Experience of Implementing a Centralized electronic Patient Record

for 6.4 million Patients

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Abstract

This paper describes the development and implementation of the corporate electronic Patient Record (ePR) for the Hong Kong Hospital Authority (HA). The ePR covers a population base of 6.4 million patients and is being used by over 40 hospitals across the whole of the Hospital Authority. Experience and challenges faced during the process of building of the ePR are discussed. Some of these issues are unique to the HA while others are general issues that other organizations may face.

*Keywords:*
Electronic Medical Record

Introduction

When the HA was established in 1991, there was very low information system penetration, with only isolated pockets of computerization. A three-stage IT/IS strategy was formulated:

Stage I - Establishment of the key corporate databases of patients, staff, finance and assets and the wide area network.

Stage II - Clinical systems at the front line and at the clinical departments

Stage III - Integrated Healthcare Information Systems: informational databases integrating clinical, financial, costing and management areas and information sharing with third parties.

During the initial 10 years, HA developed a large suite of clinical systems and implemented the same corporate systems across all its 44 hospitals and affiliating clinics. These systems include the Clinical Management System (CMS) which provided an integrated clinical workstation, giving single logon access to all available clinical information from either ward or clinical setting, Laboratory Information System (LIS), Radiology Information System (RIS), Pharmacy Management System (PMS) and various clinical areas.

From the technical perspective, these corporate systems are hospital-based systems loosely coupled together to provide a logically integrated view as depicted by the following diagram.
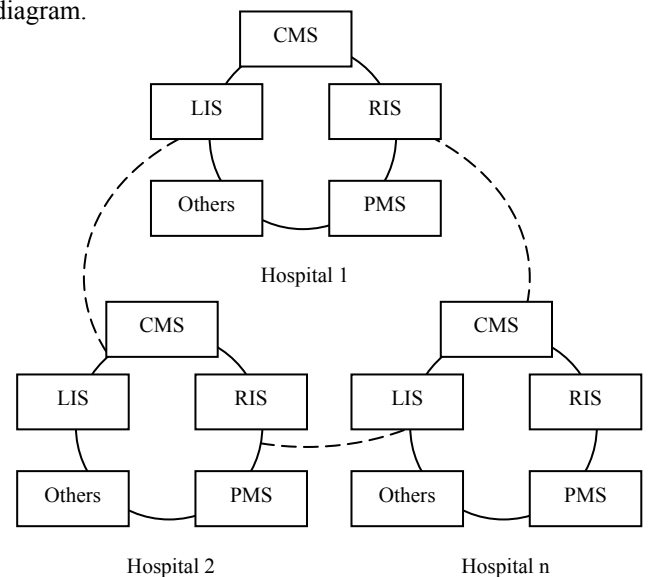
A clinician using CMS can access laboratory result in another hospital by specifying the exact hospital and similarly for other clinical records. This poses the limitation that the clinician needs to know "what" clinical information exists in "where" before one is able to access it. The history data from various operational systems may get purged because of operational performance as time goes by. Besides, there is also some response time issue as the data is retrieved from another server across the wide area network.

Electronic Patient Record (ePR)

The ePR is a core and important element in the development of the CMS Phase II which aims to provide better support for clinical care processes, while ensuring that good clinical data is available for quality initiatives, management, planning and research. The ePR aims to establish a patient-centered life long longitudinal repository of all important clinical data generated from operational systems in all hospitals and clinics and made available to all users in all hospitals via different operational systems.

There are two parts to the ePR. From the clinician point of view the key feature is the provision of an integrated view

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of all the important clinical data for a patient. This view spans both functions or disciplines and settings. The second part of the ePR is the clinical repository. This repository contains all the clinical information at a detailed level, and the ePR enables clinicians to 'drill-through' to the complete details contained within the source system.

Phase 1 of the ePR project started in April 2002. Over the past 18 months, significant amount of clinical data has been or in the process of being extracted from operational systems and put into the ePR. The ePR is now being accessed by all clinicians and relevant users from CMS and LIS. The ePR currently consists of the following data :

- Patient demographic data
- Admission, transfer and discharge data for in-patients and A&E
- Appointment and attendance for out-patients
- Alert and allergy
- Laboratory results
- Radiology results
- Diagnostics and discharge summary for inpatients
- Drug dispensing history
- Endoscopes and operations record (early 2004)
- Drug prescription history (early 2004)
- Accident & Emergency data (early 2004)

Challenges

There have been quite a number of challenges in the process of the building of the ePR. Some of these challenges include:

(i) Large Volume of Data and Transactions - The size of the current ePR is around 800 GB and estimated to grow to 5 TB in 5 years' time. There has been serious consideration as to the most appropriate system architecture including hardware, database, software tools and engines to be employed which is capable to handle the large volume of data and transactions.

(ii) Standardization of Data – Different hospitals have been using different types of laboratory diagnostic machines, different reference ranges, sets of coding and terminologies. As the ePR data will need to be used by users from other hospitals, tremendous work among users from different hospitals was done on the standardization work such that the data can be interpreted more conveniently and meaningfully.

(iii) System Performance – There are around 500,000 transaction updates coming from various systems and database servers to the ePR everyday and this number is expected to grow at 20% per year. Clinicians have also posted very stringent demand on the response time for ePR enquiry. There have been careful system design, series of testing and tuning conducted to ensure that the system performance was acceptable to end users.

(iv) Flexible Presentation of Data – The ePR is used by end users from different hospitals, specialties and in-patient and out-patient settings. The ePR user interface has to be flexible enough to meet requirements from different groups of users. In the busy Specialist Out-patient clinics, the average consultation time for each patient is usually several minutes. The ePR summary screen will need to provide clinicians a brief yet comprehensive overview of the important data for the patient including alert & allergy, recent appointments and attendances, diagnosis and procedures, recent drug records. Clinicians are able to drill to the detailed data in an easy fashion. This was achieved through series of discussions with variety groups of users, prototypes and fine-tuning.

(v) Other Technical Aspects - The ePR is becoming a more and more important and essential tool to assist the work of the front line staff. Issues regarding system security, availability with standby servers, reliability have to be addressed with due considerations in order not to have adverse impact to their daily work.

High Level System Architecture

The following provides some information on the technical platform for the ePR

Data Size (Text Data) :   800 GB (Current)
                                      5 TB (in 5 years' time)

Data Size (Document Image):   2 TB
    No. of Patients :   6.4 m
    No. of Episodes :   44 m
    No. of Laboratory Results :   213 m
    No. of Radiology Results :   21 m
    No. of Drug Dispensing Records : 120 m

Update Frequency : < 15 minutes from source systems

Hardware Platform : IBM RS600 P690 Symmetric Multi-Processor, 8-way CPU

Software Platform : AIX 5.1, Informix Dynamic Server 9.30 UC1

The following depicts the high-level system architecture for ePR:
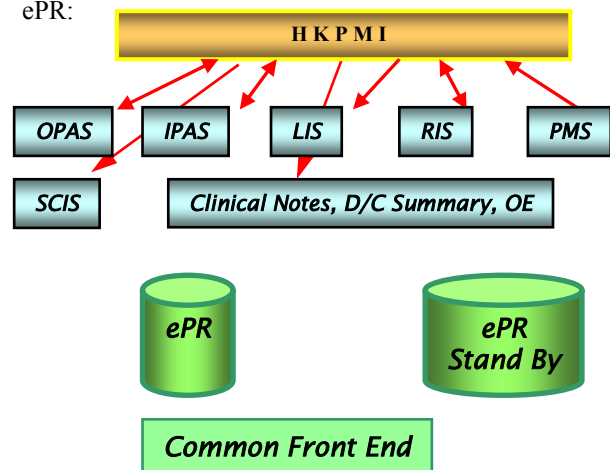
Conclusion

The implementation of a large-scale enterprise ePR across all 44 hospitals in the HA has been a challenging tasks. Despite the advancement in the hardware and software technology which has helped the technical work feasible, concerted effort was required with strong support from management level to front line staff, involvement by users from different specialties as well as effort from the IT staff. Since its implementation, positive feedbacks have been received from the front line users. The continue building of the ePR to include more clinical data and multi-media data has been planned. This would form the basic building block for the future development of the CMS to further improve the clinical process and outcome.

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