Designing a Comprehensive Medical Electronic Database for Cairo University Hospitals: Phase I

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Abstract. This study presents our experience of implementing electronic medical record system supporting a Cairo university Hospitals, one of Unique Egyptian tertiary hospital. We emphasize the following points being our *objectives*:1-generating and ensuring compliance for individual patient Medical record number (unique identifier) 2- Designing a standardized medical records admission forms for Cairo University hospitals 3- Developing accurate data base to Cairo University hospital patients 4- Introduction of electronic archiving system.

Methodology: this health system operational research study passed through three phases which are: I-Development of policies and procedures for MR&SD. ii- Redesigning of medical records and statistics department (central and peripheral) iii-Redesign of the data entry screens at MR&SD with special emphasis upon unique patient identifier. Implementation of the planned intervention was held throughout duration of 2 years.

Results: The main outcomes of this study were: a written approved policies and procedures regulating the medical record and statistics department working system, promoting the available resources through building up of the infrastructure of both the central and peripheral units belonging to MR&SD, supplementing them with both hardware and software, mutation of the traditional archiving unit to a totally electronic archiving unit belonging to the MR&SD; both security and confidentiality of the working system were ensured. These systems were strengthened by forty qualified statistical technicians recruited to the department. Finally two screens facilitating both data entry and case summary extraction were launched.

Conclusion: the use of electronic medical records was functioned aiming to ensure the applicability and convenience of the medical record and optimizing health care service introduced to our patients.

Keywords: Electronic medical records; Unique patient identifier; Tertiary hospitals, Hospital information systems.

I. Background

In recent years electronic hospital information systems have been widely used in major hospitals for the management and accumulation of clinical data (1-3) modified hospital

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information systems with multiple statistical analytic functions could meet the increasing demands of hospitals (4).In general, the development of the hospital information system has gone through two stages:1- The development of local area networks, such as charging system. Information is shared within a system but not among systems, 2- The application of modern hospital information systems national based with a unique patient identification code. Aiming to establishment of a hospital information system, an overall framework will facilitate the flow of information and sharing of information among various systems (5).

Current research focuses on the information-based integrated database design mode for a local hospital information resource (6,7) Data such as those on patients, drugs, and medical staff are needed for complex statistical analysis and for data mining techniques in order to summarize new knowledge or information from massive quantities of clinical and hospital data. Therefore, like management information systems, hospital information systems need to be based on unique data base. However, most previous works have focused on the management of medical information. At this time, data integration using uniform data base technology is an urgent problem, a qualified team assigned to conduct a conceptualization and initial development of Medical Record System (MRS) (8) an electronic medical record system supporting a Cairo university Hospitals care health. The expected Benefits of the hospital electronic data base which is a central repository for all or significant parts of the data that an enterprise's various health care systems collect is providing a thematic, consistence, and safe data model pillars the thematic component provides a common data model for all data regardless of the data's source, so far the consistency it allows prior loading data into the data base, inconsistencies are identified and resolved, which greatly simplifies reporting and analysis while the safety will allow the information in the electronic data base can be stored safely for extended periods of time (9,10). In this article, we report the preparatory phase of the MRS within Cairo university Hospitals as a mean for recording clinical data. We emphasize the following points being our objectives: 1-Designing a standardized medical records admission forms for Cairo University hospitals 2-Keeping medical records and easily retrieving needed records for follow up cases or for research or legal reasons 3-Developing accurate data base to Cairo University hospital patients and 4- Providing accurate statistical reports and indicators of Cairo University hospitals

Aiming for the development of a comprehensive medical affairs managers system it is required that the health information management system not only assists the processes involved in medical affairs but also provides data analysis to support decision making and medical diagnostics. The top hospital information system database requirements could be divided into seven functional databases according to function as shown in Figure 1: an outpatient information database, clinical information database, remote medical information database, electronic medical records information database, inpatient information database, medical imaging information database, pharmacy information database, and management information database.
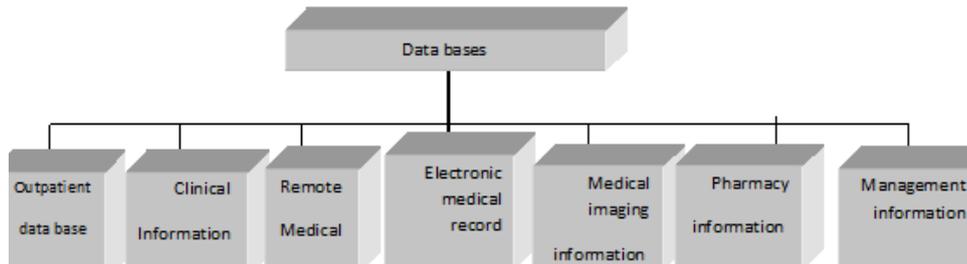
Figure 1 Functional data base of Cairo University Hospitals

Methods: type of study: this is a health system operational research study which was conducted throughout two phases first phase (lasted 2years 2010-2011) is presented in the present paper presenting the preparatory phase including situation analysis human resources development as well as upgrading of the infrastructure. While the second phase would cover the implementation of approved interventions.

Implementation site

Cairo University hospitals have twenty one administrative sectors distributed within and outside the faculty of medicine campus. Each administrative sector has its own inpatient beds, operative theaters, diagnostic units (laboratory and radio diagnosis), pharmacy and served by its own registration office

Infrastructure of statistical unit of Cairo university hospitals: this unit consists of

Central department and Peripheral units: the later is presented as the registration units present in each individual hospital while the former works centrally pooling all patients' records all over the hospitals and finally generating in complete biannual reports this department was equipped by 8 out of date computers worked upon through Access computer soft ware for recording patients' data; patients' diagnoses were coded using ICD-9. The current data base cannot meet the above requirements for two main reasons. On one hand, there is inadequate storage. On the other hand, current software systems are not suitable to work out with data missing, data analysis, decision support, and medical diagnostic support. As regards the archiving system it was conducted through adding up new files for each hospital individually through patients codes the main constrains were difficult retrieving of archived patients' files and accumulation of massive paper work in relation to delegated spaces. (Picture 1)

Picture 1 Old archiving system

Both the central and peripheral units had application forms: Only inpatients expected to receive more than 24 hours services had a hospital number which changes with each new admission for the same patient (i.e there was no unique identifier for each individual patient) with the following forms: Admission forms there were six different forms which were classified according to the department of entry and the duration of stay.

Human resources and man power: The medical statistics and record keeping department was supplemented by forty qualified assistant statisticians being small in number compared to the great bulk of patient flow through-out the year approximately two million patients /year in 2009 . Their working delegations were: 1-Deliver patient files from

patient registry office to Medical Records and Statistical Department.2-Recording patient data in database Access of statistical department on computer present inside patient registry office.3- Delivery of primitive statistical reports. 4-Monitoring and evaluation of the patients' admissions process and cycles of their files and early detection of problems

Reviewing the Cairo University Hospitals final report for year 2008-2009:

Included reports displayed: A- Total inpatient volume based on admission records for each individual hospital B- Average hospital length of stay C- Mortality indices: gross unadjusted mortality rate per each individual hospital. D- Bed occupancy rate E- Operation records in the form of number of performed operation for each specialty

II. Results

I-Development of policies and procedures: A written booklet for policies and procedures was issued to document all the work requirements and steps for medical registration system in Cairo University hospitals. In addition to development of required system flow charts and summary guide lines for all working staff members throughout the hospitals

Policy I: Forms of Medical Records Provision of a single unified Admission form for all the Cairo university Hospital regardless the specialty or way of payment, provision of revised versions of current medical forms according to different specialty needs categorized into two main sectors supplementing medical and surgical departments, case summary, Medical report or death report and a Checklist to revise file content. *Delegated departments*: All forms are the responsibility of the main store department which is responsible for printing and distribution of forms after agreement of higher council of Medical Records and Statistical Department. *Criteria of Forms*: All forms should be have a printed serial number containing a pre code for each hospital revised from higher council of Medical Records and Statistical Department and they should have unique identifier for hospital and patients. Remodeling of application forms of patients files: Admission form was designed to respect the following points: 1-Being the single form for all the administrative units of all hospitals belonging to Cairo University Hospitals, each hospital has a code number printed to the left of the serial number of each copy. 2- Recording the date of admission and the patient's demographic data including his/her national number. 3- Recording whether or not the patient took any service from the Cairo University Hospitals within 30 preceding days for internal admission or 72 hours preceding emergency care services. 4- Giving the patient a hospital number derived from the registry unit files. 5- Recoding whether or not that this case is a readmission one if yes the previous hospital number is given to the patient.6- Informed signed consent from the patient or one of his relatives denoting their agreement upon hospital measures of treatment. 7- And finally date of discharge and patient condition (complete recovery, controlled condition, upon patient request or death) is fulfilled on discharging the patient.

Policy 2: Responsibility of Medical Records Medical file is shared responsibility between resident, nurse, responsible employee in patient registry office and statistical technician

Policy 3: Confidentiality and accuracy of Medical Records Revision of Content of medical record by statistical technician and employee in patient registry office, Evaluation quantitative content through checklist form, Evaluation qualitative content through medical technical council, Systematic auditing is planned for random sampled files presenting 15% of monthly received files for each individual.

II-Collaboration between Cairo University Hospitals and Egyptian Ministry of Administration Development:

Upon frequent successive meetings between director of Medical Records and Statistics Department and representatives from Egyptian Ministry of Administration and Development the following was agreed upon: *General objectives*: National unique identifier for each Egyptian patient through-out all Egyptian health care services. *Specific Objectives*: 1- Upgrading the infrastructure of Medical Records and Statistics Department of Cairo University Hospitals 2- Designing specific electronic health recording system for Medical Records and Statistics Department of Cairo University Hospitals 3- Human resources development of Medical Records and Statistics Department of Cairo University Hospitals 4- Application of electronic archiving system at Medical Records and Statistics Department of Cairo University Hospitals

III-Implementation:

Redesigning of medical records and statistics department (central and peripheral): Building up of infrastructure: For optimum efficacy of the assigned central department of medical records and statistics, the department (MRSD) was restructured into two interrelated units one for data entry and reporting and another for electronic archiving and filing system. Each peripheral unit had assigned specific room for registration and patients admission.

Building up of the hard -wear: (Picture 2) An expansion of infrastructure was highly recommended because of shortage of available computers may lead to a decrease both in the use of and the interest in the application of EHR in MRSD. So Thirty updated computers were supplemented to the central unit of the MRSD and twenty one for the peripheral units at the registry offices of all the administrative units related to the Cairo University Hospitals. Also printers were added to the system. All of the supplemented computers were connected to an internal server allowing intranet connection. In addition scanners were supplemented for the electronic archiving subunit at the central office of MRSD

Picture 2 Upgraded infrastructure and system security

*Sustainability and security of the system were ensured through:*1- All wired connections were contained inside a duct system so as to be protected from any accidental damage 2-An uninterruptible power source (UPS) battery 3-A paper backup system (paper registration and encounter forms that can be back-entered into the system when power is restored) 4-Each user has his own pass word enabling him to get access to his own computer. 5- At the end of each working with system shutting down, the entire database is again backed up onto a CD. 6- An Updated efficient antiviral soft ware was installed to guard against accidental affection of any part of the computer system.

Conceptualization and Development of the SMART Modular System: This system was initially developed through collaboration between Minister of Administrative Development and Medical Records and Statistical Department in Cairo University Hospitals. SMART is a modular system comprised of a paper form, a Data Entry module and a Reporting Module (11).

Redesign of the data entry screens at MRSD: Figure 2 displays the first data entry screen which is the soft prototype of the patient admission forms. It has multiply levels of data validations. First the data entry depends upon patients' hospital number not permitting duplicated hospital number for the same patient. Also each individual hospital, being the responsibility of specified delegated team, has a drag list for its most frequent diagnoses codes according to ICD-10. Each screen is divided in to interrelated parts. Movement across the data entry screen is through the mouse and each part obligates saving the entered data to allow passage to the following part of the same screen.
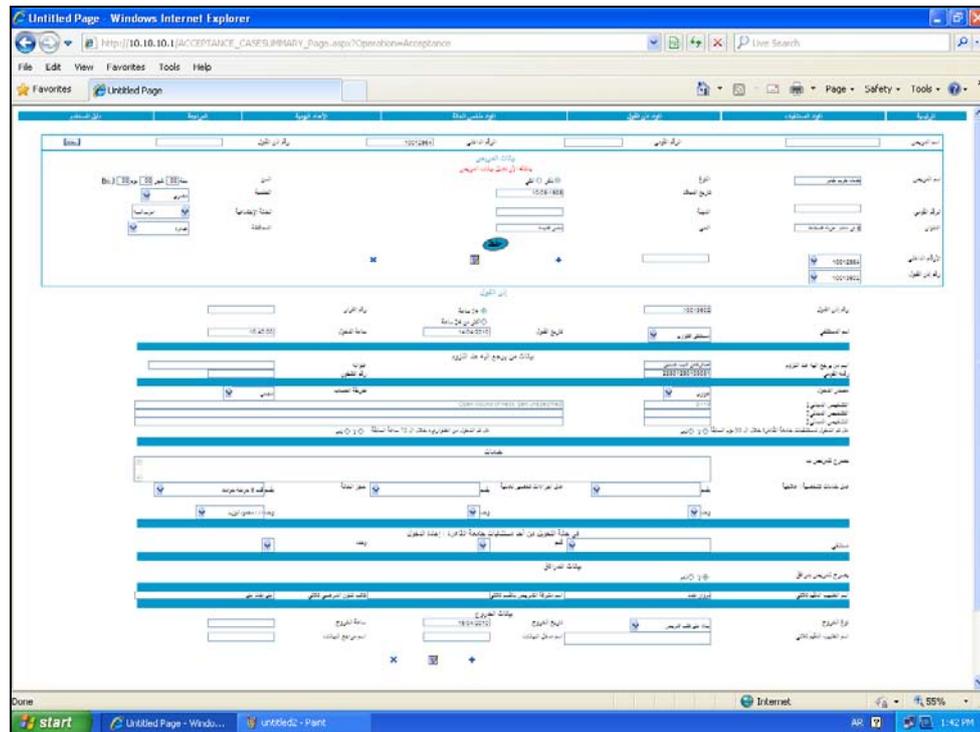

Figure 2 Data entry screen patient Admission form

The second data entry screen was that of Case Summary (figure 3) which is interrelated with that of patients admission sheet(s) every sheet has its own case summary. Being an obligation patients hospital number must be the same with that found in the patients admission form in addition coded patients diagnosis and date of discharge must be entered to allow saving of the case summary screens.

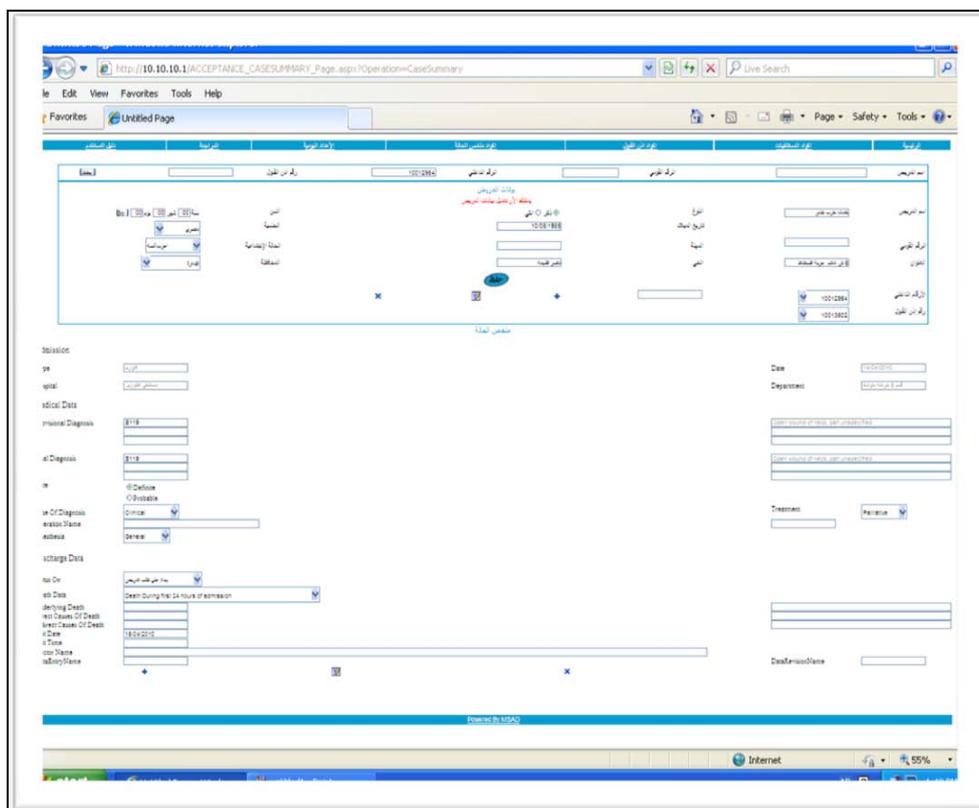If an admission screen is not accompanied by a case summary screen it is considered a non-delivered file.

Figure 3 Case Summary Data entry screen

Human resources development: This was conducted through both quantitative and qualitative approaches. First supplementation the MRSD with forty statistics technician for data coding and entry, and statistical reports preparation. As well as twenty personnel with less qualification for scanning and electronic archiving.

All of the working staff attended training courses covering the following objectives:

1- Coding of different patients diagnoses according to ICD-10.
2- The new data entry screens; including patients admission screen and case summary screen
3- Validation of entered data
4- Internal auditing for both hard and soft medical records 5- Report preparation and continous reporting on daily, weekly, monthly and finially annual bases.

III. Discussion

According to the Institute of Medicine the use of electronic medical records is essential for health care. Benefits include the potential to improve diagnostic and care decisions, adherence to clinical guidelines, and ability to identify patients that miss appointments (12). Electronic health record (EHR) systems provide various benefits for healthcare, including having positive effects on outcomes such as the efficiency of care, the effectiveness of care, the reduction of error rates, and the reduction of healthcare costs (13) The overall return on investment for introducing electronic medical records into health care providing services remains to be determined. Few studies have been conducted in Egyptian hospitals, most by system vendor; thus, the results must be viewed with caution(14). Nevertheless, the limited available data suggest that this return is excellent. For example, Renner evaluated the costs and benefits of implementing an electronic medical record for a 40- primary care physician group and found that its net present value was $279,670 in 1996 dollars based on a 5-year model (15). Further independent analyses are clearly needed. We believe that the electronic medical record keeping and similar systems can be used to improve health care in developing countries. Such systems can help managers account for the care they deliver and compete effectively for scarce resources (16). By identifying patients whose care or outcomes are suboptimal, health centers in developing countries can target limited resources toward more improvement activities. Despite limited resources, most developing countries have national and international public health initiatives that are mostly aimed at disease prevention and health promotion. Electronic medical record systems such as the electronic medical record keeping can support and enhance these initiatives by helping recognizing both appropriate targets for these activities and providing outcome data. An inexpensive and effective electronic medical record system can be established and work in a limited resource developing country (17). The key to its maximum usefulness will be its sustainability. The more such a system is used to guide care and for research and development activities, the greater the chance that the costs of implementation and maintenance will be compensated by benefits; financial and the health of the people served (18). The need for Unique Patient Identifiers (UPI) has become urgent. The widespread implementation of information technology and the emergence of computer-based patient records have prepared the way for its success. Several organizations started to address this issue of Unique Patient Identifier since the beginning of this decade. In 1993, the Computer-based Patient Record Institute created a work group to address the need for a Unique Patient Identifier. Several organizations such as called for action in this area by publishing position papers. In 1995, American Society for Testing and Materials (ASTM) published a Standards Guide for the Properties of a Unique Patient Identifier called Universal Health Identifier (UHID). Other organizations such as American National Standards Institute - Healthcare Informatics Standards Planning Panel (ANSI-HISPP), HCFA, HIBCC and NABP worked on identifiers relating to providers, employers, health plans, payer, etc. In 1994, ANSI-HISPP created a task group to review the various options in this area. The recent legislation, Health Insurance Portability and Accountability Act (HIPAA) 1996, requires the implementation of health data standards including identifier standards. A study that found the creation of unique patient identifiers could reduce medical errors, simplify electronic transactions, increase efficiency and improve patient confidence "serves as a timely reminder that smarter use of already available technologies can reap benefits and save money even in lean times," . According to the studies , UPI systems work by using a product code for each individual

patient that limits the risk of privacy breach inherent in the current practice of statistical matching, in which providers retrieve records by flagging identifiers such as name, address, birth date and Social Security numbers. The editorial notes that the RAND study found that the one-time cost of $1.5 billion to $11.1 billion to implement UPI systems "is small ... compared with the potential savings" of $77 billion annually when the adoption rate of UPI reaches 90% (19,20).

IV. Conclusion

In conclusion the target of giving every patient a single medical record number and ensuring that this number will be functioned in the return visits whenever nedded was achieved. In addition now Kasr Al Aini Teaching hospitals have a well equiped Medical records and statistical departement at both central and peripheral levels. Shiftting to electronic archiving was also achived by the updated electronic archiving system serving Kasr Al Aini Hospitals. Both the man power and program resources were supplemented in the form of forty statesticians and pretested data entry and case summery screens. All the technicians were trained upon these screens Both security and confidencialty were ensured of Kasr AlAini University hospitals' database.

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