

LEVERAGING THE HOSPITAL INFORMATION SYSTEM (HIS) FOR TEACHING AND LEARNING

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1 Introduction

The computerized Hospital Information System (HIS) has the potential of providing many benefits to learners as well as teachers in an academic environment. Many are already present within a well-designed HIS. Yet, much more opportunities exist if certain strategies and approaches are exploited. Teaching learning methods that can be facilitated by HIS include:

01. Problem-based Learning
02. Experiential learning
03. Apprenticeship

2 Benefits, Opportunities and Objectives

Many benefits can be gained from the use of computerized HIS if the opportunities are harnessed. The following objectives can be hoped for:

- a. Students acquires the skills of using a computerized patient information system and Electronic Medical Records
- b. Teachers and students can locate suitable cases for study and allocate existing patients to specific students or student groups
- c. Students have access to view all clinical data regarding the patient under their care
- d. Students acquire the competency to plan and carry out Clinical Care Processes
- e. Students are familiar with up-to-date evidence-based practice
- f. Postgraduate students and tutors gain access to standard reports (registries)
- g. Postgraduate students and tutors can extract and analyse data regarding patients to conduct studies on existing patients
- h. A library of anonymized patient data including images is made available
- i. Teachers have an additional tool to assess student's knowledge and decision-making skills

3 Strategies

Some of the objectives discussed above can be achieved through the following strategies:

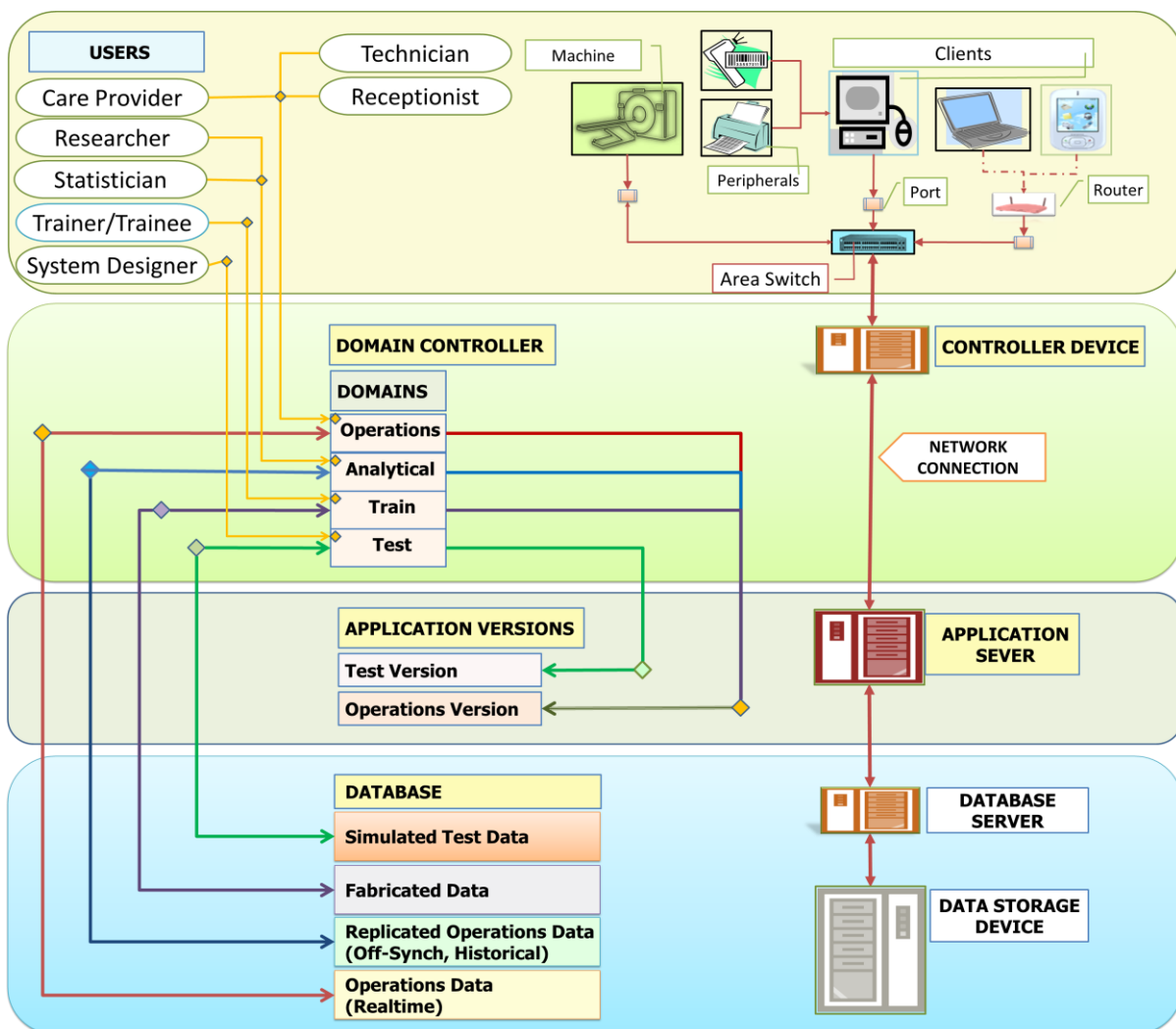
- A. Creation of different Domains for purposes other than operations
- B. Provide read-only privilege of access to actual patient data in the Operations Domain of the relevant subsystems of the Hospital Information System

- C. Provide the privilege read and write actual or fabricated data in the relevant subsystems of the HIS in the Train Domain
- D. Create fictitious patients so that fictitious data can be inserted in the Train Domain
- E. Establish a database of selected anonymized patients
- F. Ability to practice on the same information system used by care providers using the Train Domain
- G. Learn from care plans and decision support information on real or fictitious patients

3.1 Creation of Domains

The primary function of HIS is to facilitate healthcare providers and managers to carry out their work. Efforts are made to ensure the validity, accuracy and integrity of the data generated. Both the entry and retrieval of data are subjected to high levels of security, confidentiality and privacy. The route of entry and access to actual data occurs in a highly controlled environment known as the Operations Domain. Other domains is then required for purposes of data manipulation, training and testing.

Figure 3-1: HIS DOMAINS



4 Methods for the Undergraduate Students / Trainee Nurses

4.1 Provision of Privileges for Students or Trainees to Access the Operations Domain.

Often students are not allowed to view Patient Information (in the Clinical Information System-Electronic Medical Record) because of fears regarding security, confidentiality and privacy. This will constraint the students ability to learn through apprenticeship and to a certain extent bedside learning. The issue of security , Confidentiality and Privacy can be addressed by two approaches:

- i. Imparting to students the ethical values and rules of information disclosure
- ii. Providing restricted privileges of access to the Clinical Information System and the Medical Record

4.1.1 Imparting to Students Ethics and Laws Regarding Information Disclosure

The ethics regarding disclosure of information is stressed even in the Hippocratic oath. Now, laws have been enacted to safeguard confidentiality and privacy of patient data. Early in their training, trainees need to be exposed to them so that they assimilate the right attitudes and practices. They need to be aware of security rules and mechanisms. On the other hand, the HIS System Administrator need to ensure that security mechanisms are put in place. This would include recording a log of instances of access to HIS or records made by students (the Audit Trail). Students who break security rules need to be disciplined.

4.1.2 Restricting Privileges of Access through Information System Domains

In a good Hospital Information System, the path to the type of information can be segmented into domains. Real current patient data is captured and retrieved via the Operations Domain, normally restricted to care providers. Persons in training (including trainers and students) uses the Train Domain. The Test domain is restricted to developers.

4.2 Access to Operations Domain

In their earlier years, students uses cases as subjects to learn from or about. At this phase, they usually collect information regarding the patient themselves. However, access to some information in the Clinical Information System need to be provided to enable them to have a complete understanding of the patient (e.g. laboratory results, radiology reports).

At this phase, they can be given access to view (read-only privilege) relevant sections of the Clinical Information System and the Medical Record that will facilitate learning.

In later years, they may take on the function of apprentices and carry out tasks such as collect specimens, insert IV lines, give vaccinations and even deliver babies. The levels of privilege can be increased gradually. With due care, there is no reason to restrict access of students to data of current real patients i.e. Operations Data. Students can be grouped into user categories designated as, for e.g.:

01. Clinical Year 1
02. Clinical Year 2
03. Clinical Year 3
04. Post graduate Trainee (non-staff)

At this stage when they are more actively involved, certain sections of the Operations Domain may be opened to them. They would then be assumed to be part of the care-provider team. Their actions need to be verified by a supervisor. All

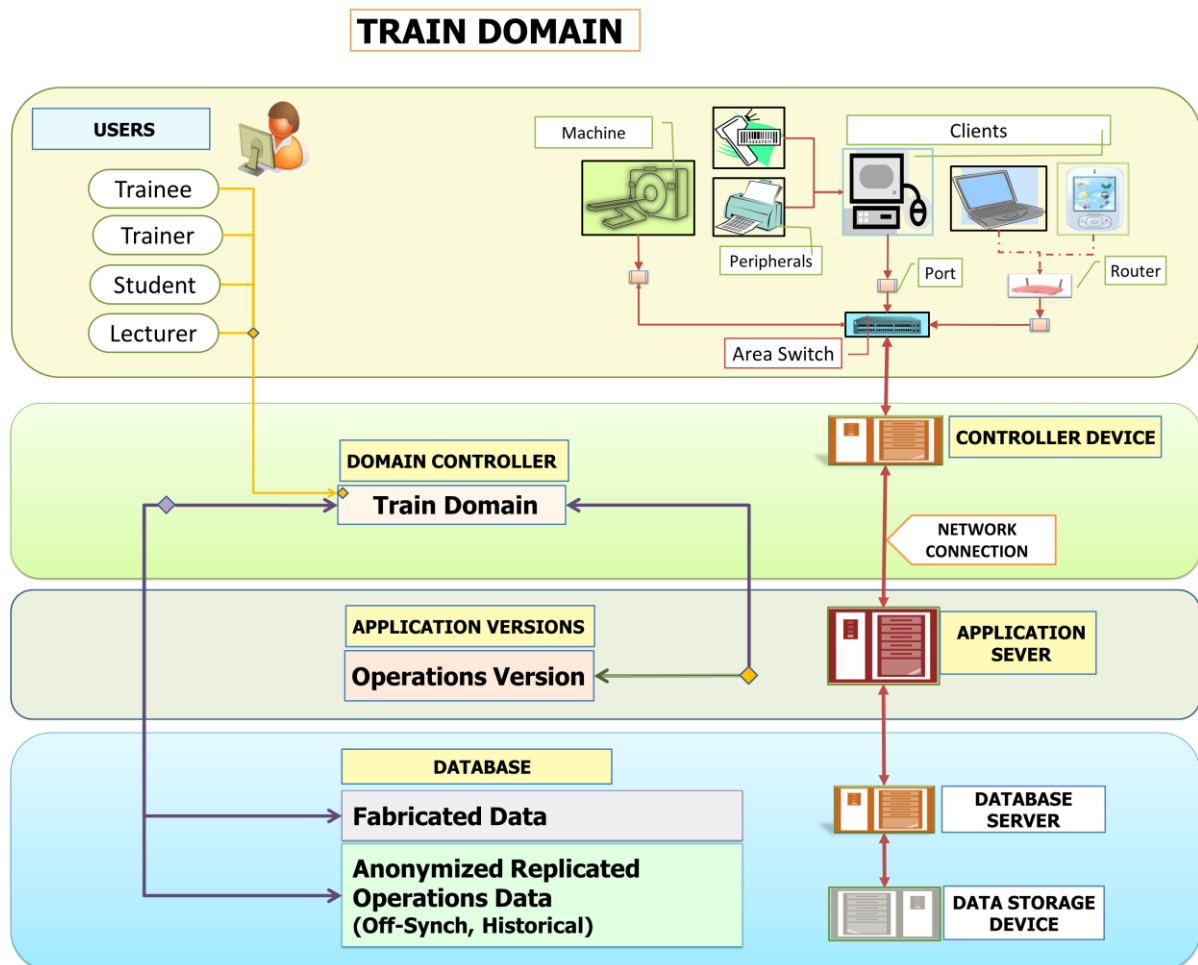
clinical phase students are enrolled as users of the system by giving them usernames. Privileges to access the information of a designated group of patients should be given for a limited period as students move frequently according to their postings. The change in privilege limits need to be done diligently.

The university/college has to constantly update the IT department on student movements. Instances of access to the Information System will be recorded as a “access trail”. Students misusing the system can be identify

4.3 Creation and Use of Train Domain

Normally the Train Domain is created for purposes of training new personnel of the health care facility on the use of the Hospital Information System. In a University/Teaching hospital this domain can be made accessible to students. The Clinical and Clinical Support applications are exact replicas of that used the Operations Domain. However dummy patients may be registered and fabricated data can be entered by students or lecturers alike. Students may also record data of anonymized current patients allocated to them. For each patient, students can plan care (place orders and create tasks). The decision support functionality is also available for use. These includes access to care plans and to reference information within internal libraries or the world wide web via hyperlinks from within the HIS application

Figure 4-1: TRAIN DOMAIN



4.3.1 Creation of Database for Fabricated Data

Fabricated data entered by students or lecturers are kept in a separate Train Database for a limited duration after which it can be erased by the student or purged automatically by the system.

4.4 Learning from Model Cases

The presentation of the illness and the care of past actual patients by experienced care providers are a good source of teaching-learning material.

4.4.1 Creation of Library of Actual but Anonymized Data and Images

Patients that are instructive, exemplary or interesting may be selected by lecturers, their data anonymized, indexed and kept temporarily or permanently in the Train Database to be used as teaching material. Such data will include investigation results and radiology images.

For images, a catalogued library of images belonging to anonymized patients that are of educational value can be created.

4.5 Postgraduate Medical Education

Postgraduate students learning through apprenticeship would be given privilege of access to the use the full function of HIS. Students not given employment (e.g. on attachment or visiting) can be given benefits similar to those provided to undergraduate students.

Postgraduate students can be given additional privileges to use the data extraction and analysis function of the system for purposes of carrying out research including:

- a. Access to standard reports including registries
- b. Ability request for or to generate ad hoc reports to conduct retrospective studies on existing patients (including list of patients they had attended to)

Another useful functionality is the creation of system generated registers of cases they are involved in to provide proof of achieving adequate exposure (number of cases) plus the degree of involvement in cases and procedures (observe, assist, perform). This would be more valid than making them up manually.

5 Methods for Teachers and Lecturers

The computerized Hospital Information System (HIS) provide opportunities for learning for undergraduate and postgraduate students that is not available with paper records. These includes ability to locate and allocate patients using the Patient Management (Administration) System by the Student Supervisor

Visiting Lecturers may be categorized accordingly and be given limited privileges. Trainees and Lecturers employed by the hospital will of course be given full user privileges according to their role.

5.1 Use of the Patient Management (Administration) System

Lecturers or Supervisors who have access to Patient Management (Administration) System can use it to allocate existing inpatients or scheduled outpatients to students. Lists could be transferred to Excel spreadsheet and the assignment can be printed.

5.2 Creating Teaching and Assessment Material

Lectures, tutors and supervisors, could be trained to create teaching-learning and assessment material. These include:

- a. Ability to create library of records of anonymized actual patients including images and case reports as teaching-learning material
- b. Ability to create test patients with fabricated data within the train domain
- c. Provide just in time reference knowledge at the point/stage of care
 - i. Using built-in care plans and decision support functions within the Train Domain of HIS as teaching-learning aids.
 - ii. Use the hyperlinks provided within HIS to access knowledge via the Internet

5.2.1 **Creation of Records of Anonymised Actual Patients in the Train Domain**

Records of historical data of previous patients can be anonymized and used for:

- Case-based learning sessions (Clinical-Pathological Conference, Clinical-Radiology Conference)
- Demonstrating the overall care (encompassing the entire care episode) of selected patients with different disease conditions

Teachers can select cases they are aware of or choose from a register. Identity data will be removed by the Database Administrator (DBA) and the data will be lodged in the database of the Train Domain.

5.2.2 **Creation of Test Patients with Fabricated Data within the Train Domain**

Test patients with fabricated data can be created for purposes of:

- a. Teaching Clinical Care Processes
- b. Assessing student's understanding and decision-making skills

Teachers can create dummy patients and insert fabricated data in stages according to the Clinical Workflow i.e. Phases of Care. Students may then interpret the data and proceed to make conclusions and further plans. For example, symptoms and signs may be provided and students are made to postulate the provisional and differential diagnosis. The proper diagnosis may then be given and students may then select the relevant investigations. This can be checked against the Care Plan provided by the Clinical Information System (CIS). The results are made known to the student. The student may then be asked to make the Definite Diagnosis. The lecturer may then correct them. Next students may be asked to plan the care and later compare it with the plan suggested by CIS.

6 **Leveraging HIS for Research**

HIS can facilitate two types of research:

01. Retrospective research on Historical Patient Data
02. Prospective research (trials etc.)

The patient Information database is an extensive source of data for observational studies. A good HIS facilitates such research through the following features:

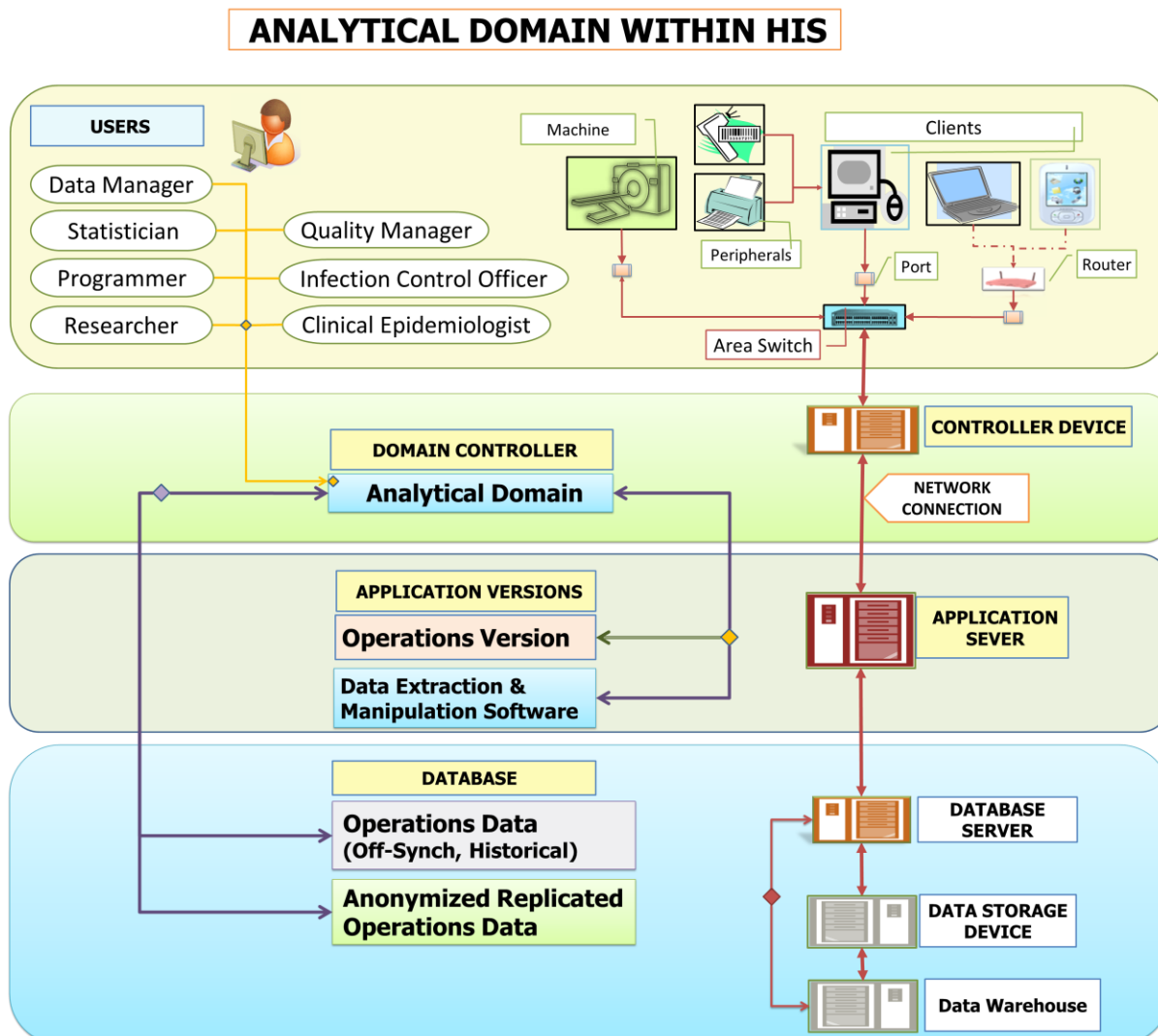
- i. Ability to create registers of patient populations based on various parameters
- ii. The facility to create an Analytical database (Data Warehouse, Data mart) with the option of making the data anonymized
- iii. Provision of built-in tools for data extraction, analysis, interpretation and presentation.
- iv. Compatibility of with third-party data extraction software software (e.g. statistical software) by

It is important that the database is based on standard data definition language and compatible with commonly used data manipulation language. The data model and

data dictionary should be well documented. Use of standard clinical terminology also goes a long way to assist clinical research.

Access to the Analytical Database is controlled by the creation of the Analytical Domain.

Figure 6-1 ANALYTICAL DOMAIN



6.1 Retrospective Research on Historical Patient Data

The common type of research that can be performed on historical operations data are:

- A. Quantitative studies
 - a. Medical audit
 - b. Quality audit / studies
 - c. Infection control studies
 - d. Incidence and Prevalence studies
- B. Qualitative studies
 - a. Case Reports
 - b. Inquiries
 - c. Descriptive studies

The database is also open to data mining i.e. attempts at finding correlations between data elements.

6.1.1 Registers

To facilitate selection of study subjects and building the study population, the Database Administrator (DBA) or any programmer can create registers based on various parameters (disease type, age, location etc.) as routine standard reports or as requested by researchers. The admissions-discharge register, birth register and death register are standard. Registers based on reason for visit or discharge diagnosis for various disease can be created if needed.

6.1.2 The Analytical Database

The Analytical Database (data warehouse, data mart) is a separate database used primarily for data extraction and manipulation. The data belonging to a subset of patients making up members of the study population can be extracted and their source be anonymized if necessary. The hospital may inform patients about the possibility of his/her data being used for research after it has been anonymized. The policy can be set that consent is assumed by default if no objections are made. The data may be transferred to simpler databases such as MS Access™ or even spreadsheets such as MS Excel™.

Third part statistical tools may be used to extract, analyse, interpret and present the data.

6.2 Prospective Clinical Research

As a cautionary note, the HIS should be designed primarily to facilitate patient care. The urge to include data elements for when (in case) they would be useful for research should be stymied. Any change in practice and the corresponding data to be collected should be determined when the research is designed. Researches should use, as much as possible, data routinely captured in the course of patient care. To maintain the integrity of the Operations database, the additional data may be written to a separate database. The collection of such data should cease once the research period is over.

6.2.1 Conduct of Clinical Trials

Trial subjects should be registered as patients but tagged as such. For the sake of “good clinical practice” they should be subjected to regular clinical practices with the exception where deviation is intended. Hence, routine care plans may be altered to include or exclude certain tasks.

For the additional data required for purposes of the study, data collection tools (forms, charts) to collect data can be designed and made available. Additional orders (e.g. drug orders or monitoring orders) may have to be created. They should be used only for the duration of the study and retracted once the study is over. The researcher has the responsibility to explain to care providers the changes to the care plan and negotiate with them to collect the additional data or employ research assistants for the purpose.

6.2.2 Comparison Studies

Prospective studies need not necessarily involve changes in clinical practice. Comparisons between different groups of patients may be done for e.g. in quality of performance studies. In these studies, the inclusion (hence identification) of patients into the study may be done prospectively to ensure that they are fairly allocated to study groups. There should be no necessity for additional data to be collected. The data analysis may be done after the defined study period.