

Information and Communication Emerging Technology: Making Sense of Healthcare Innovation

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Abstract Information and communication technology (ICT) has contributed a lot of things to support the health system in many aspects and has an impact positively. Information technology even changed on how hospital order stocks activities. E-health system is a stage that uses the ICT to interface different clients; it was intended to convey social insurance. Mobile health information system and internet support public health and clinical care-offers and also it is widely available and can enhancing electronic health for healthcare organization at different level; such as regional, community, and individual levels. Telematics has ease people from afar to do medical check via media usually. One part of e-Health is electronic medical record that contains patients information and accessible by healthcare staff. Clinical decision support system is a system that helps to make a decision regarding their patients matter. Management and maintenance of server should also be watch after as it affects many things in the information technology. Administrative staff also record their patients clinical record and organizing their financial management by using IT. Even robots have replaced some of the position such as doing surgery in health organizations. This study is an attempt to provide a picture of preferences over the information and communication emerging technology to enabling healthcare innovation through big data perspective. The results are interesting. Healthcare innovation through ICT and big data are indispensable elements of a multifaceted approach to forestall medication errors and enhance the patient safety. Clinical staff play a major role in the health organizations as information system in health organization. Improvisation of uniformity and recognition of the design aside from implementation of such systems should also be advantageous to the ICT though big data. Likewise, generating an economic and policy environment

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conducive to the financial intention of hospitals and physicians will facilitate wider adoption of such technology in the health information system sector.

Keywords Mobile health · Health information technology · Clinical decision support system

1 Introduction

As we approach the twentyfirst century, noteworthy changes in data innovation that occur will influence lives. Information system is an arrangement of interrelated parts that gather, control, store and scatter information, data and give a criticism system to meet a goal [1]. Information system nowadays has become the most crucial part in any organization including daily lives, for example health organizations such as hospitals and private clinic use information systems to operate their work such as record their patients' personal information, billing, financial management and many more. In health organizations it turns out to be more vital to arrange social insurance in a patient-driven consideration. PC and data innovation of ICT have been utilized to enhance customary general well-being honed for a long time. The existing literature on information technology in health system suggested that the information technology have a huge impact on the health systems in terms of the efficiency, quality and safety. Murray-weir et al. [2] stated that implementation of ICT in health care industry has been regarded as essential to the reduction of medical errors and increased patient safety. Also, health information technology promises to deliver the right information at the right time and the right place (Benson 2012) not to mention that a variety of mechanisms through which health ICT can improve quality, including more accurate documentation, rapid retrieval of information, management of complex information, and enhanced communication.

The most significant barriers to the implementation of the technology is the lack of appropriate incentives. Healthcare in developing countries faces a number of challenges due to economic constraints, poor infrastructure, a shortage of trained clinical staff, extreme climate and geographical barriers among others. Furthermore, individuals who are older and with less education and lack of technology experience are less likely to use a electronic health as patient portal that may lead to them low accessible electronic health management tasks ([3]).

Health Information Technology (HIT) improves the quality, patient safety and reduces the cost of healthcare. HIT can be introduced such as Electronic Health Record (EHR), Electronic Medical Record (EMR) and Clinical Decision Support System (CDSS). Health information management (HIM) is the main focus on managing medical records and since it became electronic, the overlaps between informatics grew. Moreover, the most frequently used HIT is the electronic medical record (EMR) but, it has been replaced by electronic health record (EHR) that shows more extra information about the patient. Changes in health information technology play a major role in enhancing the quality of health system especially in terms of health care.

2 ICT Emerging Technology

ICT on health system has long been established. Since 1991, the improvement of data innovation has denoted the new era of organized innovation, which influenced all ranges including social insurance administration and innovation. The compelling utilization of wellbeing data innovation by essential consideration practices to encourage quality change can offer practices some assistance with improving their capacity to convey fantastic care and enhance persistent results. In the twentyfirst century technology is becoming more advanced, it has made the system more efficient and effective. Before the existence of information technology, a lot of paperwork was involved.

Before information technology was implemented, patients' appointments were only written on paper or card. Therefore, appointments are usually missed by patients as people are rather forgetful or had other commitments. The newly implemented system helps patients to be reminded of their appointments. For example, the framework additionally offers patients the decision of having short message service (SMS) reminders for their consultation.

The inconvenience where patients were advised to go the nearest hospitals or clinics with their homes due to records not able to be in other hospitals or clinics. As records were mostly recorded on paper and it would usually take days to be transported. Therefore, information technology makes it easier for doctors and nurses to access patient's health records from the system. As in the twentyfirst century where technology is considered as the most innovative, technology is always up to date hence making every process quick. Therefore, the waiting time for patients is reduced as system keeps all patients' records. Technology is indeed efficient and effective but it comes with a price. The cost of maintaining and installing the system is expensive.

Information Technology is now widely used because population of every country is constantly growing. Therefore, information technology in health system is not recently developed. It has been used since the existence of PC or portable computers that was in the 1990s. Ever since, it has been evolving to be able for people to get the most efficient and effective health care. Due to that, this can help save paper because the amount of paper that would be used will dominate storage of folders. With that the information technology can save space for organizations and to have an efficient healthcare.

3 Big Data for Healthcare: An Critical Issues

The concept of big data for healthcare organization has been widespread within computer science since the earliest days of computing. It is defined as large quantity of data which includes new technologies and architectures so that it becomes likely to abstract value from it by seizing and analysis process. Due to such large size of data it becomes very challenging to achieve effective analysis using the existing

traditional systems. Big data due to its several characteristics such as volume, velocity, variety, variability, value and complexity put onward many challenges. Each time a different storage medium was created, the quantity of data accessible exploded because it could be simply retrieved. While Big Data can be certainly perceived as a big consecration, big tests also arise with wide-ranging data sets. The original definition focused on structured data, but most researchers and practitioners have come to understand that most of the world's information resides in massive, unstructured information, mostly in the form of text and imagery. These innovative technologies have presented significant changes to the way communication takes place between companies, people, and the community at large.

The explosion of data has not been accompanied by a consistent different storage medium. Big Data for healthcare organization also stated that as the amount of data just beyond technology's capability to store, manage and process efficiently. These imitations are only discovered by a robust analysis of the data itself, explicit processing needs, and the capabilities of the tools (hardware, software, and methods) used to analyze it. As with any new problem, the conclusion of how to proceed may lead to a recommendation that different tools need to be forged to perform the new tasks. As little as 5 years ago, we were only thinking of tens to hundreds of gigabytes of storage for our personal computers. Today, we are thinking in tens to hundreds of terabytes. Thus, big data is a moving target. In another way, it is that quantity of data that is just beyond our immediate grasp. The recent growth rate in the quantity of data collected is staggering.

One of the issues in big data is the diversity and incompleteness of data where machine analysis algorithms expect homogeneous data. Moreover, the larger set of data, the longer it takes to analyse. It is difficult to design a structure when data is growing in a very high speed. Some organizations are willing to share some information for public to use, so technical mechanism need to verify the source of external data used so that the data do not give wrong information to society. However, provenance of data may be doubtful, the ownership of the data may be subject to dispute, the classification of information discovered may not be realistic until after analysis. In order to solve thousands of unorganized data on the internet, Apache Hadoop software has been introduced. This software is an open source software that is available for any organizations to organize a large data across any servers. Apache Hadoop can handle all types of data from disparate system whether if the data is unstructured, structured, log files, pictures, video or email regardless of its built-in format. Apache Hadoop software is flexible as it helps to links together the file system on many local network and compile them into one area. The software also has high tolerance for hardware failure where the system can track down missing files and redirect work to another location. Moreover, Apache Hadoop system is cost effective as it charge the cost per terabyte of storage. It is highly known for highly scalable storage and automatic data replication. Apache Hadoop software ensure the quality of data available is reliable.

Second issue is storage. In order to keep data, we need an excessive and large space to store them as internet and websites have explosive amount of information. Data and transaction logs are stored in multi-tiered storage media. Cloud computing

would be the most common used application by public or an organization. Cloud computing can be accessed anywhere, it employs visualization of computing resources to run numerous standardized virtual servers on the same physical machine. However they charge the cost based on small time intervals, hourly. For business who wants to keep their data private, private cloud are one of the option that can be used by an organization where their database are can be accessed internally or externally. Private cloud on the other hand separate an organization's data storage and prevent incidental access through shared resources.

Third issue is regarding privacy and security, modern technology these days require us to use mobile devices technology to make payment anywhere and anytime. Online businesses are practically spreading globally, for example Zalora and Alibaba Express are the commonly visited websites. In order to make payment, we have to transfer our money by using credit or debit card where we usually type our account number and password into the system. The saved information are now kept on the websites database. However, the database can be breached by hackers. Customer need to be very careful about purchasing from online businesses. Another example would be, making payment by swiping debit card to the cash registrar machine, the organization have the access to personal and sensitive customer data and information for instance; social security numbers and purchase history. However, there are some of the people in the organization who breaks the law regarding personal data and commit crime of stealing money. An organization have to pay public relation and financial price when their database are compromised. One case where a business Target was involved in a serious financial and security breached where the retailer's payment system was hacked and lost millions of credit card number, in response Target paid \$61 million for the incident. Business need to take care of their databases carefully and place more value on protecting that data.

Fourth issue is about endpoint input validation and filtering. Endpoint is a device that is linked to the local area network (LAN) or wide area network (WAN) and allows communications across the network. An endpoint device is being used only for the internet-connected PC hardware on a transmission control protocol or internet protocol. Other users can go through the information that their network provides when they have their own endpoint devices. Input validation and filtering is an intimidating challenge posed by untrusted input sources. The case about endpoint input validation and filtering data retrieved sent by an iPhone application that shares with the same validation problem from weather sensors and feedback votes. Rivals can create fraud virtual sensors or trick iPhone to provide the results.

Fifth issue is about real time security monitoring. Real time data monitoring (RTDM) is a process in which an administrator can analyze and modify things such as the addition or deletion of a data when using a software, database or system. It ensures that the database administrator to analyze the overall functions and processes accomplished on the data in real time. It consists of monitoring Big Data infrastructure and using the similar processing of data infrastructure. Example for monitoring Big Data infrastructure is when the performance and health of all data intersection is being monitored that make up the big data infrastructure. An example of using the similar processing of data infrastructure would be a health care provider that is being applied as monitoring tools to seek fraudulent claims.

4 Featuring of Health Information Technology

The main advantages of Health Information Technology improves the quality, patient safety and reduces the cost of healthcare. Health Information Technology can be introduced such as Electronic Health Record, Electronic Medical Record and Clinical Decision Support System. Clinical Decision Support System, as tools for decision maker, is a complicated process that relies upon human ability to provide undivided attention and to memorize, recall, and retrieve big data which are susceptible. Pieces of information can be accessed and organized while the links can also be distinguished by the ICT systems.

ICT emerging technology is effective in bridging this ‘knowing–doing’ gap through relevant information provided. In other side, bar codes have been used widely for arrays of systems, for example in the distributing of drug and automated dispensing cabinets, which tends to diminish dispensing errors by packaging, dispensing, and recognizing medications using bar codes. One of the contemporary evaluation of the effects of bar-coding drugs in pharmacy have been carried out, checking them before they are sent to patient care units. The results have indicated that the dispensing error decreases by 31 % after bar-code implementation whereas the rate of adverse events fell up to 63 %.

Bar-coded medication administration (BCMA) systems require supervision of the medication at the bedside by the nurse whereby there is a scanning of the patient’s identification bracelet and the dose of the medication before given out. The system ensures vigilance in the nurse to any discrepancy on patient name to the route of administration of the medication. BCMA reduces could reduce errors by: ensuring the precision of patient, dose, route, and duration. BCMA systems allegedly results in a 54–87 % reductions in administering errors of medication. In a London teaching hospital, implementation of a ‘closed-loop’ system including CPOE and BCMA reduced prescribing and medication administration errors.

5 The E-Health Innovations and Challenges

The innovation in health was introduced through National Health Information Infrastructure (NHII). Here, NHII improved the quality of data, information, and knowledge to enabling decisions through ICT emerging technology in all domains of the health areas [4]. The NHII technology, empowering and enhancing clinicians and patients on their role *such as; health threats, enable patients to receive laboratory results promptly and reliably, allow healthcare staff to monitor disease and coach patients with chronic conditions, transform individual data elements into pools of anonymous data for research and public health needs, allow researchers from around the country to collaborate without leaving their labs, link a new medical advance to an individual patient, speed new useful knowledge to clinicians, and automate routine tasks so that chances of human error are greatly reduced* [4].

NHII as implementation of health information technology is very important part to introducing electronic health more broaden for patients and healthcare organization. Moreover, There several reasons, why Health Information Technology may poses threat to the health system. Firstly, there are insufficient evidences to support the prospect on impact of such systems on clinical outcomes. Most of the evidences available recently merely depends either on extensive collegiate hospitals that have developed a single site which uses these systems both privately and publicly, or on substantial economic models relying on projections. The former is understated by skeptical generalization of the discovery findings, as there is constant enforcement of commercially developed systems with little or no resources for customization. The latter, on the other hand, seemingly overestimate benefits of ICT by making calculations based on superiority of the cases. Assessment of these problems in more recent reports were conducted whereby the advantageous effects of distinctive ICT and their clinical implementations, across numerous institutions, on a vast area of clinical outcomes such as inpatient mortality, length of stay, complexity, and expenditure have been determined by methods of high precision.

A second concern is raised by the fact that ICT systems can rather have negative impacts on patient safety. ICT has an adverse effect on clinical care by generating extra or new workload for clinicians, causing workflow problems, or even creating new kinds of errors. These reports undermined the fact that ICT systems are necessary to be devised in order to enhance clinical workflow and improved technically. One perspective to addressing this problem is that clinical ICT systems in the markets should have standardized rules whereby they should be tested and authorized by a certification agency, such as the Certification Commission for Healthcare Information Technology (CCHIT—<http://www.cchit.org>). This recognition process assures a buyer that a system is permitted to carry out activities in the domains of functionality, interoperability, and privacy and security as they conform to the minimum standards of the system.

Thirdly, it is also strongly perceived that albeit the significance in impediment of medication errors in the IT system itself, the focal point should be on implementation, in alternative words, the way that it has been integrated into clinical processes, and workflow and how users literally use it in conventional clinical care, occasionally depicted as the sociotechnical environment of the clinical workplace. For instance, a recent result has indicated a threefold increase in mortality in infants after implementation of CPOE notwithstanding that in another study there was a decreasing rate of 36 % in standardized mortality utilizing the same software, but with implementation that varies in strategy. The current approach to IT standardization and certification is focused on the functionality of the system, but does not address its implementation or usability by clinicians.

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Furthermore, it is also strongly perceived that albeit the significance in impediment of medication errors in the IT system itself, the focal point should be on implementation, in alternative words, the way that it has been integrated into clinical processes and workflow and how users literally use it in conventional clinical care, occasionally depicted as the sociotechnical environment of the clinical workplace. For instance, a recent result has indicated a threefold increase in mortality in infants after implementation of CPOE notwithstanding that in another study there was a decreasing rate of 36 % in standardized mortality utilizing the same software but with implementation that varies in strategy. The current approach to IT standardization and certification is focused on the functionality of the system, but does not address its implementation or usability by clinicians.

The main obstacles to pervasiveness in adoption are due to the costly systems and an environment of enticements that were disorganized, whereby hospitals and physicians pay for the systems whereas the insurance companies will be beneficial financially. One mechanism that is vital on evacuation of this barrel is financial incentives to healthcare organizations. The Obama Administration has already proposed incentive payments to Medicare and Medicaid providers and hospitals for using CCHIT-certified EHRs in the widely anticipated 2009 economic stimulus bill. For years, US federal law, commonly called the Stark law, made it illegal for hospitals to assist outside physicians financially in acquiring EHRs.

5.1 Computer Provider Order Entry (CPOE)

With the quick emergence of information technology in the healthcare industry, there is a high possibility that hospitals or clinics would have less demand on the use of paper-based information while increasing the use of electronics. Various types of information technology that has been implemented and one of the types of information technology that is used is Computerized Provider Order Entry known as the CPOE. Computerized Provider Order Entry (CPOE) is a system that enables the medical professional to enter the medication orders or other specialist doctor instructions into the computer system. The aim of the Computer Provider Order Entry (CPOE) was to achieve the patient satisfaction. This has replaced the traditional way of how the medication order is done in the hospital which includes paper prescriptions and verbal as they can read and analyze all the information through the computer system. CPOE serves as a tool to increase standardization, quality, and efficiency in the delivery of care provided to patients in healthcare organizations [5]. However, the implementation of CPOE can change not just the

information technology in the healthcare industry but also in healthcare systems in the organization in terms of the clinical and ancillary department which also include the change in clinical processes. But apart from that, it could bring benefits to the health systems. By which the benefits include the minimized medication error, potential human error, handwritten error, improve communication and avoided the waste of time in gaining the data.

One of the benefits stated is reducing the medication error. Medication errors have been retaining as one of the major problems that is faced by some of the medical professional as this is a very common mistakes made by every hospital. Therefore, it could be essential for the hospital to implement the CPOE system to minimize the error to ensure the patient safety. Medication errors can also be related to potential human error. Human error can be a very common human behavior in the healthcare industry due to the busy schedules of the medical professional and the doctors whereby this could lead to a high risk of making error. Yet, each human being is capable of making an error, even on a good day [6]. So with the availability of the CPOE, it can reduce the human error to as minimal as possible. This could also leads to saving time of accessing the data without the need to search through the pile of paper or documents as the data of the patients or the hospital are extremely vast. The system in this case plays a part in enabling the doctors to receive the data or information they want by just a few clicks in the CPOE.

A reduction of medication error can also help the hospital in cost saving which literally means that it could reduce the cost of the patients care. Therefore, with the right medication order provided to the patients, it could help the patient to recover more quickly. As a result, it could lead to the reduction of the length of stay of a patient as it required a high expenditure of the patient staying at the hospital such as the medicine, food and others.

Handwritten error can also cost quite a big impact to the health organization as it is the main source of errors found in health department, especially the pharmacy where they select the patient medicine through what is written on the paper by the doctor which might not be clear. Poor handwriting to lack of attention to details causes medication errors to happen in anyplace [5].

However, CPOE does not always bring benefits as there are also drawbacks in implementation of CPOE which is the cost to implement it. The cost of implementation and the maintenance of the CPOE is high as it might cost an estimate of total of millions of dollars. A good example is in the United States where they are slow to adopt the CPOE due to the high cost, Estimated costs to implement a system at a 500-bed hospital without network upgrades is \$8 million, with ongoing maintenance costs of more than \$1 million a year [2]. Therefore, this shows that it could be a barrier for some hospital or clinics who have financial difficulties to implement this CPOE system.

Another drawback is the time taken for the implementation of CPOE in every department in the hospital as it may sometimes take years to complete the installation of CPOE which shows its quality of time-consuming. Other than that, it is also needed to provide CPOE training to operate the Computerized Provider Order Entry as the implementation of CPOE in the newly hospital has affected the

workflow of the healthcare department. For example, in the hospital that has been using the handwritten order for years or so, acquiring doctors to operate the computerized order entry would be a major change in the workload. Therefore, this could affect the productivity and the efficiency of the hospital as they are still new to the system and may need to take a longer period of time for them to be efficient in the CPOE system.

5.2 *E-Health System*

A system is a set of procedures that organized in order for the things to run smoothly. E-health system focuses on how the communications and managements have change in medical practices from a traditional method. Today, the information technology plays a vital role in health system. The doctor will use internet and computer as a tool and medium to interact with their patients. However, this system still cannot be adopted around the world especially in most developing countries because of the cost and Information Technology knowledge which act as a barrier, according to Sharez et al. [7]. World population increases over the years, currently there is about 7 billion people in the earth today. It is estimated about tens of millions patients die every year due to unsafe medical care [8]. With a proper health system implementation, this problem may be reduced in the future. Many health organizations like World Health Organizations and health industry technology try to improve the medical technology system in order to make people much healthier. In the USA, the government spends almost 38 billion dollars over the 10 years just to support health information technology [9–11].

Aside from that, E-health is a platform for medical staff to interact with the patients. E-health is a step forward for delivering a health care to the society. An increase in internet users and rapid technology improvement drives many health organizations to implement e-health system in their organization. Rising in the number of aging people mostly in the Europe region is another issue why e-health is important today. E-health helps the medical staff to manage the hospital better. E-health shows that the internet plays a vital role to support the health care today. Implementing e-health is not easy and cheap. E-health system may have some disadvantages, but it gives more benefits to the society, therefore e-health system need to be improved. This actually requires the management of server and maintenance. This is to ensure there are no unexpected events that will happen such as website traffic as there might be a lot of people updating their information online. Therefore, without proper server management and maintenance, all online related works might halt or perhaps can be hacked by someone [10, 11].

5.3 Mobile Health

Recently, mobile technology is evolving rapidly. Mobile technology is a portable gadget that is relatively easy to carry anywhere and it connects with the internet. Therefore, mobile technology is one of the other initiative to deliver health care. Recently, many people decided to use mobile health system as tools for health care. Mobile health is much cheaper than other health care technology. Mobile health connected through internet as a medium. Internet is a powerful tool that connects people. With internet, people can communicate from different places in just a second. It is assumed that in the future, face-to-face interaction amongst doctor and patient will become less common [12]. Rather than visiting the doctor, patient can do an interaction through video conferencing or communicate through email instead of visiting the doctor. With electronic communication, a doctor can monitor their patients through video conferencing if the patient prefers to stay at the comfort of their own home. Mobile health can reduce the cost of consultations since the patient does not have to visit the medical staff. The management can be fasten through internet communication rather than the manual. Any appointment with medical staff or doctor can be done online to prevent clashes with any patient. Furthermore, online appointment application is quicker rather than the manual ways where it takes a time. This is supported by the fact that online appointment is working 24 h per day.

Although it is assumed that face-to-face interaction will be less common in the future, it still stands as the best method for consultation. Mobile health is not really suitable for delivering health care since it has a limit in connection. Communication through video conferencing will not work if the internet is down. The appointment that was sent through email may not be read by the patient as not all people have a connection to the internet and not all people check their email frequently. Online application appointment is much better than the manual ways, although it is defeated by the fact that the system will not work if the server is down. This is because communicating via internet is less time-consuming.

5.4 Health Telematics System

20 or more decades ago, to meet or to get a treatment from a doctor is not easy. People must travel to the city to get a treatment. But with modern information technologies, it is not a problem anymore. For some countries, people who live in rural area can make a consultation with a medical staff through telemedicine or health telematics system. It is another type of health information system. Telemedicine is an electronic device that transfer complex data from one place to another, basically the data are in video or multimedia form [13]. According to Chandwani and Yogesh [14], telemedicine may reduce the cost of health care delivery since the isolated communities do not have to visit the medical staff at hospital. Telemedicine has been used for treatment, diagnosing and preventing

disease from spreading to other areas [14]. Telemedicine is usually used by rural hospital or clinic to communicate with specialists at other hospitals. Telemedicine can also be a medium for medical staff to interact with patients that were diagnosed with spreadable diseases or parasites and monitoring patients in the Incentive Care Unit.

It seems difficult for medical staff or doctor to monitor their patient through the screen. Probably it may take more times as compared to the traditional method where patient have to faces the doctor. Other problems that may rise are the quality of the data and the transmission or the connection. The image quality or video that are transmitted from the telemedicine is crucial for the medical staff to make decisions. If the image or video quality are bad it seems that the specialist will take more time to make a decision for the patient and it may lead to a risk. Telemedicine is not suitable for any emergency problem where treatment is needed instantly for patient. Telemedicine relies on the connection and source of power to transmit the data information. Without the power the telemedicine will not be working. Giving treatment via telemedicine is not easy since the only thing the medical staff can do is just talking and monitoring. Telemedicine is type of information technology, the cost of equipment telemedicine is not cheap. Most African countries cannot afford to implement a health technology such as telemedicine. Perhaps, only developed countries have the potential to use this health information technology.

5.5 Electronic Medical Record

Every organizations today will keep their data in digital form and prevent it from leak. Today, health organizations are implementing electronic medical record (EMR) system to store all the data information from the patients. Patients in the UK today can have an access to their health record (Fisher et al. 2009). The record not only can be accessed by the staff within the organization but with this system, the patient can look through their record. It records all the health record which includes the laboratory result, medicine prescription and appointment schedule. With this system, data will be stored safely without worrying that it can be lost like paper records. Compared to paper records, staff can get the patient's record quickly. Electronic medical record make specialists easy to analyze and retrieve the data information in order for them to pursue a better treatment for the patients. Furthermore, this system is crucial in order to make the decision making effective. This system will fasten the process of management, for instance, pharmacist can give the medicine to the patient just by accessing through the patient's health record instead of reading the description from the doctor.

Implementing this system may reduce the organization expenses since the use of paper is decreased. With electronic medical record, error can be prevented and detected through the system. Recording any information on the paper will lead to many risks compared to recording data in the digital form since some handwriting is difficult to understand and read.

5.6 *Clinical Decision Support System*

Computer plays a vital role today for medical staff either for management or decision making. Clinical decision support systems (CDSS) is a computer program that is designed to help the medical staff to make a good decision making for patients according to Bright et al. [15]. CDSS is link to EHR to get a patient health record. This system basically helps the physicians to calculate the drug dose. CDSS helps the medical staff to analyze the data or lab result. Medical staff cannot totally rely on this system because CDSS is programmed to give the doctor advice or alert on something. There is possibility that the data recorded in the EHR may not correct.

As mentioned above, e-health system gives many advantages to the society. The most important thing is e-health system is very effective for a better decision making amongst the specialist. With this system, distance is not a barrier to get a better health treatment anymore. But to implement it is not easy. The medical staff had to understand and have a good knowledge about how the e-health system works. The rapid changes in technology cannot be prevented. The health technology industry keeps improving and innovating new system. But the medical staff are struggling and stressed with the continuous health care system changes according to Yan et al. [16]. Implementing the e-health is not easy since the cost of maintenance is expensive and it requires an expert technician. Furthermore, not all patients have the knowledge on the information technology therefore only certain patients know how to use the technology.

6 **The Emerging Technology to Enabling Innovation**

As doctor's facility data framework has been secured in the substance of all healing center operations and administration, and the creations contain programming, equipment, system and other subsystems, administration and upkeep workload is critical and troublesome. This includes server upkeep, information reinforcement, client administration and system security and upkeep [17]. Hospital information system framework are numerous and scattered in destinations, the users include doctors, attendants, therapeutic specialists, administration faculty, budgetary, and so on., on the toll framework and money related information with high security and secrecy prerequisites [17]. Framework utilizes the working arrangement database and application level of client consent to run the utmost of the triple control instrument to give a brought together role based client administration devices in the framework so that every client has an exceptional account number, password, and given diverse levels of authorizations, so they can just work on their own strategies and call-related information, and cannot simply access to the information without knowing the document. In the meantime, we have the client control program as an addition. Through these measures, we can successfully keep the illicit intrusion of system clients, to guarantee the sheltered operation of the system.

6.1 Management and Maintenance of Network Security

System security is firmly related with the application of engineering, system security for the most part alludes to the system when clients get to the application server and database server, and this guarantee server security. From all levels of utilization and security investigation, the information needed of exceptional insurance layer, cannot give direct links. Application server layer is additionally the requirement for security and the need to control client access. To build up a strict system security administration framework, from the administration of system gear and lines to the server, workstation utilize, the client's login detail has been stricthen. This has been done chiefly in the accompanying measures: utilization of firewall innovation to counteract illegal access to the machine; strict control of the interior location of the management; the utilization of complex secret word framework, thorough character verification.

At present, dependability of PC programming and equipment system has been incredibly enhanced, likewise, disk arrays and other gear can be utilized to enhance framework adaptation to internal failures. These procedures enhance the unwavering quality of the framework, however, this cannot ensure framework security idiot proof, just to a specific degree, to decrease the misfortunes brought on by media disappointment. For unexpected mistakes or deliberate dangerous operation, computer virus attacks, framework disappointments brought on by standard database reinforcement is to guarantee the security of alternate things re-measure [17]. At the point when a misfortune happens, we can depend on the reinforcement to restore information. We have taken the reinforcement programs as it is takes after: at least once every morning and evening to reinforce hard drive that was ready on the server and disk arrays.

Server maintenance

Day to day server maintenance, server support concentrates on programming upkeep, including customary or incidental observing of memory, disk space monitoring, security access control, PC infection checking etc.

Reinforcement of data information is an essential issue that is a must to be considered in the framework safe operation, the framework cannot ensure solidity without any issues, equipment disappointment, programming crash, infection impact and the powerful or unusual catastrophe, this might bring about the disappointment of the framework, undermining the information security [17]. Hardware reinforcement is the best intends to recover from a catastrophe and accident. They did this to fulfill the ongoing administrations and information insurance necessities and to acknowledge high information accessibility, as a consequence, the framework is exchanging and have a least recuperation in time to outline framework reinforcement program.

Privacy and Security Awareness

Protection and security dangers are a worry because of programmers, fraud, unapproved access and defilement (adjustment) of patient information [3, 18–20],

making EMRs accessible to far-flung medicinal services suppliers fundamentally makes them more open to the world on the loose. Nevertheless, issues, for instance, dangers of security introduction, versatility in key administration, adaptable access, and productive client disavowal, have remained as the most essential difficulties towards accomplishing fine-grained, cryptographically implemented information access control [21, 22–24].

6.2 *Clinical Information System*

These are one of the most vital parts in the health system which is recording and updating patient's health record. Clinical and administrative data are related to each other because it might be impossible to make or develop a clinical system without any various types of administrative data. For instance the most essential part that can be found implemented in the system is issuing a letter to patient to request for their update of address which requires the latest patient's address details and any related information in order to follow-up. Considered rather straightforward, the center of a coordinated healing facility and clinical data framework is just an 'expert record' comprising of the most fundamental part of patient points of interest ('administrative data'), giving links to different clinical frameworks. Each departmental clinical framework then permits people to set up extra research data sets for particular exercises.

The aim for clinical and administrative system is to give a common wellspring of data around a patient's wellbeing history. The system needs to keep information in secure place and controls who can achieve the information in specific circumstances. These systems improve the capacity of social insurance experts to organize care by giving a patient's well-being data and visit history at the spot and time that it is required. Patient's research center test data additionally for visual results, for example, X-beam might be reachable from experts. Hospital information system gives interior and outside correspondence among human services suppliers.

The advantages of using information system in recording patient's health record are it allows health-care providers to record tolerant data electronically as opposed to utilize paper records. It likewise has the ability to perform different undertakings that can help with medicinal services conveyance while keeping up models of practice.

6.3 *Financial and Clinical HIS*

Hospitals around the world today might not use traditional method to record all the transaction made, for instance, doing book keeping and stock checking manually. Nowadays people do all the transactions by using an application such as UBS to record transaction and check the stocks using computers.

Billing patient

Private hospitals or clinics used mobile technology such as computer to bill their patients. For instance in the United States, computers are used widely by US hospitals and physician to bill their patients [3]. In the hospitals, they utilize electronic frameworks to track supplies, calculate profit and losses, controlling stock and process finance. Maybe no industry faces such a mind boggling errand regarding to charging as it does with the human services vertical. Medicinal charging mechanization is not exclusively a matter of expanding efficiencies. It is additionally a basic piece of enhancing income and the general patient experience.

Accounting systems in healthcare

A cost bookkeeping framework is a framework for recording, investigating and dispensing expense to the individual administrations given to patients [25]. Finance department plays a big role in the medical welfare. However, most costing is done on an expected premise based after allotting the aggregate costs reflectively or more regularly, on past years costs. As the foundation of the association, the bookkeeping division permits the association to work at its fullest potential. Without a book-keeping division, it would be unthinkable for an association to work in a financially savvy way (Hicks, n.d). At the point when working inside a medicinal office, the bookkeeping office is essential to its prosperity.

Material management and stock control

Stock control is a piece of numerous industry-neutral bookkeeping bundles. Human services associations have some particular prerequisites, however, for instance, the capacity to build charge catch (charging for things utilized as a part of treatment) is a neglected hotspot for overhead cost lessening in therapeutic associations. On the other hand, robotics such as bar-coding and RFID can expand the straightforwardness with which stock is overseen and enhance charge catch. Managing perishable solutions is another one of a kind component of medicinal materials administration. Moreover, elements, for example, parcel and termination following are not just monetarily invaluable; they give an imperative well-being related part.

Creditors and purchasing

Successful money administration depends on wise records of payable handling. Creditor liabilities modules handle the dispersal of installments to merchants. Propelled money administration highlights incorporate the capacity to enhance installments. This can be proficient through an assortment of means keeping so as to incorporate trade out procuring positions until installment dates arrive, diminishing mistakes and late installments, and notwithstanding exploiting economies of scale through clumped orders or early installment rebates. Electronic installment strategies, for example, electronic assets exchanges (EFT) are helping associations to deal with their payables with lower handling costs and enhanced unwavering quality. Complete acquiring frameworks give the capacity to oversee extensive scale buying reliably and with the fitting endorsements and control. Reporting components can enhance seller administration and interest computation. Mechanization elements, for example, programmed acquiring taking stock limits into account can promote and enhance effectiveness.

6.4 *Medical Robotics*

Medical robotics has become increasingly important part of the healthcare system around the world. Robots are already beginning to affect medicine (the application of science and technology to treat and prevent injury and disease) and health care (the availability of treatment and prevention of illness) [27]. The technologies in medical robotics keep on advancing therefore there would a possibility that there is a potential to trigger the development of the new treatments for the wide variety kind of disease and also the rehabilitation systems. Most of the medical robotics are mostly implemented in the surgery section in the health industry. With the implementation of medical robotics, this has help the hospital to perform difficult procedures and more patients can be rehabilitated as most of the task or treatment are limited by the human abilities that were handling them.

One of the medical robotics that has been used are surgical robotics. The surgical robotics functions are to carry out the process of the surgery procedures during the ongoing surgery which was controlled by the computer systems. This benefits the surgeon as the surgeon can program the robot motion precisely about the procedure of the surgery which results in high accuracy in making the surgery and increasing velocities with no overshoot. Surgical robotics also eliminate the tremors of the surgeon whereby this avoid any surgical error or mistakes as this could result in the injury of the patient.

However, surgical robotics can also have disadvantages as well which includes surgical robotics do not have the hesitant to make any move during surgery as it was computerized completely. This can have a great risk of making errors if the surgeon did not input the right procedure to the robot.

Computer-assisted surgery

Computer assisted surgery (CAS) is a technology that have the possibility to empower the healthcare services to improve proficiency of diagnosis, treatments and clinical administration. The introduction of computer-assisted surgery was to enhance the performance of surgical interventions with electronic instruments and software [26]. The computer assisted surgery has been increasingly used worldwide in wide variety of surgical processes. It is also regularly considered an image guidance such as 3D image which is mostly used in computer tomography (CT) or magnetic resonance imaging (MRI) and navigation as this acts as a guidance for surgeon during the surgery. With the availability of this technology surgeon can now be able to plan the surgery carefully and precisely and able to match the goal of the surgery [10].

The benefits of the computer assisted surgery (CAS) are surgeons can acquired a better visualization of the internal infrastructures of the body by using the MRI or CT. Therefore, this allows the surgeon and the medical professional to have a better and accurate diagnostics of the patients. CAS can also provide simulations to the physicians to perform difficult surgery before handling the real surgery. The rising in public demand for patient safety and the complicated operations, the necessity of operative training outside the operating room is not a question any longer [28].

This can help to improve their skills and surgical knowledge needed during the surgical. However, the disadvantage of CAS is the cost as the machines of the CAS can be very costly therefore it can be hard for hospital that has a tight finance to invest on the machines. CAS may also sometimes cause error which can lead to wrong or inaccurate diagnostics of the patients [11].

Computer assisted surgery is greatly demanded by all the health care authorities as it has become machine that is used on a daily basis in the hospital or clinics. With the CAS, there is a reduce in the risk of making wrong diagnostics, it has improved the safety of the patient care significantly and improve the health of the patient. Therefore, the case of the limitations of the high cost of the machines may not have really affected the healthcare industry.

7 Managing Change and Innovation

To proceed further, it is necessary to have a straightforward yet dynamic perception for navigation of investments in Health Information Technology. Nowadays, people can go online and have an instant access for the sake of managing their personal financial information. With a few clicks of a mouse, people can move their money and even have bank accounts transferring from one institution to another. This has been impossible with most of electronic health records, but there has been an innovation recently.

For the determination of accomplishing an exceptionally competitive health-care marketplace, the focal point should be shifting electronic health information to the patient rather than staying in the hands of an individual provider.

Health IT systems should also be relatively easy to use whereby instead of hindering it, the systems facilitate the work of clinicians. User interfaces should be identical enough that a clinician working in one health system can instinctively distinguish how to use another without the need of large-scale training. For instance, car manufacturers offer an assortment of models, however, the control indicates a persistence and enable a customer to drive any vehicle off a rental lot without instruction are more crucial. Comparatively, Health IT should make no distinction.

Health IT systems with low complications will not only be less oppressive on suppliers and patients, but they will also be ensured of the secureness of the system. Lately, there has been an imposition of laws by the Institute of Medicine Department of Health and Human Services whereby providers are obliged to report on health IT vendors and volunteers to identify correlation between Health IT inimical events and uncertain circumstances. Establishment of domestic report and monitoring instruments would instantaneously causes an upsurge of our understanding towards the finest practices for high security adoption and implementation of health IT.

8 Limitation and Future Research

This study incorporates two main issues of electronic health innovation: ICT emerging technology and Health Information Technology. ICT emerging technology refined the authorization of information, trigger the business process reengineering, and the collaboration within the healthcare organization. It is not just simply supporting process reengineering but it also has a strong impact in improving efficiency and effectiveness of healthcare organization. Health Information Technology improved the quality of health data, information, and knowledge used to support decisions at all levels and in all domains of the health sector; i.e., personal health, health care delivery, public health, and research.

The study triggers a future research direction in health information technology strategy which would focus on enhancing patient and healthcare organization, change management associated with the implementation of paperless cultures; support decision making for clinicians and patients, empowering patient and allow clinicians to monitor disease and coach patients with chronic conditions.

The future direction of this study can also accommodate and customise for integration of more complete and robust security support features, particularly the integration of an information security decision for electronic health for support system, an expert system and a security pattern recognition system, complemented with a knowledge inference and learning system to emulate the decision-making ability of a human expert. This software ability could solve compliance barriers, create an early warning system for suspected security breaches and help enhance strategic planning of electronic health.

9 Conclusions

IT systems ICT emerging technology are indispensable elements of a multifaceted approach to forestall medication errors and enhance the patient safety. Nonetheless, we need to be observant of their capability of adverse effects on clinical workflow with consequential complexity. Improvisation of uniformity and recognition of the design aside from implementation of such systems should also be advantageous to the IT system. Likewise, generating an economic and policy environment conducive to the financial intention of hospitals and physicians will facilitate wider adoption of such technology in the health information system sector. Staff that are in-charge of clinical and administrative information system also play a major role in the health organizations as information system in health organization requires a lot of skilled staff in IT so that the technology used in administration are useful wherein it helps the finance sector in the health organizations in their stocks update. However, the factor cost may need to be considered such as the installation, overheads and the training.

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