

## Medical informatics In Clinical Practice: An Overview

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### ABSTRACT

Health and patient care is data intensive and involves a wide spectrum of information and often may involve input from other clinical departments and ancillary or clinical support departments. For efficient care patient data should be integrated and accessible throughout clinics and hospitals. Clinical departmental computer systems can enhance the collection, distribution and interpretation of patient data. Providing a high-quality service to patients involves having the right information at the right place and at the right time. Computer technology and networking have revolutionized access and transmission of medical knowledge. Medical informatics involves the use of computer system-analytic tools to support patient or public health care and this forms the basis of hospital information systems.

Although the subject of medical informatics has been popularized over two decades in many countries including South Africa, it remains a largely unexplored subject in the Nigerian medical community. Knowledge and practice about application of computer technology in both private and public Nigerian educational and health institutions are largely rudimentary or non-existent. Yet, health information systems hold tremendous benefits for improving the quality of care including effective utilization of scarce human resources.

This review article is aimed at providing an overview on medical informatics and to stimulate interest in computer support in health care in our locality.

**Keywords:** Medical informatics, Computer technology, Clinical support.

### INTRODUCTION

Information and communication are crucial to medical education, diagnosis and treatment of illness, and in the running of health services. Sir William Osler said over a century ago "To study the phenomena of disease without books is to sail an uncharted sea"<sup>1</sup>. Advancement in telecommunication technology and the World Wide Web (WWW) has provided unlimited access to information and knowledge such that multimedia data can be transferred speedily across the globe<sup>2</sup>. Computer technology, especially local and wide area computer network communication, forms the basis for the explosive growth in information technology (IT) in the past two decade. This has been matched by a dramatic growth and access to medical knowledge and in the application of computers to support various aspects of health care including patient records, clinical decision-making and research. Also,

patients and other health consumers now have unlimited access to health information hitherto the exclusive province of their physicians. Decisions that were once the exclusive prerogative of the doctor are now shared between physician and patient and may be examined by a third party; someone accountable to an employer, insurer, health maintenance organization (HMO), well-informed relations or other entities responsible for all or most of the cost of patient care. Consequently, traditional paternalistic practice model in which the physician's decisions are largely unquestionable and the patient is a passive consumer of his expertise has been brought under intense challenge. With the information age medical practice is rapidly evolving into a more active partnership or shared care between patients/consumers and physicians. The physician provides extensive information on a health problem, the treatment options, their adverse effects, and counsels the patient. All parties are jointly involved in decision-making and the patient or any other consumer who may have access to information on his disease, may suggest preferences.

The health care sector is data and information intensive, but unfortunately, it has lagged far behind other sectors in applying communication technology in data processing especially in developing countries. Hospitals, clinics, service departments or individual physician offices that may be computerized are mostly used for administrative duties and only isolated and small segments of clinical operations are delegated to them.

Throughout the world but particularly in resource poor countries, health care professional generally lack knowledge about the possibilities & limitations of the information technology, reflection of the non-inclusion of relevant aspects of information technology in the medical curriculum<sup>3,4</sup>. They are often asked to use computer systems they have limited appreciation, and could enhance their practices via better use of information resources. This review article on medical informatics is aimed at informing members of the medical community in our locality about the rapidly developing field of application of computer technology in health care and challenging readers to undertake medical computing in order to improve on quality of patient and public healthcare.

### What is Medical Informatics?

Medical informatics is at the intersection of information technology and health care. It is defined as the science and art of applying information technology in medicine and health care to support patient care and public health. It involves the use of computer system-analytic tools to develop procedures (algorithms) for the acquisition (collection & storage), processing (analysis &

communication) and application (interpretation & decision-making) of medical knowledge and patient data. Similar to medicine, medical informatics is both science and art requiring theoretical knowledge and practical skills<sup>5-7</sup>. The term medical informatics originally derived from a French expression "informatique médicale" dates from the mid 1970s. Other terms used prior to this time included the following: Bioinformatics, Health informatics, Medical computer science, Computers in medicine, Clinical computing, Biomedical computing and Medical information science. These terms suggest the principle role of computers in realizing the goals of medical informatics.

#### Computer Applications in Patient Care

Practicing medicine increasingly requires adequate management and rapid access to information particularly in hospital settings. Additionally, the rapid growth in medical knowledge, particularly biomedical literature poses even greater challenge to health care providers to provide optimum care<sup>5</sup>. Computer applications in a hospital setting can reduce costs, errors and increase the speed with which patient care can be delivered, thereby improving the quality of care.

Computer may be applied at various levels of health care for the following functions: communication and telematics; storage and retrieval of patient data; processing and automation; diagnosis and decision-making; therapy and control; research and development. Telematics refers to the application of computers to transfer and communicate data from one location to another through local area networks (LAN) of personal computers or workstations in a hospital; through Wide Area Networks (WAN) using the Internet and/or the World Wide Web (WWW).

Examples of different types of messages that may be exchanged in health care via local or wide area computer networks:

- a) Clinical messages--
- b) Exchange of service requests to and reports from laboratories, radiology departments and ancillary services.
  - Exchange of information/patient data between clinical departments and clinical support departments.
  - Prescriptions from physician to pharmacies and clarifications from pharmacists on physician's prescriptions.
  - Hospital admission data and discharge summaries.
  - Multimedia electronic patient medical record.
  - Surgical waiting lists, cardiac catheterization appointments, transplantation data and organ matching.
  - Data from pharmaceutical industry e.g. information on drugs, drug surveillance, and drug trials.
  - Interpersonal mail between general practitioners e.g. general practitioners and specialists.
  - Information retrieval from external literature and medical knowledge bases.
  - Communication public authorities in connection with epidemiology, quality assessment schemes or utilization review.
- c) Medical images, biosignals and multimedia data
  - Multimedia patient record.
  - Conventional X-ray images from radiology

department.

- Digital images from CT scanners, MR imagers, ultrasound equipment.
- Images processed for radiotherapy and neurosurgery.
- Biosignals-ECGs, EEGs, EMGs e.t.c.
- Scanned documents.
- d) Logistics and financial messages
  - Communication between hospitals and suppliers; purchasing, invoicing and logistics.
  - Exchange of information between insurance agencies, Health medical organizations and other third-party payers; billing and reimbursement.

#### Patient Records: Paper versus Computer-Based Patient Records

Patient records deserve special mention in this review. Patient data are often massive and in multimedia forms, and prompt access are crucial to quality care. Some patients may have multiple consultations on any clinic day and access to case records is paramount for any meaningful continuity in care. Traditionally, patient data are available in written format only, mainly as free text, but sometimes also as numeric data, such as laboratory test results; they are used primarily to support patient care, that is for diagnosis, therapy, and prognosis. The important question is how well the current traditional paper-based patient record is suited for its purpose. Well-recognized ways of using the patient record include the following:

1. To support patient care
  - A source of for evaluation and decision-making and a source of shared information among care providers.
2. Legal report of medical actions
3. Support research
  - Clinical research
  - Epidemiological studies
  - Assessing quality of care
  - Post marketing surveillance of drugs
4. Educating clinicians
5. Health care management and services:
  - Providing support for billing and reimbursement
  - Basis for pre-authorization by payers
  - Providing support for organizational issues
  - Providing support for cost management.

Although patient records are commonly documented on paper, paper-based records have disadvantages that outweigh any advantages<sup>8,9</sup>.

Computers have the potential to improve legibility, accessibility and structure, but these pose heavy demands on data collection. The main constraints to CBPR include the huge logistic and financial implications. Any meaningful use of CBPR requires that inpatient and outpatient medical and nursing records become available in electronic format.

#### Paper-Based Patient Records (PBPR)

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• They can easily be carried around</li> <li>• Much freedom in reporting style</li> <li>• Easy to understand and use</li> <li>• Requires no special training</li> </ul>	<ul style="list-style-type: none"> <li>One user at a time, local to site.</li> <li>Data often fragmented</li> <li>Poor legibility</li> <li>Easily lost</li> </ul>

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• Never "down" as computers sometimes do</li> <li>• Quick to add data</li> </ul> | <ul style="list-style-type: none"> <li>Hard to find data</li> <li>Hard to compare patient data</li> <li>Bulky storage</li> <li>Cannot actively remind, warn or advice clinicians.</li> </ul> |
|---|--|

#### Computer-Based Patient Records (CBPRs)

- | Advantages   | Disadvantages  |
|--|--|
| <ul style="list-style-type: none"> <li>• Simultaneous access from many sites</li> <li>• Integrated system, clearly readable</li> <li>• Structured, searchable</li> <li>• Decision/Research support</li> <li>• Accessible at a distance</li> <li>• Very compact storage/Multimedia storage possible</li> <li>• Good backups and availability</li> <li>• Easy data aggregation</li> <li>• Electronic database and shared care support</li> </ul> | <ul style="list-style-type: none"> <li>Requires special training</li> <li>Can be difficult to enter data</li> <li>May crash</li> <li>Requires security codes (encryption)</li> </ul> |

#### Internet, World Wide Web (www) and E-mail in Clinical Practice

The Internet is a worldwide network of computers and represents one of the fastest growing areas in network technology. It is an information resource, a communications superhighway, a framework which allows the free exchange of information between computers. It originated in the 1960s from an American military project intended to provide reliable communication in the event of a nuclear war<sup>10</sup>.

The Internet has important potential for clinical medicine and the World Wide Web (WWW) and electronic-mail (e-mail), are its most popular applications. Services available on the internet include the following:

- Information browsing (professional or commercial)
- Access to on-line medical journals/literature search,
- Access to medical knowledge-bases (text files)
- Access to clinical data e.g. pictures, sound, video, programs and text files.
- Consultation of medical experts (teleconsultation)

The WWW is an on-line document application system that supports links between documents on the Internet and it has several client applications called browsers such as explorer, Netscape, which facilitate network connection to WWW services. WWW documents may consist of text, images, video or sound in still or real time. WWW is a resource for medical databases such as MEDLINE, a large database of all medical articles that appear in the international refereed medical journals clinical evidence, medical journal publications. Slide making programs now permit slides to be converted to web pages which can be useful for previewing lectures and other teaching materials. Clinical decision support programs are also accessible on web sites.

Electronic mail (e-mail) is the other popular network application on the Internet and with it the user can compose a message and send it to an addressee. Apart from text messages, multimedia data can be saved, stored and forwarded through the e-mail and this has become a popular

mode of telemedicine<sup>11,12</sup>.

#### Issues in Medical Informatics

Cost remains a major consideration in setting up institutional information system. Although the cost of computers continues to show a downward trend, cost of the various components of an information system apart from hardware, includes consumables, software, personnel, housing and overhead. Therefore, from an economic point of view, costs and benefits should keep each other in balance. In resource poor countries, the temptation to set up elaborate, sophisticated institutional information system must be balanced against sustainability and the need for drugs, medical equipment and relevant training for health care providers.

Security of patient databases has become a major issue in both local and wide area networking of clinical data. Patient confidentiality is of paramount importance and has legal implications. Presently most hospital information systems operate only within the private hospital network (intranet), possibly with telephone connections for doctors on call. There are several devices now available to secure patient data and limit unauthorized access and forgery and ensure professional accountability. These measures are aimed protecting patient privacy as well as professional accountability<sup>13,14</sup>. The use of passwords that are difficult to configure by illegal users is presently the most common means of authentication in most computer systems. However, conventional passwords have several disadvantages. For example, they can easily be shared among multiple users and the use of unprotected networks make them targets for eavesdropping, and to be secure they may be hard to remember. An additional method of certifying text or computer programs and electronic data is the use of smart cards and digital signatures<sup>15</sup>.

#### Education and Training in Medical Informatics

Health professionals who are well-trained in medical or health informatics are needed to improve the management of data and knowledge throughout the clinical enterprise. In some developed countries, training in medical informatics may be undertaken as part of educational programs or dedicated programs or continuing education as well as fellowship. In several countries, medical students are being trained in medical informatics as part of the medical curriculum. This is mostly as introduction to the potential uses of computers and information systems in medicine and how to use knowledge-based systems. Both lectures and practical exercises are undertaken<sup>16</sup>.

#### CONCLUSION

As more physicians become comfortable with the Internet; the e-mail, and the World Wide Web and other applications in medical computing, and as cheaper, user-friendly devices become available, electronic medicine will become more popular. Training of all health care professionals in medical informatics and the incorporation of medical informatics into the medical curriculum for medical undergraduates and residency training are recommended.

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