (Reference Terminology) and Read codes.</td>
<td>28</td>
</tr>
<tr>
<td>Unified Medical Language System [UMLS] Metathesaurus</td>
<td>The UMLS is a long-term research and development project of the National Library of Medicine (NLM) that develops and distributes multi-purpose, electronic “Knowledge Sources.” Researchers will find the UMLS products useful in investigating knowledge representation and retrieval questions.</td>
<td>29</td>
</tr>
<tr>
<td>X12N</td>
<td>X12N is the standard for electronic commerce in the US, set by the American National Standards Institute Accredited Standards Committee X12 [ASC X12] selected X12N as the standard for electronic data interchange (EDI). It is used in administrative and financial healthcare transactions.</td>
<td>30</td>
</tr>
<tr>
<td>HIPAA</td>
<td>HIPAA is the acronym for the (US) Health Insurance Portability and Accountability Act of 1996. The Centers for Medicare &amp; Medicaid Services (CMS) implements the various unrelated provisions of HIPAA.</td>
<td>31</td>
</tr>
<tr>
<td>W3C</td>
<td>The World Wide Web Consortium (W3C) develops interoperable technologies (specifications, guidelines, software, and tools). W3C is a forum for information, commerce, communication, and collective understanding.</td>
<td>32</td>
</tr>
<tr>
<td>Internet2</td>
<td>Internet2 is a consortium being led by 205 universities working in partnership with industry and government to develop and deploy advanced network applications and technologies, accelerating the creation of tomorrow’s Internet. Internet2 is recreating the partnership among academia, industry and government that fostered today’s Internet in its infancy. The primary goals of Internet2 are to: (i) Create a leading edge network capability for the national research community; (ii) Enable revolutionary Internet applications; and (iii) Ensure the rapid transfer of new network services and applications.</td>
<td>33</td>
</tr>
</tbody>
</table>
ADVERT

Quintec
(to come)
Challenges in Implementing the Electronic Health Record

Technically achieving a workable EHR is not a difficult task and indeed it also has been done successfully in many settings and using a variety of technical platforms. Implementing an EHR on a national scale is however a much greater challenge as has been witnessed by the UK in implementing its National Programme for IT, for which EHR is a major priority. HER is in use however in <5% of UK hospitals and the deadline for full implementation has been extended until 2010.

Priorities for development include:

- Providing a route to other more detailed health record services.
- Linking other, local or national, clinical data sources that are person-based.
- Implementing more detailed patient consent mechanisms, if necessary.
- Patient read-only access.
- Patient maintained health information.

The major hurdles in wide scale successful implementation have been:

- Concerns over security
- Issues of patient consent and confidentiality
- Acceptability by clinicians
- A lack of clinical consultation in their development
- Adaptation of XML standards and issues of interoperability

Advantages of Electronic Medical Records

EMRs offer many potential advantages over traditional paper-based records (46):

1) The primary benefit of using electronic records is limiting access for authorized and authenticated users.
2) EHRs allow providers to access health information from a variety of locations
3) EHRs allow clinicians to share that information more easily with other potential users.
4) Multiple users may access the information simultaneously.
INFRASTRUCTURE: ELECTRONIC HEALTH RECORDS

5) EHRs can reduce the number of redundant queries and diagnostic tests
6) They can improve the availability of health-related information at the point of care delivery.
7) EHRs also offer opportunities for improving security. Paper records are very insecure and there are studies demonstrating the ability for non-authorized access to paper records is significant in a variety of hospital settings.
8) Access can be limited to just that portion of the record that is pertinent for the user.
9) EHRs can allow all instances of access to be recorded in audit logs so that there is a record of who saw what information at what time and date on which patients. There is little questioning that EHRs offer significant improvement in ease of patient care, security and have many advantages over paper records. Change Management principles must be implemented in instituting EHRs in any clinical setting. Furthermore all stakeholders, including clinicians and patients should be consulted early in the process for successful EHR management. Successful programmes in the USA (46), Canada (47), and the UK (49) are in development.

References
6 Suliman, Abu Baker, Telemedicine & TeleHealth Networks National Networks, presentation at International summit, University of Michigan, August, 2001 www.med.umich.edu/telemedicine/Symposium/suliman.ppt
7 Department of Health (Malaysia) http://wehpla.dph.gov.my/
9 Department of Health (Mexico) Tecnologia de la Informacion http://www.salud.gob.mx/
11 McConnell, H. Africa has a right to support from international community in its fight against HIV/AIDS, malaria, and tuberculosis BMJ 2003; 327: 124
17 Dermer, D. Building the national health information infrastructure for personal health, health care services, public health, and research BMC Medical Informatics and Decision Making 2003; 3:http://www.biomedcentral.com/1472-6947/3/1
18 Department of Health and Human Services (USA), The National Health Information Infrastructure (NHII), 2004 http://aspe.hhs.gov/sp/nhii/
20 Digital Imaging and Communications in Medicine (DICOM) www.xray.hmc.psu.edu/physresources/dicom/basicinfo.html
22 Health Level 7 (HL7):www.hl7.org
23 Health Information Standards Board (HISB) www.ansi.org/standards_activities/standards_boards_panels/hisb/overview.aspx?menuid=3
24 Institute of Electrical and Electronics Engineers, Inc (IEEE) http://standards.ieee.org/resources/index.html
25 The Institute of Medicine (IOM) Committee on Patient Safety Data Standards www.iom.edu/pstds
26 International Classification of Diseases (World Health Organization) www.who.int/nachic/ecl10/otherclca.htm
27 Logical Observations: Identifiers, Names, Codes (LOINC) www.loinc.org/
28 Systematized Nomenclature of Medicine (SNOMED) www.snomed.org/
30 American National Standards Institute (ANSI) www.ansi.org
31 HIPAA http://www.cms.hhs.gov/hipaa/hipaa1/default.asp
32 The World Wide Web Consortium http://www.w3.org/
33 Internet2 www.internet2.org
34 European Commission http://europa.eu.int/comm/enterprise/newapproach/standardization/harmstds/reflst.html
35 (a) CEN (Comité Européen de Normalisation / European Committee for Standardisation), www.cen.org (b) ETIS (European Telecommunication Standards Institute), www.etsi.org (c) CENELEC, European committee for Electrotechnical Standardization, www.cenelec.org
36 International Medical Informatics Association, www.imia.org
38 ACR (American College of Radiology). www.acr.org
40 EEG9 (European Board for EDI/EC Standardisation Expert Group 9 for Healthcare)
41 IEC (International Electrotechnical Commission)
42 ISO (International Standards Organisation) www.iso.ch
45 The International Telecommunications Union www.itu.int