Telemedicine from the Perspective of a Medical Student Graduated Twenty Years Ago

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Abstract

In a situation in which the extraordinary facilities of information and communication are provided in the integrated global community, we are more and more exposed to its symbols. Any organization and institution needs to use information and communication technology optimally for survival. It is the only way the organization can survive. In this regard, the current study aimed to investigate the facilities and advancements made in terms of services in the ICUs and hospitals by the use of computer and information technology, and compare them with the material and personnel facilities in Iran, especially the ICU unit in Imam Khomeini Hospital, and provide solutions to use these advancements in this unit. The highest emphasis in the current study is put on the wireless equipment used in ICUs such as the IP Phone Pager, Wireless Monitoring, and PDA as well as the electronic ordering systems and computerized systems and protocols of intelligent medial error or drug interaction detection, or the changes in patient's vital or laboratory signs and sending electronic messages in the form of SMS to the physician's mobile phone, PDA, or pager, to expedite action in cases of medical emergencies. The results indicated that the physician can assess the patient in the ICU without visiting him/her in person, and have access to the patient's file via the internet or even his/her mobile phone or PDA.

Keywords: Wireless monitoring, electronic prescription, information technology, portable computers.

INTRODUCTION

In today's modern hospitals, all hospital affairs including the admission, diagnosis, treatment, ICU, laboratory, discharge, etc. are controlled by a comprehensive computer network system that in most cases, not only increases the quality and accuracy of the services but also reduces the costs. In terms of the ICU that is also a part of the same hospital network and actually is one of the most important ones, Information Technology (IT) has made huge evolutions in services in this department. The hospitals' ICUs are the main place for medical errors, and since the patients in these units are acutely ill, most of these errors lead to mortality, while by the use of information and communication technology, today, there is no room for drug interactions or wrong errors, and the system itself informs the physician about his/her errors. In modern ICUs, the physician not only receives the information about the patient status inside the ICU, but also from the entire hospital, or city, or the world, and changes the patient's order if required (1, 2, 3). For example, today, all the telecommunication and communication systems such as the

internet, mobile phones, pager, IP phone, or wireless PDAs can be linked to ICU's comprehensive system.

Today, there is no need for the physician to keep all unnecessary information in his/her memory, but with a useful device called the Wireless PDA that is a pocket computer with the capability of connecting to the hospital and ICU network, he/she can have access to all necessary medical information and the information from the patient. This device is also used as an intra-hospital pager. The physician can remotely check all the patent's vital signs and study his/her ECG, and apply the necessary changes if required, without even entering the ICU.

Personal Digital Assistant (PDA) is actually a type of pocket computer whose wireless type can be connected to the LAN (Local Area Network) without a wired connection, and most of the tasks done by a computer can be done with it. For example, it can store the drug information or send the information to the physician through the LAN. Also, when, several wireless PDAs are connected to a LAN, it can be used as a pager in the range of the waves. (4 and 5).

Today, clinical information can be transferred anywhere in the shortest time, and there is no need for the physician to visit the patient in person. Today, these communicative devices are Web-Based, i.e. they are not dependent on the type of the server or a computer, and are also User-Friendly, i.e. they are very easy to operate and do not need much training (6, 7, 8).

WAP (Wireless Application Protocol) is also today used for connecting mobile phones to the internet and World Wide Web (WWW). Actually, it translates the information on the Web to be used in a small display such as that of a mobile phone or PDA (9).

The rapid expansion of computer technology has had a great effect on medical science, especially in units such as the ICU that are dependent on the technology. The electronic files require coordination between the hardware and software as well as training and support. Today, in many places, the information of the

healthcare provided to the patient is still recorded on paper to be then transferred to the computer, and it reduces the network system's ability in controlling the information (5,10). Based on what was mentioned, the current study aimed to investigate information technology in ICU.

METHOD:

The current study is more of an article review, and mostly, new articles and references about the IT systems in the ICUs have been used that have been mainly obtained from the internet. Also, the catalogs of the modern devices in the ICU and correspondence with the ICU equipment manufacturers have been effective. The internet websites of the large ICU equipment manufacturers have been also studied. The preparations for conducting the current study were initiated in May 2002, and several articles were extracted from international magazines and the internet. After translating the articles, due to their large volume, they were summarized and categorized, and in October 2002, the system in the Imam Hospital's ICU was inspected and the feasibility of the recommended projects in this study was evaluated. Also, the current structure of the ICU in Tabriz's Imam Khomeini Hospital's ICU as well as the possibility of its promotion to an efficient and modern system was investigated.

DISCUSSION:

The necessity of Creation of a Comprehensive Medical Information System in the ICU and the Entire Hospital:

The American Medical Institute published some statistics in 1999 in which it was mentioned that 44000-98000 preventable deaths happen annually in the United States due to medical errors with a financial loss equivalent to 17-29 million dollars. A comprehensive medical information system can significantly reduce these errors. This system includes a central data bank in which all the patient's information is stored and the

physicians and healthcare personnel can have access to it through the internet, PDA, and mobile phone when required.

This system includes intelligent software that can detect and indicate the medical errors from the patient's information (laboratory, biography, intake/output order, etc.) and the diagnostic algorithms. 44000-98000 preventable deaths happen annually in the United States due to medical errors with a financial loss equivalent to 17-29 million dollars. So, there is still much room to improve the healthcare process. A study on the Siemens Medical Company has revealed that 7000 deaths among these mortalities have been due to mistakes in drug prescription and these drugs cost about two million dollars. An effective system can even reduce medical costs and it is a useful side effect of this information system.

There are various reasons behind these human mistakes especially in medicine with two main categories:

Mistake= An error in the intention

Slip= An error in carrying out the intention

This system detects both types of errors and prevents them. For example, the system prevents both "mistake" (wrong diagnosis) and "slip" (failure in properly reading the physician's handwriting). The errors that can be prevented by a comprehensive medical system include the diagnosis errors, error or delay in diagnosis, error in using the laboratory results, errors in using outdated methods and tests, and error and failure in timely usage of the monitoring results.

Medical errors include errors in the prescription of drugs, errors in dosage or prescription instructions, preventable delays in abnormal test results, and improper care.

The preventive medical errors include errors in the initiation of the prophylactic treatment, insufficient monitoring, insufficient follow-up, and insufficient treatment.

The Medical Information System intended to be designed in the current study includes a central data bank in which the complete patient's information is stored and can be accessed by the physician through the internet by a PDA from anywhere. It has the following capabilities:

It provides the physician with full access to complete patient information. The emergency information of any patient can be accessed at any time. It is used for a drug prescription in the form of an electronic prescription. It creates a diseases' data bank and develops the researches.
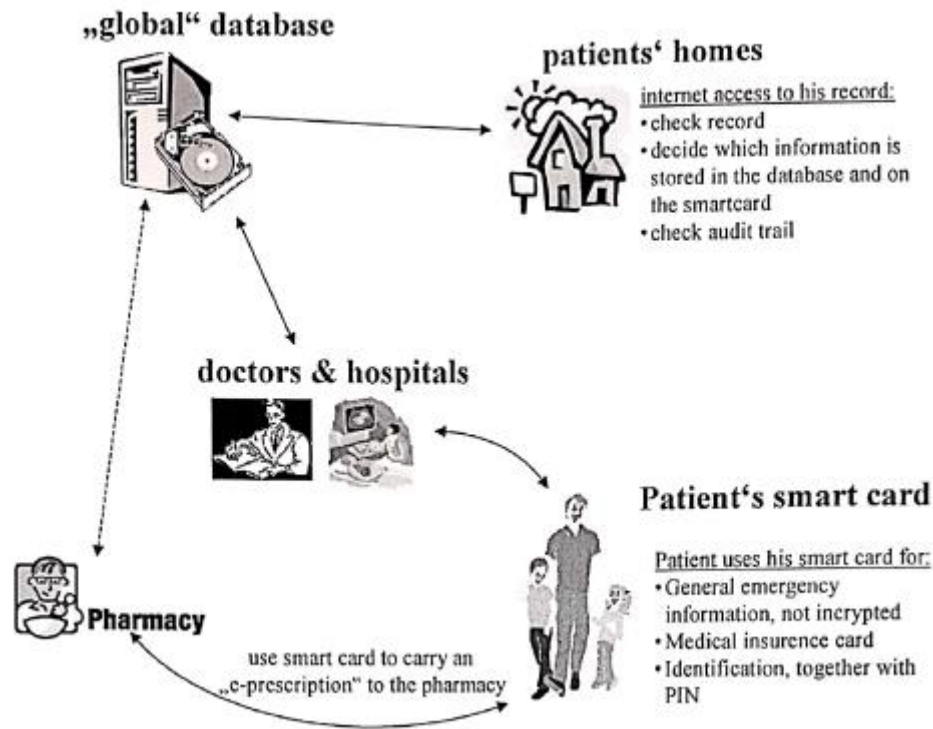
Figure1: The relationship between the physician, hospital, and pharmacy in a comprehensive medical system

The Advantages of Medical Protocols in ICU:

In the current study, the advantages of the use of computerized protocols with other guidelines and paper protocols will be discussed. However, it should be noted that these protocols never replace the ICU decision-maker (the physician). In a computerized protocol for controlling a clinical problem, more details can be mentioned than instruction or flowchart that increases the accuracy and leads to a reduction in the difference between the cases.

There are reasons for the need for these protocols, since the clinical errors are very prevalent, ranging from 1 to 50%. A very common issue states that human mistakes are inevitable and because the patent in ten ICU is critically ill, even tiny mistakes can be dangerous.

These protocols increase the efficacy and safety and it has been determined by the studies that only 50% of chronic patients receive the required healthcare at the hospital.

This standardization of the protocols is useful not only for the patients, but also for medical research, and it also expands the medical training.

Discussion about the Advantages of the Use of PDA in the Hospital and ICU:

In the hospitals in which the physicians use Wireless PDA for communication with the hospital's information network and recording system, the communicative affairs can be facilitated as follows:

1- The physicians tend to use it.

2- The information accessible by the PDA can be valuable and necessary.

3- It saves time.

4- The information on the PDA can be easily accessed and require no training.

5- The information needed by the physicians is sent to their PDA and there is no need for them to refer to anywhere to acquire information.

The physicians in this hospital receive all information including the laboratory results, critical values, cause of transfer, case summary, EEG results, consultation, instructions, graphy

results, costs, and operative reports on a pocket PDA.

The physicians benefit from this system due to quick access to patient information, reduced time required to write on paper, reduced nightly telephone calls, doctor-hospital communication at all hours, and improved patient care.

Also, the hospital benefits from this system due to the facilitation of the hospital's relationship with the physician, facilitation of the hospital's relationship with insurance systems, the expedition of the billing, and improvement in patient care. The patent also receives better service and spends less time at the hospital.

Such costs lead to earlier discharge, faster information transfer for the physician's decision-making, better medication care, better medication management, and faster reception of the test results by the physicians, so that they can stop the patient's expensive medicine sooner if required. It also saves the physician's time and he/she can visit more patients, in this case, it is more cost-efficient than the PDA and the bill is also issued faster.

PDAs have several basic advantages in hospitals. They facilitate the connections between the hospital members. They are a real-time and online device for hospital incidents notifications. They are a source of access to pharmaceutical and medical resources. They can be used to enter the patents' orders. This device can warn about the physician's errors (e.g. drug interactions).

In a study in Coiera, pagers have been considered as a popular device for physicians connecting, since they have had an answer right after a call without visiting the patient in person. The studies show that directly notifying the physicians by the PDAs (including the critical laboratory information, vital signs, drug interactions, etc.) without the nurses' intervention leads to the improvement in treatment status in the hospitals and ICUs.

Discussion about the Wireless Medical Information System:

Nowadays, Clinical Information Systems (CIS) are increasingly used to manage the information in the ICUs. The CIS's change the patient's bedside clinical and laboratory information into a visual representation and transmit it to the physician's pager. Having the entire information in an electronic representation provides an opportunity for earlier detection of critical situations.

In this hospital, a software system has been created that receives all the information from the central data bank, and by the use of detective algorithms, perceives the critical situations and informs the physician about these situations via a wireless pager system. These algorithms are designed in a way that they can detect abnormal physiological or laboratory information, or drug interactions and side effects.

When an abnormal situation is detected, it is instantly translated to alphabetical abbreviations, and transmitted to the physician's urban pager system to notify him/her, so that he/she can take the necessary measures.

The modern CIS system can automatically receive information from the following sources and store them in the hospital data bank:

1- Laboratory system

2- Arterial blood gas system

3- Medications

4- Drug prescription devices

5- Monitoring devices

6- Ventilators

7- Pumps

8- Urine measuring devices

A recent study has shown that drug interactions reach up to 7.3% in the ICUs. A suitable CIS system can easily detect such errors in a real-time order and at the time of drug orders, and notify them as an electronic message. In this hospital, the HP CareVue CIS (Hewlett-Packard Co.,) Clinical Information Systems was used in a 20-bed ICU.

This system analyzes the patient's bedside physiological information including the heart rate, arrhythmia, blood pressure, oxygen treatments (approximately 20 parameters), ventilator settings including respiratory rate, current volume (approximately 61 parameters), ventilator settings including speed, volume, (approximately 8 parameters), Urimeter information such as biochemistry, cell count, volume (approximately 4 parameters), laboratory information including cell count (approximately 200 parameters), and arterial blood gas information (approximately 8 parameters).

In this hospital, the software is designed in C++ and detects critical situations in a separate server. This system consists of three main forms of critical mode detection.

1- Laboratory critical information: this system analyzes the raw data received from the laboratory and informs the physician in case of a critical situation. For example, when the calcium rate is abnormal, it revises it with albumin and serum pH, or when the serial Hb is dropping, it announces a critical situation even if it is in the normal range.

2- Exceptional conditions: this system intelligently detects the following cases:

• FiO2 > 60% for > 4 hours

• PEEP> 15 cm H20

• Systolic BP <80 mm Hg and no pulmonary artery catheter

• Systolic BP < 80 mm Hg and pulmonary wedge pressure < 10 mm Hg

• Pulmonary wedge pressure > 22 mm Hg

•Urine output <0.3 cc/kg/hr and not admitted in chronic renal failure

• Ventricular tachycardia

• Code Blue

• Re-admission to ICU < 48 hours post discharge

3- Medication Mistakes Notifications:

This system checks the drug information with the patient's order and detects the drug interactions, drug-lab, drug-drug, or overdose. For example, if renal failure is diagnosed in the patient's tests, it notifies for dose adjustment of the drugs that caused it or stopping the nephrotoxic drug. The drug dosage warnings, the drug type warnings, the drug interactions warnings, and drug allergy warnings are also given by this system.

CONCLUSION:

Since communicative and computer technologies have become cheaper in the recent decades, and the presence of Iranian specialists in the country to plan and establish modern hospitals under modern standards, hospital and ICU comprehensive information systems can be created and the quality service provided to the patients can be increased. In the long term, it reduces the costs and increases the community's public health and training quality in the teaching hospitals.

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