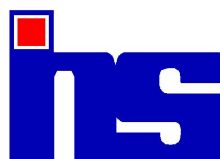


**IHSNET: Indian Health Systems Network.
Developing Health Informatics Infrastructure (HII)
in India.**

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I. Health informatics - an overview

A. What is health informatics?

1. Application of information technology to the health and allied sector is called health informatics.
2. Application of information technology to practice of medicine is called medical informatics.
3. Since practice of medicine and health care delivery are very closely inter linked, both terms are used interchangeably, in this paper. However, it will be useful to recognise the subtle difference in emphasis of the two terms. Medical informatics tend to focus on digital interfacing of medical instruments, digital assistance to doctors, clinic management software, computerised patient record, etc. Health informatics tend to emphasise management information systems in health care institutions, electronic health record, electronic data interchange etc. The electronic health record concept is similar to computerised patient record but extends to healthy people as well. Coverage of information technology solutions in the medical and health field under the rubrics of the two terms is converging.
4. The term medical and health informatics is also used synonymously with health or medical informatics.
5. Telemedicine has been defined as the use of telecommunications to provide medical information and services. (Perednia and Allen, 1995). It may be as simple as two health professionals discussing a case over the telephone, or as sophisticated as using satellite technology to broadcast a consultation between facilities in two countries using video conference equipment. Current usage of the term tends to mean the use of sophisticated telecommunication and digital technology.
6. Telehealth is some times used as an umbrella term for the full spectrum of applications using computers and telecommunications for health. Relationship of the two terms, namely telemedicine and telehealth is similar to the case of medical informatics and health informatics.

B. Health Informatic Applications:

Agreed typology of health informatic applications is not yet available. Based on survey of various medical and health informatic sites in the world wide web, the following typology is proposed. This is the first formal attempt to build a typology of IT applications in the health sector. Usage characteristics and functional relevance to various areas of health care delivery is the primary basis of this proposed typology. Technological characteristic of solutions may be used modifiers to primary usage groups, where such technological inputs significantly contribute to common identification of the solution area among health informatics community. Major areas of health informatic applications are listed below.

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1. Health institution management and information systems (HIMIS). These include;
 - i. Clinic management soft wares,
 - ii. Computerised patient record / electronic health records, and
 - iii. Hospital management and information systems (HIS).
2. Medical device communications.
3. Digital assistance to doctors (DADs) i.e. specialised software for hand held computers and personal digital assistants to provide bedside knowledge bases for use by doctors.
4. Telemedicine:
 - i. Digital imaging and communication,
 - ii. Telepathology, and
 - iii. Video conference aided collaborative patient care.
5. Expert systems. These include clinical decision support systems supporting the movement towards evidence based medicine.
6. Medical and health knowledge bases and bibliographic resources.
7. Computer aided medical and health education.
8. Electronic public registries (EPR) and databases of the health sector.
9. Electronic data interchange for health (EDIH).
10. Health Intranets and Extranets.
11. Epidemiological, and bio statistical applications.
12. General purpose office computing for health.

C. What is Health Informatics Infrastructure (HII)?

1. Health informatics infrastructure, refers to (a) a set of infrastructure services, and (b) the institutional system to support the set of infrastructure services.
 - i. The set of infrastructure services will include standards, skills and applications that support communications and information in the health sector. The standards, technological choices and applications would encompass domain knowledge on health and information technology.
 - ii. The supporting institutional system will include formal, and informal organisational mechanisms for development, implementation and quality assurance of health informatic standards, technology and applications respectively.
2. The role played by health informatic standards for development of information technology applications for health can be inferred from an overview of such standards in vogue elsewhere in the world, their source and primary sponsors. Available health informatic standards may be classified on the basis of the extent of domain knowledge input versus information technology inputs. Some of the well known health informatic standards in both groups are listed below:
 - i. Health informatic standards driven by the information technology, health management, and engineering community:
 - a. Health Level Seven (HL7) is a set of application layer (OSI Layer-7) standards to facilitate electronic interchange of health system data.
 - b. Electronic data interchange (EDI) standards like the ASC X12N Insurance subcommittee standards of the ANSI, and Electronic data interchange for administration commerce and transportation (EDIFACT) of the UN.
 - c. The American Society of Testing and Materials (ASTM) Standards on medical and health informatics like;
 - 1) ASTM1238-88 standards for laboratory data reporting,
 - 2) E1238-97 specification for transferring clinical observations between independent computer systems,

- 3) E1394-97 specification for transferring information between clinical instruments and computer systems,
 - 4) etceteras.
 - d. The medical device data language (MDDL) and IEEE1073 standard on medical information bus (MIB) is meant for communication between various medical devices, and intercommunication with other computing systems.
 - e. Digital Imaging and Communications (DICOM) standards for imaging and other aspects of radiology information systems.
 - ii. Health informatic standards driven by the medical and health community:
 - a. International Classification of Diseases (ICD) prescribed by the World Health Organization (WHO). ICD-10 is currently in use. In India an abbreviated ICD list (National List) is used for reporting of cause of death in urban areas.
 - b. Current Procedural Terms (CPT-x) where x represents the version number. Version 4 is currently in use.
 - c. Unified Medical Language System (UMLS) Metathesaurus of the US National Library of Medicine.
 - d. Systematized nomenclature of pathology (SNOMED) maintained by the College of American Pathologists. Version 3.4 is currently in use.
3. Health informatic skills: Health informatic solutions come out of joint efforts of interdisciplinary teams. These would require human resources with information technology skills and domain knowledge of the health sector. Health Information Infrastructure would mean existence institutions and programs that generate such manpower resources on a continuing basis, provide environment for fostering of interdisciplinary teams, research and development on health informatic solutions. Thus the human capacity component of health informatic infrastructure will include;
- i. Training programs to meet the special needs of information technology applications in the health sector, and to build interdisciplinary communication skills.
 - ii. Research and evaluation programs on efficacy of health informatic solutions, their relevance and scope for improvement etc.
 - iii. Experimental technology demonstrator programs to test potential applications of information technology for health. For example, it is learnt, that India's Centre for Development of Advanced Computing, is about to start an experimental project on telemedicine.
 - iv. Knowledge repository and research on medical and health terminology, classification systems and typologies, which are of immediate relevance to development of information technology solutions for health sector. For example the Institute of Health Systems Cause of Death Reporting in AP project allows the Institute to have a group of faculties well versed with the International Classification of Diseases (ICD) prescribed by WHO from time to time.
4. Availability of health informatic applications addressing specific tasks, events and situations is the final step in use of information technology for health.
- i. World over computer software flow from three distinct sources;
 - a. Public domain software,
 - b. Shareware, and
 - c. Commercial software vendors.
 - ii. Each of the above three sources have their distinctive financing and sustenance mechanisms. They complement each other. A healthy balance of activity in each

of the three areas is required to ensure accessibility and widespread use of health informatic applications.

- iii. Public domain soft wares: These are usually created by educational and research institutions or groups of volunteers and can be used by any one for free. Availability of public domain software increases accessibility of information technology solutions to people who can not afford commercial software. One shortcoming of public domain software is lack of technical support. This situation can be easily remedied by educational institutions, non profit organisations and government agencies assuming responsibility to host knowledge and skill repositories for public domain soft wares of interest to them. These institutions and groups will constitute an important component of the HII. Three well known public domain soft wares in the health informatic field are cited below for illustrative purposes.
 - a. EPIINFO: Epidemiological surveillance and research tool developed by the WHO and US Centers of Disease Control (CDC). The software allows for word processing, questionnaire construction, survey data entry, statistical analysis etc. Latest version is EPIINFO6.3.
 - b. CONQUEST: COmputerized Needs-Oriented Quality Measurement Evaluation SysTem is a prototype system for collecting and evaluating clinical performance measures. It includes two interlocking databases—a Measure Database and a Condition Database—with a user-friendly interface to help you find measures to fit your needs. It summarizes information on approximately 1,200 clinical performance measures developed by public- and private-sector organizations, and summarizes recommendations from the United States Agency for Health Care Policy and Research-supported clinical practice guidelines and findings from AHCPR's Patient Outcomes Research Team (PORT) projects.
 - c. PEDSBASE: A popular Web database of pediatric diseases.
 - iv. Shareware: Share wares are copyright software made freely available to interested and potential users for trial purposes. Thus potential users get to try the software before purchase. Satisfied users are expected to make a contribution. Shareware activity is an indicator of start up software entrepreneurs, educational institutions and volunteer groups in the field of health informatic soft wares.
 - v. Vendor base for health informatic solutions: Commercial vendors of health informatic solutions make important contributions to sustainable information technology applications for health. Sustainability is achieved by financial viability of solutions implied in the commercial evaluations of such investments and by continuing product support. Major categories of health informatic vendors will include;
 - a. System integration,
 - b. Hospital information systems,
 - c. Laboratory software,
 - d. etc.
5. Institutional system to support the set of infrastructure services: Major health informatic standard bodies in the world are listed below.
- i. American National Standards Institute (ANSI):
 - a. ANSI HISB: Health Information Standards Board of the American National Standards Institution.

- ii. Data Interchange Standards Association (DISA): ANSI Accredited Standards Committee X12N (ASC X12N) Insurance subcommittee - group for external EDI standards
- iii. ASTM Committee E.31 on Health Care Informatics and ASTM1238-88 standards for laboratory data reporting,
- iv. Institution of Electrical and Electronic Engineers (IEEE):
 - a. Medical Information Bus (MIB): IEEE 1073 standard for medical device communications.
 - b. MEDIX: Standard for medical data interchange proposed by IEEE (IEEE P1157) group for medical data interchange.
- v. ISO TC215: Technical Committee 215 on Health Informatics. This committee is of recent origin and its deliberations are going on. Formal standards from this committee are yet to flow.
- vi. American College of Radiology (ACR) / National Electrical Manufacturer's Association (NEMA) Digital Imaging and Communications (DICOM) standards for imaging and other aspects of radiology information systems.

D. The need for health informatics infrastructure in India:

1. Information is a basic requirement for efficient management of resources, handling of consumer grievances, planning and policy formulation in any social system. The ever increasing demand from health care service institutions, rising aspiration of people, rising cost of medical and health care technology coupled with resource constraints, make it all the more important for timely generation, analysis and use of health care and related information. Unfortunately system of generation, reporting and flow of health care and related information in India continues to be poorly developed and poorly operated. Some commonly encountered problems are:
 - i. Unacceptable time lag in flow of information to managerial and policy analysis levels. Current practice of mailing health information reports through the organisation hierarchy leads to enormous delays.
 - ii. The time lag contributes to lack of interest in the information and its quality both at the managerial, policy analytic level and the data collection points.
 - iii. Poor accuracy of information due to misunderstanding of terms, lack of clarity in data definitions.
 - iv. No facility for interchange of medical care, laboratory investigation and such other information, which can improve the quality of clinical information availability for patient management.
 - v. Interfacing of medical devices with Health Institution's Intranet holds the potential for efficacy and improved quality of service in health care institutions.
2. Renewed interest in usefulness of reliable and valid health management information, and emerging interest in development of information infrastructure of the country has opened up new possibilities and created opportunities for use of health informatics for expansion of health and medical care service opportunities and efficacy of the health care delivery system.
3. Although development of general information infrastructure is a prerequisite for application of information technology to any area, it is not sufficient for development of health informatic solutions. The health sector can leverage the National Information Infrastructure (NII) only if commensurate development of health informatics infrastructure (HII) takes place.

II. The IHSNET

1. The Indian Health System Network (IHSNET) is a non profit closed user group wide area network and associated health information infrastructure resource in India, developed by the Institute of Health System (IHS), Hyderabad. At present IHSNET is supported by the Institute of Health System. Eventually, IHSNET is expected to develop an organisational form separate from IHS.
2. The network will to assist hospital and health care system managers in reducing operating expenses while improving the quality of patient care.
3. IHSNET is a non profit health care wide area network available on membership and cost sharing basis to health care and related institutions.

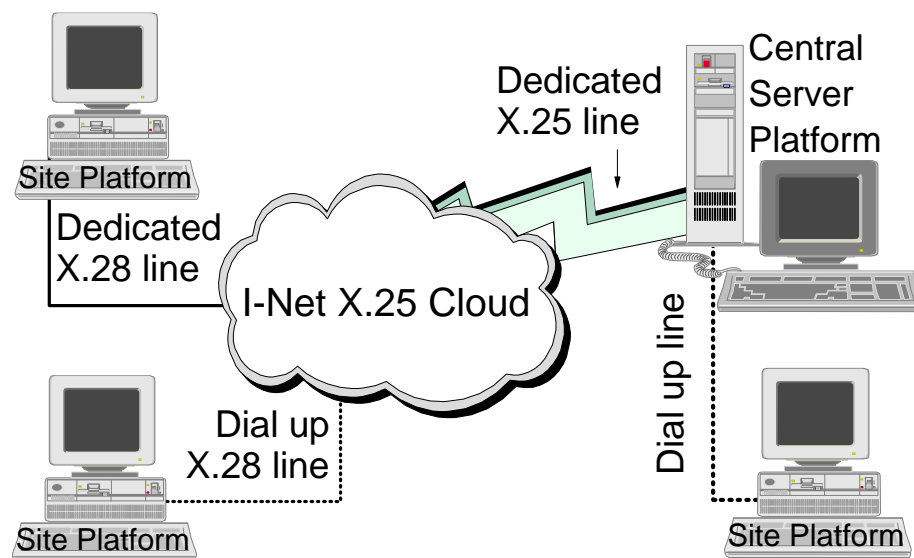
A. IHSNET Components

1. The Network.
2. Health Informatic Standards.
3. Public domain applications for health (PAH).
4. Public health databases (PHDs).
5. Applications, objects and components for health (AOCH).

III. The IHSNET Network:

1. The network consists of a central server platform available round the clock through the I-Net which is public X.25 packet switching network of India. Presence on the I-Net cloud through a leased line circuit means that the server can be accessed from many places in the world having a local access to the world wide X.25 network. The server can also be accessed by direct dial up lines. The central platform runs IHSNET server software that handles IHSNET messages, and data using a store and forward, logic.

IHSNET: Indian Health Systems Network



2. IHSNET allows for custom development of software server applications to run on the IHSNET servers to meet specific needs of a health care organisation. For example a server application can be designed to receive management information from hospitals and health care institutions belonging to the same organisation. This allows for privacy and satisfaction of special needs of each organisation.
3. Standard formats are used for information interchange. IHSNET seeks to conform to the HL7 health information interchange standard.

IV. Health Informatic Standards:

1. A repository of major health informatic standards in the world is maintained at the project site.
2. IHSNET is developing data definition standards for use by developers of software and applications to meet needs of medical and health sectors. The standards will facilitate easy interchange of patient and other health care information.
3. Data definitions are developed by conducting focus group discussions among potential users, health care personnel and information system personnel to keep the nomenclature easily understood and consistent.
4. It is proposed to constitute a Health Informatic Standards Committee (HISC) with membership from users, solution providers and academic community. The proposed committee will constitute working groups to debate suitability of existing standards in the world and recommend adoption of the ones considered suitable for the Indian context. These working groups will develop extensions to standards chosen for adoption or where necessary, develop new standards to meet the requirement of health care institutions in India.

V. Public domain applications for health (PAH):

1. A repository of public domain soft wares is maintained at the central server, by periodical downloading from the world wide web or by directly obtaining the application through alternate means.
2. Training and familiarisation programs on most popular public domain software will be conducted. For this purpose IHSNET project will dedicate faculty resources to build and maintain skills in the respective soft wares.

VI. Public health databases (PHDs)

1. IHSNET will allow ware housing of health and medical care information, historical records, medical records etc. from participating health care institutions for easy and faster retrieval.
2. Certain standard public databases and electronic registries will be made available. Two such databases now available through IHSNET are;
 - i. The Andhra Pradesh Health Institutions Database (APHIDB), and
 - ii. The MEDFLOR-India database of medicinal plants.

VII. Applications, objects and components for health (AOCH)

1. The IHSNET promotes and requires adherence to standards based, health informatic applications development.
2. Following activities are undertaken to further this objective.

- i. Provide a repository of reusable objects, application components, and applets to be shared with health informatic application developers. Examples of such application objects are;
 - a. IHSNET message readers,
 - b. Diagnostic and therapeutic procedure dictionary objects,
 - c. Inpatient / Outpatient number space objects,
 - d. etc.
- ii. Fully functional applications compatible with IHSNET specifications are developed. For example HiMan: Health information Manager being developed by the Health Information Technology (HIT) group at the Institute of Health Systems. HiMan is designed to be the health institution's software platform to manage its information needs and to interchange information with the IHSNET. This is the institution end local software platform providing services to manage information within the health care institution and exchange information with the IHSNET.
- iii. Maintain a database of available health informatic applications in India. This database will be a central register of all commercial health informatic soft wares in India. Its contents will be made available to health care organisations, doctors, health administrators and interested public. Software vendors can register their products and services here. Users can register their experiences about specific products.

VIII.How to access IHSNET?

A. Access routes and address:

1. IHSNET can be accessed through a variety of means both online and off line. These include;
 - i. Through the I-Net,
 - ii. Direct dial up,
 - iii. Through Internet,
 - iv. Local access, and
 - v. Floppy disk by mail or courier.
2. User accounts and guest log ins:
 - i. Sites should have a pre assigned userid from the IHSNET Project office. Any institution or individual can seek an user account by becoming an associate member of IHS, at the least, and agreeing to pay monthly contribution for maintenance of the network.
 - ii. Guest log ins do not require any pre assigned user account. Guests can not exchange messages through the network. Guests can, however, browse the IHSNET home page and down load material, if any, posted for use by general public.
3. IHSNET addresses:
 - i. X.25 address: 404340017332
 - ii. Dial up telephone number: 91-40-3299138.
 - iii. Mail or courier: IHSNET Project, Institute of Health Systems, HACA Bhavan, Hyderabad, AP 500004, Tel: 91-40-210136.

B. Access through the I-Net:

1. I-Net leased line: The most reliable means to access IHSNET is to have a I-Net X.28 leased line connection from the DoT. Site platforms on a leased line can be programmed to log in to the IHSNET central server platforms at regular intervals, say once every half hour. Since IHSNET is based on a store and forward system, all waiting messages are exchanged between the central server and site platform.
2. Dial up I-Net from cities with I-Net Pad: Most large cities in India have an I-Net packet assembler disassembler (PAD). The Department of Telephones provides information about the cities where I-Net pads are available at any point of time. I-Net cloud can be accessed from these cities through a dial up I-Net connection.
3. Dial up I-Net from other cities in India: The DoT provides a special I-Net access STD code to reach the nearest I-Net PAD. Charges for these calls are fixed at a level close to the local call charges, even though the user is actually making a long distance call to the nearest I-Net PAD. The subscriber must have an STD enabled line.

C. Direct dial up:

Users located in IHSNET nodes can directly dial into the IHSNET by placing a local call. At present IHSNET has only one node at Hyderabad.

D. Through Internet:

1. IHSNET can be accessed by sending a structured e-mail message to the network at the address ihernet@hd2.dot.net.in. The messages will be batch processed by the central server and return messages to the site platform will be sent to the sites e-mail address.
2. Format of structured messages through Internet mail are provided to network members.

E. Local access:

The network can be accessed locally at the Institute of Health Systems, Hyderabad, where the central server is located. This mode may be useful for members who want to download public domain software, etc.

F. Floppy disk by mail or courier:

In India the communication network is yet to achieve full reliability. Although incidence of network failure are reducing day by day, this problem is going to be there for a few more years. More over health care organisations may have some of their institutions located at remote places, without dial up access to I-Net. To provide for temporary breakdowns, and to allow processing of health information from all institutions of an organisations, the IHSNET allows batch processing of messages received through floppy disks. Participating site platforms will have options to download IHSNET messages to a floppy disk. The disk is then mailed to IHSNET Project office, where it is processed by the central server platform. Return messages, including acknowledgement messages etc. for the site are downloaded to the floppy disk, which is to be mailed back to the originating site. At the site the floppy disk is read by the IHSNET site server, to take in acknowledgement messages, and new messages.

IX. Summary:

Indian Health Systems Network (IHSNET) is a non-profit closed user group wide area network to provide information infrastructure services to health care organisations in India. IHSNET consists of a set of health informatic infrastructure (HII) services, and provides a forum to support the HII services, through participatory consensus building mechanisms. The

services component consist of the wide area network, health informatic standards, repository of public domain software applications for health (PAH), public health databases (PHDs), and a repository of applications, reusable objects, components, and applets for health (AOCH). The network can be accessed by direct dialup connections or through the I-Net, which is available all over India. I-Net is the X.25 protocol based packet switching network maintained by the Department of Telecommunications. The institutional component of IHSNET will include the health informatic standards committee, and its working groups. These forums will consider available health informatic standards for adoption by IHSNET, develop and approve extensions to them to meet requirement of the Indian situation and will develop new standards, data dictionaries etc. where ever needed.

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