Development of Medical Informatics in Singapore
-- Keeping Pace with Healthcare Challenges

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Abstract

The development of Medical Informatics in Singapore is closely intertwined with that of the overall healthcare system and has moved in concert with changing healthcare needs. This paper provides an overview of Medical informatics development in relation to key strategic directions in Singapore healthcare.

1. Introduction

In recent years, the Singapore healthcare system has had to react rapidly to the changing needs of the nation and its population. There have been several key drivers of change: fundamental shifts in national demographics and the burden of disease, the threat of emerging infectious diseases and the globalization of healthcare services.

The development of Medical Informatics in Singapore is closely intertwined with that of the overall healthcare system, and thus far has moved in concert with changing healthcare needs.

This paper provides an overview of Medical Informatics in Singapore and its development in relation to some of the key strategic directions in Singapore healthcare.

2. Overview of Singapore Health System

As with most other developed countries, the burden of disease has shifted towards non-communicable chronic illnesses: Cancer, stroke and cardiovascular diseases together account for approximately 65% of the total causes of death.

In Singapore, there is a dual system of healthcare delivery. The public system is managed by the Government while the private system is provided by the private hospitals and general practitioners. The majority of primary healthcare is provided by private practitioners, whereas the reverse is true for hospital care. Public healthcare delivery is structured into two vertically integrated healthcare clusters, namely Singapore Health Services (SHS) and National Healthcare Group (NHG).

Medical savings accounts are the cornerstone of healthcare financing. These are supplemented by Government as well as private insurance schemes. Until recently, use of funds in medical savings accounts was restricted to in-patient stays.

3. Electronic Medical Records Development

3.1. First Steps

The first hospital information systems in Singapore were primarily administrative systems supporting admissions/discharge and billing processes. Users of these systems were largely administrative staff and nurses.

The process of growing these systems into comprehensive electronic medical records (EMRs) has been an organic one. Initial functionality was a reflection of the system's administrative origins: patient demographics, medical alerts and electronic discharge summaries.

In para-clinical areas, pockets of computerization have arisen independently. The implementation of such para-clinical systems (Laboratory Information Systems, Radiology Information Systems) have been facilitated by the relatively compartmentalized nature and specific scope of their related work-processes. This has provided avenues for organic growth of core EMR systems, by providing additional sources of electronic clinical data.

As such, current hospital-based EMRs have grown into the role of umbrella systems that aggregate clinically relevant electronic data from various sources.

3.2. Beyond Organic Growth

The organic model still offers room for expansion. New systems such as operating theatre management systems, e-Archival for paper-based records, web-based radiological image and ECG repositories continue to emerge, and can be integrated under the EMR umbrella.

However, with regards to clinical documentation, functionality has been relatively slow in developing. Fully electronic clinical documentation has been limited to specific clinical scenarios i.e. Emergency Medicine Departments, Armed Forces Outpatient Services.

To address this, the two healthcare clusters have taken steps to engage commercial vendors in the development of the next generation of EMRs. The distinguishing feature of these next generation systems is a ground-up attempt to incorporate clinical workflows such as computerized physician order entry (CPOE), clinical results tracking and nursing records. This has necessitated deeper involvement on the part of healthcare users, which could be seen as a co-development role.

These large scale efforts to develop and implement next generation EMRs are similar to efforts in other healthcare systems such as UK's NHS.

3.3. Towards a Life-time Health Record

The shift in the burden of disease to chronic illnesses such as diabetes, hypertension, lipid disorders and stroke has changed the mode of healthcare delivery from one that is episodic and acute to one that is life-long and involves a spectrum of healthcare providers.

The implication for medical records is that institution or provider-centric silos of information would not suffice. What is needed is a record that brings together relevant clinical information irrespective of timeframe and provider, – a life-time health record.

In this respect, there have been efforts to bring a level of inter-operability to EMRs belonging to various healthcare system stakeholders. However, promotion of data standards has been hampered by the heterogeneity of the overall EMR environment. There is no dominant EMR system and there is a great deal of variation in the stage of EMR implementation amongst providers. Part of the reason for this is the organic fashion in which EMRs have developed.

To circumvent the thorny issue of data standards, the Ministry of Health (MOH) as well as the two clusters launched the EMRX (Electronic Medical Record Exchange) initiative in 2004. The scope of the initiative was to provide an electronic platform for the sharing of medical documents such as discharge summaries, laboratory/radiological reports and prescriptions. Although this approach does not provide for full inter-operability i.e. exchange of machine-readable information, EMRX has functioned as credible bridging solution within a relatively short implementation time-frame.

The main public sector stakeholders do recognize data standards as a desirable longer term objective. This is being approached in a targeted fashion, focussing on critical medical information via the CMIS (Critical Medical Information Store) initiative. CMIS serves as a shared electronic repository for structured medical alerts and allergy data. In requiring participating organizations to adopt standards for exchange of such information, CMIS is one possible avenue for greater promotion of data standards.

4. Development of Integrated Care

4.1. Building Connections

As chronic disease management requires the involvement of a spectrum of providers and services, building connections and improving co-ordination amongst these parties is crucial in avoiding "disconnects" or lapses in the delivery of care.

There have been recent efforts to address this on a community basis. For example, the Jurong HealthConnect project [1] was launched in 2004 with the objective of connecting residents of Jurong Town with healthcare providers, services and resources in their community. One of the features of the project is a community web portal that provides information on healthcare providers, services and resources in the Jurong area. Other than directory services, the portal also offers self-administered questionnaires that are able to suggest resources that best match a resident's medical conditions and daily needs. The web portal is complemented by a bricks and mortar information counter and a call centre hotline for residents who are less IT savvy.

On a national level, the ICS (Integrated Care Services) web portal [2] provides similar tools to connect acute hospitals, primary care providers and the public with step-down services such as nursing homes and chronic sick facilities. In addition, the previously manual process for making referrals to these facilities has been replaced by online referral forms.

4.2. Strengthening Provider Networks

To further develop integrated care, some of the key connections will have to be formalized. The main limitation of existing managed care schemes is that their provider networks are primarily in the private sector which is largely oriented towards primary health care, whereas the public sector accounts for the bulk of hospital care.

There is a need to form healthcare networks that include both public and private providers, so as to offer a balanced range of services from primary care to quaternary hospitals.

Within these networks, healthcare processes, in particular transfer of care processes (step-down, escalation), need to be standardized and made explicit. Although, existing shared care and disease management programmes do achieve some of these goals in terms of specifying and documenting processes, the medical informatics challenge is to streamline these processes.

This may take the form of standardized communication models, minimum datasets or electronic platforms for collaboration.

4.3. Patient Empowerment

The key to integrated care is still the patient. The patient has to want to connect with the network of healthcare providers and services.

One aspect of this is education. This may take the form of general education on chronic illness and self-care and is currently readily available via community and national health portals.

Specific to the individual, there needs to be individual ownership of health information. The personal health record (PHR) is one way of empowering the patient to educate himself on his individual condition.

Currently, these take the form of hardcopy personal health books that are available from public primary care facilities. Recent efforts have been to re-focus these hardcopy PHRs on key chronic illnesses such as diabetes, hypertension, lipid disorders and stroke. The key goal in this regard is not technological but rather to effect a change in information ownership attitudes. i.e. to have patients "own their condition". However, technology such as online PHRs or portable flash memory PHRs can facilitate this.

5. Developing Health Intelligence

5.1. Infectious Disease Threats

Recent years have seen the emergence of infectious disease threats such as SARS and Avian Influenza. In responding to these threats, the requirement is not individual but aggregate information.

Traditionally one of the main sources of infectious disease intelligence has been the pool of practising medical professionals. Under the Infectious Diseases Act [3], there is a statutory requirement to report any of a schedule of 29 notifiable diseases. Currently, aggregation of disease notification data is facilitated by an online portal for electronic disease notification.

There are on-going efforts to expand the scope of disease surveillance beyond disease notification. These include the use of intelligent agents to trawl news feeds and internet sites for relevant information. The Defence Science Organization (DSO) together with the Armed Forces Medical Corps has successfully built a prototype system of this nature, Medical Large Scale Integrated Search and Analysis System (MELISA), that uses natural language processing to process large amounts of textual data.

In hospital settings, wireless positioning and tracking based on RFID and WiFi technologies have been piloted in both healthcare clusters. The aim of such systems is to provide an alternative to tedious and error-prone manual contact tracing. Some of the newer wireless patient tags have incorporated sensors for wireless monitoring of vital signs such as temperature.

As automated processes for aggregating infectious disease information grow in use, the problem shifts to making sense of large volumes of information. New tools such as Geographic Information Systems (GIS) are being used to help visualize disease information with a spatial component. The National Environment Agency (NEA) uses a GIS to map vector distribution and plan eradication efforts. The Ministry of Health is also in the process of applying GIS technologies to mapping of other diseases, for example in portraying fever clusters.

One of the possible areas for exploration is the development of similar information visualization tools to generate contact tracing “maps”.

5.2. Population-based Disease Management

Disease registries are the means by which chronic disease information is aggregated. Registries have proliferated both at hospital department as well as national levels.

Although national registries exist for a considerable number of chronic disease e.g. cancer, renal, cardiac, myopia, stroke, thalassemia etc., the number of hospital departments attempting to maintain their own intra-departmental registries indicates that beyond administrative or epidemiological requirements, there is an operational requirement for disease registry data.

It has not been possible to implement national registries that cater to the diverse operational requirements of a multitude of hospital departments. The future of registry systems may be one in which registries are based at both institution and national levels, and designed to co-exist and inter-operate seamlessly.

Institutional registries could then serve an important role in bringing information back to the point of care by:

- Identifying patients overdue for assessment/treatment or not meeting treatment goals
- Stratifying patients into various categories of risk in order to target interventions at high-risk populations
- Providing information on how well individual care teams are doing in the delivery of care

5.3. Healthcare Performance

The concept of a standardized approach to measure healthcare quality and performance is relatively new. In spite of this, there has been a strong trend towards healthcare accreditation and rating. Part of the reason for this is that quality marks allow providers to demonstrate their quality of patient care to an evermore discriminating pool of domestic and international patients. Singapore is the only country in the world where all public hospitals have achieved Joint Commission International (JCI) [4] accreditation.

Medical information systems can serve an important role in providing the raw data for the measurement of clinical as well as business process performance, from turnaround times for reporting of X-rays to average length of stays.

Much of this data is currently extracted on an ad-hoc basis from operational systems. In order to support the on-going measurement of healthcare and business process performance, there is a need to enhance these ad-hoc processes. One possible avenue is through the implementation of the business intelligence equivalent of disease registries. In fact, there may a degree of overlap between business intelligence systems and disease registries, as clinical performance indicators are also an integral part of the disease registry dataset.

6. Supporting New Models of Healthcare Financing

The denominator of performance is cost. In the financing of healthcare, Singapore has always been on the cutting edge. The government has consistently introduced new financing models to ensure continued healthcare affordability.

Medical Informatics can help streamline financial and administrative processes. This is likely to be a mutually beneficial arrangement.

For example, government subvention to public hospitals was previously based on the Casemix classification system. Although this is no longer in use, it had a beneficial effect in spurring the adoption of standardized diagnoses coding (ICD coding) amongst public hospitals.

More recently, the Ministry of Health has decided to extend the use of Medical Savings Accounts to outpatient consultations for key chronic illnesses. (previously deductions from Medical Savings Accounts were allowed only for in-patient care) As participating primary care providers will have to provide standardized claims information, this represents an opportunity to further promote the use of data standards for the coding of diagnoses, investigations, medications and procedures. Downstream, standardized coding would facilitate the monitoring of provider performance, with the possibility of adopting a pay-for-performance approach.

Data-standards aside, the administrative cost savings from electronic claims processing may be sufficient to self-fund the IT infrastructure needed for healthcare inter-operability. This IT infrastructure could then be used for electronic exchange of clinical information.

7. Improving Global Competitiveness

Economic pressures are driving the globalization of Medicine.

As a consumer of healthcare services, Singapore can benefit from outsourcing components of medical care to more cost effective foreign providers through telemedicine.

Currently, teleradiology is being piloted in three public primary care clinics. X-rays are now read in India, with an average turnaround time of one hour.

Conversely, telemedicine can be used to position Singapore as a healthcare service provider in the global marketplace.

8. Conclusion – Enhancing Medical Informatics Education

Medical Informatics initiatives should be approached in the same empirical manner as clinical interventions. Ideally, with a strong body of supporting evidence.

However, given the sheer number of initiatives, it is unlikely that all will benefit from the presence of an experienced Medical Informatician.

One of the ways in which experienced Informaticians can maximize their value is by imparting key informatics concepts and principles to other healthcare team members. This can be done via a role as internal consultant, or in providing continuing education to other healthcare team members. This will help provide some uniformity and structure in the approach to new initiatives.

Ultimately, it is important to develop Medical Informatics as an academic discipline. Although local universities do not currently offer specific programmes in Medical Informatics, collaborations with established international centres may provide an avenue for them to do so in the near term.

References

[1] Jurong Healthconnect Accessed at http://www.juronghealthconnect.com.sg/eng/index2.aspx on 20 May 2006

[2] Integrated Care Services Accessed at http://www.ics.com.sg/ICS2006/Main/default.aspx on 20 May 2006

[3] Infectious Diseases Act (Chapter 137) Accessed at http://www.moh.gov.sg/corp/systems/acts/infectious.do on 21 May 2006

[4] Joint Commission International Accessed at http://www.jointcommissioninternational.com/ on 21 May 2006