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Integrated Hospital Management System [IHMS]

Developed by: LAICO – Aravind Eye Care System Madurai, India	Funded by: CBM International (SARO – South) Bangalore, India

Integrated Hospital Management System (IHMS)

Introduction:

Lions Aravind Institute of Community Ophthalmology (LAICO) had initiated software development project with an intention to support voluntary hospitals by providing software solutions for hospital management. The project was started in Sep. 1999 with funding from CBM. LAICO with its 15 years of experience in using computers for various applications at Aravind Eye Hospitals took responsibility to define the software requirements and system designs.

Allied Dunbar, UK had sent two volunteers to help us in system designing and in developing guidelines for implementation of this software.

IHMS development was completed by April 2001 and it has been first implemented at Aravind Eye Hospital, Madurai to evaluate the product in various dimensions. After evaluating for 6 months, it was implemented at Aravind Eye Hospital, Theni in Dec.2001. Today it is running at 4 branches of Aravind Eye Hospitals and also deployed in 3 other hospitals.

IHMS:

IHMS is an integrated information system that covers the following aspects of patient care and administration in hospital management.

Patient Care Domain	Administrative Domain
• Out-Patient Registration • Out-Patient Billing ** • In-Patient Reservation** • In-Patient Admission • Operation Theatre Management • Inpatient Discharge • Ward Management** • Medical records • Medical Record Tracking** • Referral Patient Management ** • Patient flow management** • Appointments**	• Community Outreach • Material Management • Links with standard Financial Accounting software • Intranet (for information access) Note: Material Management module is under trial run at Aravind Eye Hospital, Madurai. It would be made available to others shortly after certified.

** Add-on modules (user hospital will have choice to include in the integrated system)

IHMS software is built with certain flexibilities in each module, which can be customized to suit the needs of the individual hospital.

Overall System Features:

- **Modular design**: Other than the basic modules, user will have choice to include optional modules. Depends upon the manpower and finance availability, one could decide on the options.
- **Relational Database**: Microsoft SQL Server is used at the backend for data management. It has powerful features of data management to access the data efficiently.
- **It's Flexible** – User Specified rule: Wherever it is possible, user will have the choice to select the right combination of rules, which is suitable to their organization.
- **Client/Server technology**: Enhance the performance of the application.
- **Windows environment**

IHMS helps to maintain the valuable patient data for providing better information system. Also it insists on standardizing the workflow, patient flow and various activities, which enhance overall performance of the organization. Through Intranet services, management will have access of online information about key factors. Cataract surgical outcome monitoring system helps to assess the outcome of the service provided and also improve one's competency.

Modules Description

Patient Care Domain:

1. Appointments module:

This module supports making patient appointments and also block time for other activities of the doctor like Operation, Ward Visit, meeting medical representatives etc.

Outputs: List of patients for a given date, schedule for a given date

2. Out-Patient Registration:

This is the fundamental module of the Hospital Management System. Every Patient visiting the hospital for outpatient service or inpatient service is first registered using this module. The module captures the basic personal details of the patient and generates the Unique Sequential Medical Record Number, which can be used for coding the medical records for outpatient as well as inpatient services. Patients can be classified as Free, Direct or Camp and Direct patients in turn can be classified as Paying, Corporate or Subsidy.

3. Patient Billing:

This module is used to record the charges for the patient services provided by the various clinical departments, e.g. lab tests. The module can be set up either in centralized or decentralized format, e.g. to suit the setup of the cash department(s) in the Hospital

4. Inpatient Reservation:

This module is used to reserve the room for admission. It takes into account the capacity of the resources available. It supports reservation with or without advance amount collected from the patients. A reservation slip is issued to the patient and if he

Pays an amount as an advance, a receipt is also issued. When the patient actually gets admitted, the detail captured by this module is used in the admissions module.

5. Inpatient Admission:

This is the base module for inpatient services. A separate unique account is generated internally to control all procedures and activities relating to that admission. The module also captures and updates the room and surgery details, and also computes the cost of surgery, etc. It also allows for collection of an advance.

6. Operation Theatre Module:

This module records the surgery details, OT charges, including details of any complications, and updates the system with the details of the costs incurred. You can generate surgery schedule and surgery report from this module. It is supported with the inventory module to manage the inventory maintained at operation theatre.

7. Discharge Module:

This module takes care of preparing the final bill for inpatient services, and issues the gate pass to the patient enabling them to leave the hospital after payment is received.

8. Ward Management:

This module, depending on the functionality, is divided into five sub modules as follows:

8.1) Inventory management:

This sub module interfaces closely with the Housekeeping and Patient Care sub modules of Ward Management to ensure that the materials required at the ward are optimized and provided at the right time.

8.2) Dietary Services:

This sub module takes care of the daily dietary requirements of the patients and updates the inpatient billing accounts with the cost of providing them.

8.3) Room Status module:

This sub module retrieves the cost details for the specified room type and it's availability, and updates the current room status when the room is allocated.

8.4) Patient Care Services:

This is the main 'core' in the sub module of Ward Management. It deals with preparing the bed census report and the surgery schedule list. It also maintains details of the medicines required by the patients and updates the medicines received status, the surgery fitness details and records. It also keeps track of whether a patient needs any special pre or postoperative medication and whether any complications have been identified, and if so what action was taken. It also issues the discharge summary and certificates to the patient.

8.5) Housekeeping activities:

This sub module takes care of scheduling and monitoring housekeeping activities, e.g. the attendance of cleaners, and record details of any complaints made by the patients or by the supervisor of the ward. Details of any action taken regarding complaints are also recorded.

9. Medical Record:

This module helps to maintain the core information on clinical care. A complete standard International Classification Diagnosis (ICD) is used to build up the data for medical records. You can maintain diagnosis, treatment advised and surgery/treatment details in the record. It provides two levels of medical records: One is to have the basic data and other level helps to have the detailed records of surgery, diagnosis etc.

As part of the medical records, it allows to store image output from any equipment.

10. Medical Record Tracking:

This module keeps track of the location of medical records when it is out of its place. It keeps track, as the patient moves around the hospital during their stay and also keeps track when they are issued to doctors or students for research purposes.

11. Patient Flow Management:

This module keeps track of a patient's location during their stay in the hospital or on an outpatient visits. It also identifies the resource utilization and workload distribution at various points. It helps you to plan for reallocation of resources and other activities to meet the unforeseen instance.

12. Referral Patient Management:

This module helps to handle the patients referred by various source. It helps to communicate to the referring body about the treatment given or condition of the patient. It promotes a better relationship. A database of referring persons is also built up.

Administrative Domain:

1. **Material Management**

   This module covers entire material management functions. Purchase process starts from, getting quotation and continues comparing and choosing the right supplier. Issues are controlled by on-line information like last issue details, available stock-in-hand etc.

   All inventory control features are included. Standard and other useful reports and information could be generated for efficient management of materials department.

2. **Management Reporting**

   In addition to the routine reports, some specific reports related to supporting agencies, and government reports are also incorporated.

3. **Community Outreach:**

   It helps to document the data related to eye camps and other community activities. Information could be generated for planning and running eye camps effectively.

4. **Financial Accounting:**

   A lot of software is available in the market for financial accounting and hence the choice is left to the hospitals on what hey want to choose. IHMS can provide an interface to upload and download data to such software.

Using the Software

Who can use this software?

Eye Hospitals, Eye department or other specialty department in a general hospital can use this software. Though this software was designed primarily with the inputs from eye hospitals, it could be adoptable in other specialty hospitals also, with some little changes in the medical terms, database etc.

Can this software be used for any size of hospital?

IHMS software has been developed to provide comprehensive software solution for the hospitals. But there are hospitals that cannot afford to run such comprehensive system or may not be required due to the volume of work handled. Still to encourage such hospitals to use computers for generating useful information to run the organization efficiently, we provide the following options from which one can choose according to their requirement.

I. All or specific modules under LAN
II. Using a single (or two) computer for all the applications.
III. Using the Basic modules to generate statistics and information in a single computer.

What are required to implement this software?

Unlike other standard PC software, it requires more resources in terms of hardware, software, training, implementation and post-implementation support requirement so as to implement this system in a hospital.

Hardware:

There are certain essential Hardware requirements and certain need-based requirements. Depending upon the size and volume of work, a hospital can decide whether to provide one or more computers for each area or one computer to manage more than one application area.

E.g.: There are 3 computers for New patients registration alone and 1 computer for old patient registration at Aravind Eye Hospital, Madurai but at Aravind Eye hospital, Theni, there is only one computer for both new as well

as old patients registration Following table shows ideal hardware requirement for a hospital with workload of 100 to 125 outpatients and 5000 surgeries a year.

Software:

Apart from IHMS software, you should have certain basic software to run the IHMS and also to perform other office automation works.

Infrastructure requirement varies according to the option preferred by a hospital. Following sections provide the detailed list of requirement for these three options.

Requirement for Option I: All or specific modules under LAN

Scenario: Any hospital with reasonable workload (5000 or more surgeries per year and on an average 25 to 30 admission and discharges per day) can choose this option. You should have minimum two people doing the registration, inpatient admission and discharge activities. You can either manage with the same staff for other areas or have additional staff depending upon the workload of the hospital.

HardWare:

Item	Nos.	Rate	Value	Remarks
File Server (with tape backup)	1	Rs.75,000	Rs.75,000	Central computer that serves other computers in the network
Computer	5*	Rs.30,000	Rs.150,000	1.Registration, Billing 2.Admission & Discharge 3.OT & Ward 4.Medical Records 5.Office work and reports
Printers	4*	Rs.8,000	Rs.32,000	To use at registration, billing, admission, discharge, OT and ward
Laser printer	1	Rs.18,000	Rs.18,000	Printing reports
Networking cables, accessories			Rs.40,000	
Total			Rs.315,000	

* Varies depending on the workload

Software:

Item	Nos.	Rate	Value	Remarks
Windows 'NT Server	1	Rs.20,000	Rs.20,000	Networking software
SQL Server	1	Rs.40,000	Rs.40,000	Relation database software
Office'97	1	Rs.15,000	Rs.15,000	Office automation software to use in documentation, worksheet preparation, presentation preparation, email and internet access software.
Norton/VX-2000	1	Rs.5,000	Rs.5,000	Virus protection software
Windows'95	1	Rs.10,000	Rs.10,000	Client level operating system software
Total			Rs.90,000	

Local Area Network (LAN): Any computer systems should be introduced as part of the workflow (online) to run the efficiently and to gain the potential benefits of computer system. In this case, you will have to setup more than one computer. Networking is fundamental requirement for on-line system, which is to connect all the computers in the hospital with the server, which maintains data generated and updated by various computers in the network.

Advantages:

Networking has a lot of advantages and we list the following as key benefits.

Avoid duplication of entry: Since data entered from various departments are stored in a single computer (file server), others in the networking can share the data that is already entered instead of entering again.

Multi-User: More than one user can access the data or program simultaneously without affecting each other work.
Expansion: Expanding computer application in new areas with minimum efforts.

Disadvantage:

Local technical support: Maintaining LAN requires a person with technical know-how to some extend which might be an obstacle to set up LAN in some areas. This has been planned to resolve by providing adequate training or identifying a person who can support more than one particular hospital from a central place

Expensive for low turnover organizations: It requires investment on hardware as well as networking software. It may not be feasible or applicable who handle very low patients volume.

Option II. Using a single computer for all the applications.

Scenario:

This may be practical where the workload is even and low. You will have to perform certain works off-line or batch mode. In this situation, the user should ensure that all the transactions have been updated into the system at regular intervals.

In this option, the hospital may not be able to realize the potential benefits of having computer system in the hospital but in terms of the reports and statistics, you will be able to generate all the reports available in the system.

Requirements:

Item	Nos.	Rate	Value	Remarks
Computer	1	Rs.60,000	Rs.60,000	Computer with 512 MB RAM 20 GB Hard Drive, 144 FDD CD Writer (for backup)
Printers	2	Rs.8,000	Rs.16,000	Two printers can be connected to one computer using switch
Laser printer (optional)	1	Rs.18,000	Rs.18,000	Printing reports (if required)
Windows 2000	1	Rs.10,000	Rs.10,000	Operating System software (not necessary if already included in the hardware)
SQL Server (Developer Edition)	1	Rs.22,000	Rs.22,000	Relational database software (essential to run this package)
Norton/VX-2000	1	Rs.5,000	Rs.5,000	Virus protection software
Total			**Rs.131,000**	
			US$ 2,675	

Note: It is advisable to use a separate computer for Internet and email applications to avoid virus problems, which often come through emails.

Option III. **Using the Basic modules to generate statistics and information**.

Scenario:

You can choose this option when you do not want to introduce the computers for hospital management functions but still want to use for generating all the reports and statistics.

In this option, you will be using following specific modules related to generating statistics.

Module	**Purpose**
Registration	- to enter patient demographic details
Medical Records	- to enter medical records of diagnosis, advised, Treatment, Surgery and Procedure details.
Cataract Surgery record	– to enter pre-operative, intra-operative, Post-operative and follow-up details of cataract Operated patients.

In terms of the reports, you will be able to generate the following reports.

1. Age-sex, region distribution of outpatients and inpatients
2. Diagnosis, Advised, Surgery, Treatment and procedure details
3. Cataract surgery audit related reports

Hardware & Software Requirement: (Option 3)

Item	Nos.	Rate	Value	Remarks
Computer	1	Rs.60,000	Rs.60,000	Pentium-IV computer with 512 MB RAM 20 GB Hard Drive, 144 FDD CD Writer (for backup)
Printers	1	Rs.8,000	Rs.8,000	
Laser printer (optional)	1	Rs.18,000	Rs.18,000	Printing reports (if required)
Windows 2000	1	Rs.10,000	Rs.10,000	Operating System software (not necessary if already included in the hardware)
SQL Server (Developer Edition)	1	Rs.22,000	Rs.22,000	Relational database software (essential to run this package)
Norton/VX-2000	1	Rs.5,000	Rs.5,000	Virus protection software
Total			**Rs.123,000**	
			US$ 2,510	

Implementation Plan

IHMS has been first installed at Aravind Eye Hospital, Madurai for not just to evaluate the system but also to setup the base for giving live-demonstration as well as hands-on training as required.
Once a hospital decides to go for this solution, we would like to take them through the following process:

I. Demonstration of the software:

The hospital should form a team who can decide the adoptability of the IHMS for their situation. They should visit Aravind for two days and during the demonstration, the team can learn entire features of the software and its application. They should then make the decision about the desirability of the software in their setting. Hence the team making the visit should be fairly senior staff. A Demonstration kit would be sent if required by the user.

II. Workout details for adapting the software and customization.

Once the decision to go ahead has been made, the next step is to understand how their existing work processes need to be aligned or modified/added to be in line with the software (the software has limitations on the extent of customization).

Core staff of the Hospital management and staff should sit together to arrive the requirements and compare availability of the feature in the IHMS. If any changes or customization is required, it should be documented. (A format will be suggested to document such changes)

III. Plan for hardware procurement:

This will be a first step once a hospital decides to adopt this software.
Depending upon the size and volume of work, a hospital can decide on the number of computers and printers.
Routing of cables and placing network accessories should be planned. If it is possible to bring a blue print of the hospital building or rough layout with distance and location, we can have discussion to decide the networking accessories requirements.

One can place the order for materials before sending the team for training at LAICO.

IV. Training:

The hospital should send two or three of their staff along with computer literate person (who can help in installation and maintenance of the software). The team members should have full knowledge about existing system of the hospital.

Since it may not be appropriate to recruit a computer literate person for higher salary, the management can identify and train one of their existing staff in the computer or they can hire local computer professionals to support you.

Training will be for the duration of 2 weeks and following will be covered.

- Using computers
- Operating IHMS (Hands-on training)
- Generating reports
- Trouble shooting and maintaining IHMS
- Backup plan

After having initial classroom teaching and discussions, trainees will be posted at various locations to run the system and can become familiar with operating the system. Evaluation will be done regularly during this process.

There are certain tables in the database that should contain master details specific to a hospital like region, population, employees, treatment, charges, external corporate companies, list of beds etc. All these details should be entered into the system before starting training the users. (Refer Annexure-A for the details of requirement – under preparation).

Visiting team should bring all these data, formats of all kinds of registers and various forms that are in use presently in the hospital. The team can also investigate the feasibility of using the formats that are proposed in the software. (Most of the LAICO trained hospitals are likely to be using similar formats as used by Aravind)

LAICO prefers to conduct the training program at the Aravind Eye Hospitals initially. At the later stage, we can try to find some nearest user of IHMS and decide how to share the training activities based on their capacity. LAICO wants to engage a few other hospitals for conducting the training and other support, which could be studied for the feasibility.

V. Installation and Customization:

Based on the details worked out during process III, the hospital can place the order for the hardware and software, which normally takes one month from the date of order to installation.

a. Hardware installations.

Hardware supplying company will be helping you in setting up the computer, laying network cables and accessories.

b. **Software installations:**

Hardware supplying company will install, Operating System (Windows'95) and PC software (Office-97) and other tools as part of the installation process.

The server machine should be loaded with Windows NT and SQL Server. Usually, the software supplier or hardware supplier handles it.

c. IHMS installation

It has two major tasks.

1. To create the database in the SQL server
2. To install the software in all the client (users) machines.

These two processes of installation are simple but the customization might take more time and this could be controlled if the hospital can come with all the details and the data required initially for the master table and for customization.

Note: It is recommended to bring the file server or hard disk of file server to load the data and customize the software when the team comes to LAICO for training. We will also experiment by loading the customized software and data tables from the CD.

Note: Implementation guidelines has the full details

VI. User (Operator) Training:

Once the visiting team returns to their hospital, they have to train the actual users of the system or demonstrate the features and redefined workflow/patient flow, data capturing, reports generation etc.

User Manual for this software will be provided for reference.

VII. Implementation & Evaluation

Implementation:

Depends upon the situation, a hospital can implement all the modules in a single stage or in a phased manner. It should be discussed during the training period at LAICO.

When a hospital is ready with the hardware and has had the training, they can implement IHMS. If required a team of 2 members from (LAICO/Others) would visit the hospital to render onsite support for implementation. Depending upon the requirements, the team will decide on the duration to stay at the hospital.

Implementation can happen in many ways. Followings are some common approaches.

a. Live Running Trial

This involves running a system in a real life environment with the aim of determining what changes may be needed.

Advantages:

- early identification of problems (e.g. to software or operational procedures) before the system is implemented

- other benefits such as to encounter any possible bottlenecks in the process, run times, and metrics
- allows to set the pace/scope/timescales, assuming user resource available.

Disadvantages

- takes time, including user resource
- may require additional hardware/software, which increases costs and logistics.

b. Phased Implementation (Modular)

This entails implementing the system in stages, e.g. by department, user, or functionality. In these cases, the system has been implemented for real and it entails a commitment to continue the implementation.

Advantages

- less risk than a “big bang” approach
- may help to get better support by spreading the load over a longer period.

Disadvantages

- implementation costs may be greater because of extended implementation window
- may require additional software changes/support especially if new and old systems are running in parallel for a period.

c. Parallel Run

This involves running the old and new systems simultaneously. The intention is that, this forms part of a real life implementation.

Advantages

- less risky than a “big bang” approach

- useful where it may take some time to create the core data needed for running the new system, e.g. adding new data items to existing records
- may help to get better support resource by spreading the load over a longer period.

Disadvantages

- implementation costs may be greater than a "big bang" approach because of extended implementation window
- takes time, including user resource
- may require additional hardware/software, which increases costs and logistics.

d. Big Bang (Direct)

This involves implementing the new system in all areas at the same time.

Advantages

- may reduce overall support and user costs, by concentrating all effort on a single implementation
- provides a clean change over from old system (computerized or manual) to the new

Disadvantages

- high risk, particularly if a software is not fully tested by the user and if implementation planning is not thorough
- limits the contingency options if things go wrong and can cause a lose in the business money if unacceptable delays occur.

If a hospital is going to introduce computers for the first time for such application, then we can choose Big Bang or Phased conversion depending upon the workload of the hospital.

If a hospital is running already with computers, then we can choose parallel run approach for implementation. We should bring the new system front for using on-line and the old system can continue at the backend till satisfied. As mentioned earlier, it should not be continued for a long time to avoid frustration from user side.

Monitoring the Implementation process:

Monitoring will be done at each of the stages - pre-implementation, training and post-implementation etc. A checklist of various tasks and outputs related had been prepared to use in this process.

Evaluation & Support: We will decide the system to render the post implementation services and also get feedback.

Cost of Software:

The software is available in two forms. As mentioned earlier, you can choose as per the requirement.

Options	Cost of software	
	In Indian Rupees	In US$
Full Package (covers all the patient Care modules)	Rs. 50,000	$ 1,000
Basic module (essentially the medical records for taking out reports periodically)	Rs. 25,000	$ 500

The above cost covers

- Training on using and maintaining the software
- Customization of software
- Assistance in creating master data and
- Advice on hardware procurement

The travel and other costs of sending your staff to LAICO for training would be extra at actual.

A demo of the above software is given as a PowerPoint Presentation. Click on the following link:

IHMS - Demo