

Network Security & Online Communication: Improving Hospital Staff Performance and Patient Privacy Through Technology

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Abstract—Keeping confidential hospital data away from outsiders and protecting patients' information is a basic right to privacy that people should expect and have. At the same time, the medical records of past and current patients should be up-to-date when a doctor or nurse needs them. In this modern age, it is vital that hospital staffs are trained in creating and updating eHealth applications to best facilitate privacy and record retrieval. Doing so is necessary for future decisions. All of these factors force hospitals to adopt the new technologies of internet communication. This initial step of bringing hospitals into the electronic-age can be costly; installing a computer station in every department and floor to insert and update a patient's data quickly and smoothly involves not only hardware and software installation, but staff training, as well. As with any network system or Internet-based application, spectrums broaden, but security risks do, as well. In an ideal world, Internet and network security would not be a barrier to hospital staff keeping patients' records safe and providing their patients with the most high-tech and modern procedures possible. To ensure the highest levels of security, it must come at every level of access entrance. Hardware such as face recognition, fingerprint recognition, hand scanning, and wipe cards. Software such as usernames, passwords, and pin numbers are reinforcements to the hardware. Ideally, multiple levels of security will allow hospital staff to give their patients better privacy and medical care.

Keywords—*performance; security; proficiency; flexibility; e-Health; Electronic Medical Records; EMR.*

I. INTRODUCTION

Performance is one of the many elements used to measure a hospital's quality beside the doctors' and nurses' experience, healthy environment, service, and standardization. As a consequence, the hospitals create comfortable environments for their faculties, staffs, and patients to improve their performance[1]. They design their buildings in a ways that can easily and quickly be accessed from each section to another and where staff are able to move smoothly within the hospital's campus. Sometimes hospital designers create facilities to not

only treat patients, but to create a more comfortable environment for staff, visitors, and patients. To accomplish this, often times flower & gift shops, small grocery stores, salon, cafes and other such places are set within the hospital's walls. Hospitals also will often times welcome patient and visitor feedback by way of comment and suggestion forms. Moreover, hospitals strive to meet the latest technology of medicine and security; unfortunately, much of this often depends on the hospital's budget [2].

Doctors and nurses are the second layer of hospital hierarchy after the hospital administration. Often times doctors and nurses are the benchmark of evaluation performance of the hospital as a whole. In the patients' views, the way that doctors and nurses interact with them is often times the one and only way that the hospital is evaluated through the patients' perspective [3]. However, from a non-patient perspective, doctors and nurses need more than a friendly bedside manner and good medical knowledge; today, they increasingly need a stronghold on how to use the latest technology.

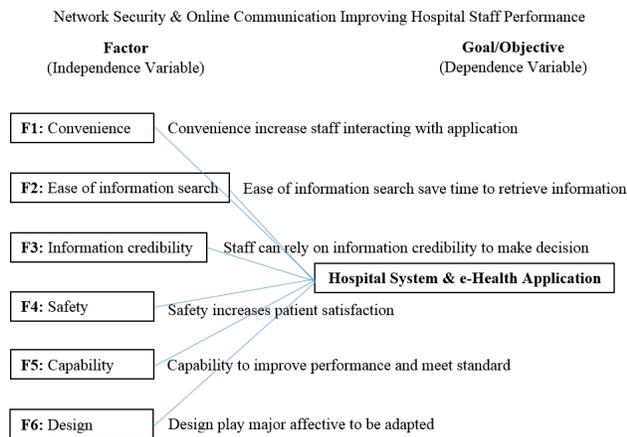
There is no doubt about how important the customers are in any business because they are one of the main parts in any transaction. Patients, in this situation, are the customers, whereas the hospitals are the suppliers. Patients are the judges and the evaluators of a hospital's services and staff performance. They are the source to give feedback and their satisfaction is a reflection of receiving good treatment. At the same time, patients are increasingly concerned about their confidentiality and the accuracy of analyzing their condition [4]. During hospital intake of a patient, patients are aware that not only are their medical records kept by the hospital, but other highly confidential information, such as full name, date of birth, social security number, and address.

As a consequence, hospitals reinforce their system with restricted rules to prevent leaking patient information and raise regulation to ensure privacy. Moreover, the hospitals demand that both doctors and nurses document every single detail and seal it by their signature; this allows for the medical staff to be

both responsible and accountable to their patients and the establishment for which they work. In the past, hospitals used paper for documentation and storage of archived information [5]. Since computers have the power and the ability to store and retrieve information so easy, hospitals have naturally adopted them, but this does not come without both difficulties and barriers. Human nature stands against change and naturally does not like large changes in routine. However, once they have adopted it and feel how good it is, they will fight to keep it. When the documents and records were stored as hard copies, doctors and nurses were not willing to go electronically because they did not want to reenter the data in computers because this requires extra time. After initial resistance in many hospitals, they saw that electronic retrieval of information made their jobs much easier and more efficient.

II. ACCESSING AND FILING

Many hospitals have shifted from the traditional procedure of paper to digital documents. This helps businesses to improve in many aspects. For instance, they will gain capability, timing, and convenience. On the other hand, there are many majors effects to the movement, too, such as security, equipment or material, software application and the human factor [6].



- **FACTOR 1:** When e-Health applications have full functionality to store and retrieve the data, they will become a convenience for staff to interact with. Additionally, they will save time to speed patient treatment, and it will be easy to make backup of information for a future restore if data is lost [7].
- **FACTOR 2:** Comparing e-Health applications with paper document storage shows the wide range of advantages of technology. One of them is the search function which provides more opportunity for hospitals to search about patient in a variety of different ways such as by name, social security number, address, etc.[8].
- **FACTOR 3:** Storing accurate information into the e-Health application provides credibility of the source to help the doctor best ascertain the patient's history to

make a judgment on how to treat a condition or disease [9].

- **FACTOR 4:** Hospitals that enhance security in their system will conserve patient details from being shared with an unauthorized parties [10].
- **FACTOR 5:** Internet network, security, and e-Health applications have the capability to improve hospital jobs and equip hospitals with the modern standards of hospital administration [11].
- **FACTOR 6:** Internet network patterns and application design play a major part of employees' work environment [12].

A. Convenience

The e-Health application is software that has many functions and features. Staff can open a new form to register a new patient in the reception area. The same software can be used in any computer that connects to a hospital's network by a nurse and a doctor to write or read a patient's record. However, the application needs to support real time life updating [13]. In additional, a disaster might cause a hospital to lose data about a patient or software may be targeted to be hacked like any program, so a hospital can have the choice to backup data by setup daily schedule and store it in different location.[14]

B. Ease of Information search

Retrieving information for any patient in a short amount of time is considered as a high priority in the medical area. Especially if that case is in an emergency room. With paper, a hospital organizes them in particular, sorting which limits the hospital to use another index key to look at patient profile[15]. With the e-Health application, it can be added by picture comparison, and that has high possibility to save life for which the hospital receives in coma status. Moreover, digital data allows a hospital to sort a patient profile with a multi-index key to search. Also, when the data is recorded electronically, it will make them easier to reach and to update than being in a hard copy.

C. Information Credibility

Sometimes, some hospitals will send a patient's x-ray to an expert doctor for a consultation where they work in different location or another organization. In this case, a doctor's distance can participate in a quick treatment. Moreover, this feature will allow the doctor to access the date from his home during his break or vacation. When they can access the hospital's database, they will be able to review a patient's information for further understanding. The source can assist consuler judgment and help them to make their final decision in easier way and without any worry.[16]

D. Safety

Patient confidentiality is the aim from an outsider. Some of them need information for good reasons and other want them for business benefits. [17] Exclusively famous people are being targeted by the media, and others, to broadcast their news. Some research organizations thirst for feedback to improve a new generation treatment. This type of seeker of information can have green light from the patient to provide a certain

amount of privacy. However, hospitals need to build an invisible shield to prevent other types who sniff out patient data[17].

E. Capability

Not every person in hospital has a good handwriting. As a consequence, inserting patient information in standard form helps any doctor to read them in future. Besides, having a copy of handwritten documentation is worse when compared to taking a copy of digital documentation in a quality term. Internet connection makes data transmission faster and easier between database, and staff to read, update, and etc. That increases the capability to progress interacting with technology which drives better performance[18].

F. Design

Most of the time, employees give offers based on the environment capacity. When the internet is wireless, staff can come closer to patient's bed and they can record their information and at same time, they can read the impression of the patient's face. However, the e-Health's application appearance is important. If it is colorful, that will help staff to remember every page because the human brain easily remembers colors and shapes. Furthermore, each color can be categorized for particular use.

G. Pattern of Computer

A hospital's faculties need to look at patient's record before seeing their patient every time, and they need to update the details of their patient's status. To do that, every hospital has its own procedure. Some of them grab a patient's file from the archive or print it to retrieve data, and write everything in paper. [19] After that, nurses enter information again into the computer in the room station. However, this procedure takes more than two steps to retrieve data and update record, which has many disadvantages. First, by duplicating information in the paper and the computer cost more time.[20] Besides that, doctors and nurses might not find an available computer to retrieve or update data when they walk to computer station for any reason such as computers are occupied by other staff. Computer might be occupied for long time if doctors and nurses have not finished filing resources. Otherwise, they will lose where they left the form if computer is used by another user to fill information for another patient.[19]

Additionally, the hospitals adopt different architectures of distributing computers instead the centralization computer in the stationary room. They will be able to reduce some disadvantages which exist in pervious scenario. For instance, using the stationary room causes bottle neck among coworkers, and is reducing resources by occupying some computer.[21] Moreover, some issues are carrying of in this model too, and one of them is pattern of network connection to link computers to the server, and whatever that connection is wire or wireless. Moreover, when the network topic exists, the security topic exists because they are a perfect match in terms of piracy.[13] Besides, for trucking and responsibility purposes, doctors and nurses require using a user name and password to access a computer for user authentication. That procedure is used with the classical system where it has many disadvantages in terms of proficiency and timing because they need to enter their user

name and password every time whenever they change computers. Besides, hospitals should have standard user names and passwords or otherwise doctors or nurses will create a variety user names and easy passwords related to what is familiar to them such as their phone number, etc. [22].

H. Access Technique

Furthermore, hospitals takes steps ahead in providing special equipment to make accessing computers easier, and by standard, they aim to decrease the barrier to achieve a high performance of technology. [18] Question will rise by evaluators about a hospital's equipment choice. Many hospitals use different techniques in accessing to increase security not only with computers but with other various departments.

The technique can be one of two types. The first type is an encrypted key that is based on an unduplicated code. For instance, there are face log on, finger print, and eye scanners. The second type is an encrypted key that is based on an algorithm code. For example, they swipe the card and flash drive. However, each type has advantages and disadvantages so what is the best choice? The decision will be based on the features of each technique. [17]

First, face log on is a modern unique technique because no two faces are the same based on scientific facts, and it has been used in android phone as well as other personal devices. Sometimes it takes time to recognize the person because of the natural elements that are affecting the technology such as light and shadow, glasses, etc. Following this further, the tools of this technique is expensive to be applied with the awareness of the disadvantages mentioned before. [23] Second, using fingerprints is one well known technique, and the tools are affordable, but the disadvantage of this technique is it requires doctors and nurses to use their finger directly, which highly limits their support staff. As a consequence of direct touch, other problems exist like creating a germ sharing environment where hospitals seek purity. In addition, the fingerprint device might miss recognize the finger if finger is injured or in any way compromised from its original state. Third, the swipe card is the technique used in most hospitals. Another alternative is the magnetic plastic card that can be read by a special device. It is made of a cheap material but on the other hand, it has a high risk, especially if it is stolen, because the device cannot give the decision if the card is being used by incorrect person or not. Same thing goes for the flash drive [9].

I. Authority

Next, the authority of a medical system is different from one country to another. American nurses have much more authority in treating patients and carrying out the doctor's orders while not under his or her direct watch. On the contrary, Japanese nurses need a doctor's permission to carry out many more tasks than their American counterparts. Furthermore, hospitals obligate a doctor's and a nurse's signature whenever they access patient records or provide treatment to a patient. The philosophy behind this is increasing the restriction of responsibility and, ultimately, limiting authority [24]. Since hospitals decided to shift to an electronic application, they need to adopt a friendly application to meet the rules of security and provide real time checking to help them to perform a better job. Again, applications should be secure to prevent hacking and

leaking information, or twisting it. In this case, providing fingerprints or eye scans as way of guarantee makes sure the medicine was prescribed by an authorized person.

J. Human interacting

Shifting from one pattern to another is not simple unless people are willing to do so. Even so, willingness is not enough to adopt a new and costly procedure unless a hospital makes a decision to put its resources behind it [16]. It is entirely possible that some staff members do not know how to use a computer; this greatly increases the allocation of funds to train staff on the basics of computer use. On the other hand, other employees might have experience to deal with computers to assist other staff members along the way. However, just because someone is familiar with computers, does not mean they will do well with a specific application, especially if the application contains many functions. Generally, the common phrase of “Keep It Simple Stupid” is the best when first implementing hardware and new applications. Simplicity of use helps to ensure that all staff members become masters of the applications. Furthermore, it is necessary that doctors, nurses, and their support staff are given training in the use of their new programs. This ensures confidence, efficiency, and proper use. Striking the balance between a simple, yet secure network can be a challenge for designers.

K. Internet network pattern

There are many architectures of networks such as IEEE 802.3, IEEE 802.11, or IEEE 802.16. IEEE is abbreviation of Institutes of Electrical and Electronics Engineering [8]. Each architecture has its own features. IEEE 802.3 is wired Ethernet. IEEE802.11 is a wireless local area network (WLAN). IEEE 802.16 is a wireless broadband standard for metropolitan area networks (MANs). Hospitals need to decide in advance the best network architecture to suit their establishment’s individual needs. That might be easy to do during building of the hospital. Even if the hospital is already built, they should still be able to install an internet network that works within their existing structure [7].

If hospitals choose the IEEE 802.3 model, it has advantages. Hospitals do not need to worry about the wave of signal because hospitals will be using it in a specific department and with some sensitive devices, which is easy to be effected by any signal wave [4]. For instance, a magnetic resonance imaging (MRI) scanner is one of the devices in hospitals. Because of that, doctors request the patients to take any metal out before they enter the room. However, this architecture requires cables to connect the devices with the main server [3]. The disadvantage of this model is that the cable might get damaged. Besides, it requires a certain device to extend the connection if the hospital expands the internet in future. In addition, hospitals need to provide a computer in every room because this model does not support the mobility of devices.

IEEE 802.11 and IEEE 802.16 architecture are both free wire. IEEE 802.11 is wireless Ethernet, and it has many types. They are: 802.11a, b, g, and n, and they are free licensed [25]. Typically, they cover a couple of meters. Additionally, they are easy to extend coverage and they support mobile devices which helps hospitals to reduce costs. A disadvantage of the wireless

model is that they need to consider that the signal wave does not interfere with other devices’ performance ([26].

IEEE 802.16 is known as WiMAX, the abbreviation for Worldwide Interoperability for Microwave Access; it also has many versions. They are 802.16a, b, c, d, and e [27]. Some of the versions require a license, and they cover hundreds of miles. A hospital can save many Internet extending devices, which existed in previous models. Besides, it provides up to 300 Mbps of shared space and it has a high quality of service [28].

III. OPTIMIZING PERFORMANCE

Optimization of performance is the aim of this paper after analyzing the issues in hospitals. One of the issues was incomplete filing data, which is sometimes caused by an occupied computer. This common problem is not solved neither in centralization nor decentralization forms [29].

A. Multipoint connection

Virtual interface is a page or site retrieved from the server or centralization computer whenever a user accesses any computer. The idea is similar to email with an auto session to save the last update that was done in the last access point. This solution helps to release an occupied computer and save time for staff to complete a task where they left off when they are able to return to it [30]. Computers that use this scheme are called multipoint connections. A great advantage of a multipoint connection is that it allows a doctor or nurse to use any computer in the hospital to access files and documents that they had worked on previously while using another computers within the hospital network.

B. Signature

Updating signatures can be done automatically when doctors or nurses do modifications, and updating in patients files. The signature contains the date, time, name of staff, and their individualized identification to ensure authenticity. To ensure the highest level of security, once entered, the signature cannot be delete; it may only be overlapped/overridden, leaving the initial signature intact for retrieval [31]. Many applications have time saving steps, such as allowing a nurse to sign-in and enter that the presiding doctor has given the nurse permission to dispense medication under the doctor’s supervision, for instance. Delegating this task to the nurse, saves the doctor’s valuable time; the doctor is able to spend more time with his or her patients instead of in front of a computer. Meanwhile, both the nurse and doctor are still accountable for the dispensing of medication by use of both of their signatures.

C. Smart swipe card

The swipe card, with some technological modifications, can be the best selection. This technology is referred to as the Smart Swipe Card (SSC). Swipe cards connect with a hospital’s wireless network. They are programmed to lose functionality if the card is a certain amount of feet away from hospital. That helps in improving the security. If the card is lost or stolen, it can easily be deactivated remotely. However, there

is a human element that is needed to ensure proper maintenance of the cards. For instance, the cards are usually programmed to an employee's shift hours, i.e. the SSC will not work outside of the employee's programmed hours. Therefore, the SSC would need a supervisor or administrator with authority to change the SSC's authorized hours if the employee were to work an unscheduled shift or over-time, for instance [32].

Hospitals probably need to arrange courses to educate their employee to interact with their systems. Furthermore, hospitals require hiring experts in information technology or signing contracts with companies to monitor their network; these can become costly, but will save the hospital money in the long run, by way of efficiency and time management with labor hours [33].

IV. CONCLUSION

Hospitals evaluate their performance to meet the scale of quality in patient care. To ensure the quickest access to patient records and superior care, new technologies in hospital administration are now being implemented. Where accessing data is a necessity to provide care, security is essential to provide confidentiality. With the advent of the Internet and network age, patients have a greater concern than ever for their right to privacy when receiving medical treatment. Patients increasingly have the expectation that their confidential information will be kept secure, away from public view, and controlled. Security and privacy are important elements sought out by patients when choosing a hospital for treatment[34]. Today, not only is a doctor's performance the way to evaluate a hospital as a whole, but the efficiency and privacy of the hospital network is the new benchmark for superior treatment in the medical world, also.

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