CHAPTER 2: ICT AND MEDICINE

2.1 The use of ICT in Health Care

Computers have been used in health care for many years in the developed world but it is only in the past decade that developing countries have begun to look at its use in earnest. In its report in 2001, the Institute of Medicine in the US declared that IT has enormous potential for transforming the health care delivery system (Committee on Quality of Health Care in America, 2001). Even before this, it was recognised that compared to other domains, health care has yet to fully exploit the advances of ICT (Brender et al., 2000).

Computers have been used in hospitals for some time now. While health care financial and administrative functions have been aided by computers, clinical practice has remained relatively unaffected, until rather recently (Stahlhut, 1994). In some branches of medicine, computer use has taken off more quickly than others. Yet, ICT and medicine cannot be separated and it is a matter of time before it becomes as ubiquitous as the pocket calculator. The information revolution is inevitable, and in some places is occurring at an unprecedented pace. Before long, doctors and nurses may well require computer skills commensurate with the level of health care they are expected to deliver.

There are many applications of ICT in health care. The first one, which comes to mind readily, would be the recording of the patient's details. The patient who comes to the hospital or clinic needs to have his/her demographic details recorded in some form or other and issued with a unique hospital number to identify him/her. Information can be stored and retrieved efficiently based on a search criterion. Patient

registration can be decentralised to several locations within the medical complex as the information is stored in a central location. Clinic appointments can be scheduled without overlapping and patient billing can be done automatically under a Hospital Information System (HIS) or Patient Registration System. This system is advantageous to the hospital management as it facilitates planning and management of resources. Recording of patient diagnosis makes for quick and easy analysis of time series data, and short and long-term projections can be also done much more efficiently. The system will also be advantageous to patients as they would have shorter waiting times and a better service.

Another information system that is used widely throughout the world is the Laboratory Information System (LIS). As the name implies, this records laboratory tests done on the patient. The simplest of this system would be a database in which the results of the lab tests are entered manually into the system after the tests are done on separate machines. The most sophisticated system would be a system whereby lab tests are electronically ordered with lab machines connected directly to database systems, thus ensuring that results are available immediately when the test is completed. The advantage of having such a system is the speed of access to lab results and the easy analysis of lab results, without having to manually input the results into a separate database for analysis.

A third information system employed in many developed and some developing countries is the Picture Archiving and Communication System (PACS). This system mainly deals with medical images generated by many imaging instruments employing such diverse technologies as X-rays, computerised tomography (CT) and magnetic

resonance imaging (MRI). There are obvious advantages in these types of systems as images can be stored electronically and transmitted at great speed anywhere in the world. Electronic storage of images means that lost films are a thing of the past, and at the same time reduces the need for large storage space.

The electronic medical record (also known as the electronic patient record) is a fourth system being used in a number of hospitals throughout the world. In essence, this means that all medical management of the patients is recorded electronically (either in real-time or after seeing the patient) and retrieved without the need for paper-based records.

There are many uses of the information systems, as alluded to above. They provide a repository of valuable data, which is very helpful to the hospital management. Projections can be made easily and work can be done more efficiently with certain tasks being automated. This makes for more efficient use of the workforce and frees up manpower for other jobs. For example, manual searching of records for patient registration can be done away with queries being done via the HIS. The LIS makes test results instantly available without the need for porters to fetch paper-based results, thus cutting down on waiting time. Lost results become a thing of the past with electronic storage. The PACS system will result in better storage and certainly easier and faster retrieval without the need for human intervention to search for films.

Patient safety will also be enhanced with the use of decision-support systems, which checks for conflicting patient treatment orders or adverse drug reactions. This is particularly useful because it is very difficult for health care providers to remember all

potentially harmful interactions or reactions and it is possible for a physician or nurse to miss an idiosyncratic reaction. ICT can help minimise this so that health care providers can give the best possible care to the patients. The issue of patient safety has been discussed in some papers (Ball and Douglas, 2001;Valusek, 2001) and the use of decision support systems reduces the possibility of litigation that is potentially damaging to the healthcare industry.

Of course there are some disadvantages of having electronic systems. Dependence on electronic systems means that the hospital must be prepared to have back-up systems in case of power failure. Threats to patient information now come from other sources and counter-measures to deal with these threats must be in place. Training of personnel to handle these systems must be carried out and this entails a lot of time and money. Despite all these problems, the advantages of having such systems in place far outweigh the disadvantages so much so that all over the world, healthcare systems are increasingly turning to ICT to help them in information management.

2.2 Development of ICT in Malaysian health care

In the early stages, ICT was used mainly for office productivity work and as such was limited to desktop applications. Increasingly, however, ICT is seen as something that is absolutely essential to patient care. The Multi-media Super Corridor (MSC) project specifically mentions Tele-health as a flagship application and this has helped to push forward the idea of using ICT in healthcare. Admittedly there is some way to go before Malaysia can realise its aim of maximising ICT in health care but efforts in this direction are gathering momentum quickly. There are various levels where this is taking place.

The first level is the use of ICT as office productivity tools and desktop applications. They are mainly used in administrators' offices and are basically only used for document preparation as well as preparing payrolls, and updating of information etc. Most of the work is still paper-based in this type of environment. Most district hospitals and some general hospitals are still at this level of development in ICT.

The second level is where ICT is used for patient registration, billing etc. but not much beyond that. Using ICT in this manner ensures that the registration number is unique and no duplication of registration occurs. Thus demographic details of patients are kept in electronic form but not much else is kept under this application. Some general hospitals are at this level of development.

The third level is where ICT is used for patient registration, billing, laboratory investigations and perhaps for imaging investigations. ICT may even be used for human resource management, financial dealings etc. The systems are also interfaced with one another, thus avoiding duplication of data entry and ensuring that errors are kept to a minimum. Laboratory investigation results can be retrieved online and are thus available the moment the investigation is finished. All the three university hospitals in Malaysia are at this stage of development.

The fourth and highest level is when all patient records, investigations and imaging records are kept in electronic form. Investigation results can be retrieved online. Images are stored digitally and are retrieved online too. Systems are interfaced with one another. Billing is done electronically and linked to financial systems. Human resource management is also done electronically. Doctors enter patient notes into a

computer (desktop/notebook depending on location) and nurses do their charting using electronic forms. Presently only 2 new hospitals in Malaysia are at this level of ICT application. More are set to follow and the 5 new hospitals in the country presently being built will embrace this concept, albeit using different systems from different vendors.

2.3 ICT in medical education

While the use of ICT has permeated many aspects of life, there is a still a dearth of research on ICT in medical education. Apparently, this area has not been given much emphasis, but it is likely to receive more attention in the near future. Medical informatics has been around for some time and there is every reason to believe that it will grow in importance. The scenario in Malaysia is not very encouraging. None of the medical schools have any unit dealing with medical informatics; far less incorporated it into the medical curriculum. This seems to be true both for the undergraduate and postgraduate level. While efforts have been made by the public health postgraduate departments to equip students in the Masters program with some ICT skills, these tend to be limited to their own personal use. The lack of ICT in the medical curriculum can be attributed to the fact that very few academics in the medical world are interested in advancing the course of medical informatics. The emphasis in the medical schools remains that of producing competent doctors, pharmacists and other related staff rather than looking into what some would consider the murky world of information technology. However, with the move by the health authorities towards computerisation, the use of ICT in medical training can be expected to gain momentum soon.

The Ministry of Health in Malaysia is at the forefront of ICT developments in health care. Being the main health care provider in the country, it is entrusted with one of the flagships applications of the Multimedia Super Corridor. However, the Ministry of Health is mainly involved in the provision of health care but does not involve itself in medical education. The role of providing medical professionals especially doctors and pharmacists mainly falls on the Ministry of Education through its universities. Currently, there are 6 public universities providing medical education. They are the University of Malaya, Universiti Kebangsaan Malaysia, Universiti Sains Malaysia, Universiti Malaysia Sabah, Universiti Malaysia Sarawak and Universiti Putra Malaysia. The three private medical colleges are the International Medical University, Penang Medical College and Perak College of Medicine. More private medical colleges are at various stages of being set up.

While the introduction of ICT in medical education has been going on for some time now, few studies have been done locally to look at computer usage among medical students. The medical curriculum in the University of Malaya does not, at the moment, contain much ICT element as the emphasis has been on producing doctors of calibre rather than ICT-literate doctors. All this is set to change in the next few years as Malaysia embarks on its plan to computerise all its government hospitals. Two new hospitals are already paperless and utilise ICT in all aspects of its operations. These two new hospitals, Hospital Selayang and Hospital Putrajaya are already operational and form the test beds for implementation of ICT in medical care in the country. Patient notes are recorded electronically and can be retrieved from a central database. Laboratory instruments are connected directly to computers and imaging instruments send digital images to servers, which in turn can disseminate images far faster than

any manual system can. While the benefits of being paperless are seriously being debated, the government has indicated that there is no turning back. More new hospitals are poised to be implemented as "paperless" hospitals and plans are afoot to turn existing paper-based hospitals into "paperless" ones. This "revolution" that is sweeping the health and medical services is set to demand changes in the medical curriculum. No medical school in Malaysia at the moment requires that its students be ICT-literate or that its graduates be computer-savvy. There is however a growing consciousness that the future will be different. Medical informatics is set to be an important part of the hospital and this has prompted moves to set up a unit to deal with it and ensure that it is part of the hospital.

A cursory survey of literature on ICT literacy among medical and related disciplines in Malaysia reveals a dismal lack of publications on the subject. It appears that there is very little work in this direction.

The GPEP Subgroup Report on Medical Information Science Skills concluded that "the use of computer systems to help physicians retrieve information from the literature and analyse and correlate data about patients can be expected to grow." (Muller, 1984). A dozen years later, Smith's review of the information needs of physicians found that experienced physicians used approximately two million pieces of information to manage patients, and that with the current doubling time of the biomedical knowledge base of 19 years, a physician can expect a fourfold increase in available medical knowledge during a typical professional lifetime (Smith, 1996).

While health care administrators and financial managers have been quick to adopt computer technology, physicians in clinical practice have made comparably little use of computers to manage information (Stahlhut, 1994). This is perhaps not so surprising, given that doctors are busy people and the use of technology may have been perceived to impede rather than assist in the management of patients.

The increased availability of micro-computers in medical schools runs parallel to the increased computer literacy of medical students. A 1985 survey of medical students at one medical school revealed that students experienced with microcomputers prior to medical school were much more likely to use them while in medical school (Bresnitz et al., 1986). Medical students used computers for telecommunications and word processing, though few were interested in their use for office management or database purposes.

Computer skills are vital for medical practitioners of the future. A survey conducted in a large university hospital indicated that 66% of medical students and staff admitted that they had low computer literacy, a situation little changed by the provision of an electronic classroom (Crowe et al., 1998). The classroom provided easy access to educational programs, a suite of software products and on-line resources. A second survey 6 months later in the same hospital showed that the availability of these facilities had little impact on perceived computer literacy or experience, except the Internet, which was widely demonstrated (an increase in use of over 300% was reported). This suggests that appropriate computer training may be necessary in future medical curricula.

Insofar as medical education is concerned, there has been some progress in the education of nurses with respect to information technology. It is generally agreed that nurses must know how to use the computer for word-processing purposes, for accessing and using the hospital information system, and for e-mailing. Nurses must also be aware of system security and show a positive attitude towards computers. A study concluded that hospital information systems and nursing informatics should be integrated into laboratory and hospital training (Saranto and Leino-Kilpi, 1997). One of the main problems facing continuing nurse education is that of matching the learning needs of the individual nurse with the needs of the care setting. This endeavour is inescapable because of the necessity for giving high quality care within financial constraints. Modern information and communication technology can be helpful in fulfilling the task more easily. A theoretical framework with the aim of developing a computer program for the purpose of matching learning and caring needs will hopefully be available in the near future (Lindner, 1998).

Doctors use some two million pieces of information to manage patients, but little research has been done on the information needs that arise while treating patients Textbooks, journals, and other existing information tools are not adequate for answering the questions that arise: textbooks are out of date, and "the signal to noise" ratio of journals is too low for them to be useful in daily practice. Computer systems that have been developed to help doctors are not widely used, probably because they have not been developed to meet doctors' information needs. When doctors see patients they usually generate at least one question; more questions arise than the doctors seem to recognise. Most of the questions concern treatment. Many of the questions are highly complex, simultaneously asking about individual patients and

particular areas of medical knowledge. Often doctors are asking not simply for information but for support, guidance, affirmation, and feedback. Many of the questions go unanswered, but most could be answered. It is time consuming and expensive to answer all of them. Doctors are most likely to seek answers to these questions from other doctors. New information tools are needed: they are likely to be electronic, portable, fast, easy to use, connected to both a large valid database of medical knowledge and the patient record, and a servant of patients as well as doctors (Smith, 1996).

The Internet, an extensive network of inter-linked computers storing immense volume of information, is growing exponentially. The use of the Internet as a source of information to doctors is growing steadily. For instance, one might be interested in discovering what sources of information exist on the network that might be of importance to the paediatric health care provider. To accomplish this aim, one might undertake a literature review, study relevant articles, and the Internet and its own resources are used to seek out information that might be helpful to paediatric practitioners. Besides being an important storehouse of documents, images, and factual information, the Internet has, in addition, communication facilities, such as e-mail and Listserv, that make it a particularly useful resource (Fikar, 1996).

Recent developments have made the Internet a helpful professional resource for primary care practitioners. The introduction of the World Wide Web has overcome many of the barriers that previously made it difficult to access useful information on the Internet. For teachers of primary care, the capability of combining graphic, sound, and video files is particularly exciting. User-friendly search strategies help users find

needed information quickly. There exist web pages which provide practical steps for accessing the Internet, introduce the concept of the World Wide Web, and provides a list of specific resources useful to primary care teachers, clinicians, and researchers (Steiner et al., 1996).

Stahlhut and co-researchers have developed a curriculum in medical informatics that focuses on practical problems in clinical medicine, rather than on the details of informatics technologies (Stahlhut et al., 1997). Their development of this human-centred curriculum was guided by the identification of six key clinical challenges that must be addressed by practitioners in the near future and by an examination of the failures of past informatic efforts to make a significant difference in the everyday practice of clinical medicine. Principles of human factors engineering (the body of knowledge about those human abilities, limitations, and characteristics that are relevant to design) are an essential part of this curriculum. Human factors engineering also provides the necessary perspective, as well as the concrete knowledge and methods, that can enable practitioners to evaluate their clinical information needs, weigh the merits of proposed technology-based solutions, and understand their own inherent performance limitations.

In 1991, the Monash University undertook a study to evaluate the computer knowledge and skills of its medical students in the first, fourth and final years. The students in the first year were found to have greater computer skills than those in the sixth year. There were also significant differences between the sexes, particularly in the sixth year, with male students having significantly greater computer skills than female students. It was concluded that the perceived importance of computing in

medicine was high among all students and there was enthusiasm for the development and inclusion of a course on medical computing in the undergraduate curriculum (Kidd et al., 1993).

A study was undertaken by Edinburgh University in March 1995 to assess the attitude of its medical students towards computers and to evaluate the effects of changes in the curriculum and intercalated BSc towards computer knowledge. Overall, 65% of students returned the questionnaire, divided equally between the males and females. The study found that only 2% of students had not used a computer in the previous year. In that study, the most frequent application used was e-mail; and the most frequent site, the Greenfield suite micro lab. The average score for self-perceived computer knowledge on a scale of 0-10 was 4.19. This score was significantly higher for the students who own a computer and who have an intercalated BSc honours degree as well as the pre-clinical students compared to the clinical students. There is also a strong correlation between computer use and doing a second year special option module. With regards to attitude towards computers, 86% of students agreed that computer skills will be beneficial to them in their future career and 62% of all students wanted a structured course in computer use as part of the MB ChB course. The study also found that there has been a general increase in computer literacy amongst the medical students in Edinburgh. This is especially so for the pre-clinical students who have had the brunt of the changes in the curriculum. The tendency for both the lower knowledge and use by the clinical students can, in part, be due to the accessibility of computers to these students (Asgari-Jirhandeh and Haywood, 1997).