

Evaluation and Assessment of implementation of QR code-based Identity system for Healthcare Provider in Princess Nourah University Dental Hospital, Riyadh City

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ABSTRACT

Regarding this study, we assessed the possibility of conducting a QR code identity tags to integrate dental hospital staff of Princess Nourah University into the Saudi Arabian healthcare system. Hence, this system provides QR code-based medical identification alerts. First, via determining the possibility to implement the code system (QR) printed on wristband which is assessed by utilization of a questionnaire for dental staff opinion. On a next step, construct a customize medical ID wristband which is featured as a time-tested and it showed in combination with information technology, a successful outcome due to its reliability, accuracy, and speed. In some developed countries, emergencies outside the era of the hospitals can be managed by determining a detailed medical history via utilizing some methods for example: using QR code wristband, necklace, ID card, and bracelets to facilitate extracting of information by using technical devices such as: smartphones or a standalone QR code scanner allowing authorized personnel (e.g., paramedics, firefighters, or police) to engage into a more detailed patient information, the main aim is to provide an accurate medical treatment and reduce medical errors. Reversely, miscommunication between healthcare provider and the patient will affect aggressively and negatively on patient survival. Although, it is not widely applied globally. This research covers various aspect of QR code system and its application in hospital's staff. Also, exhibiting the thoughts of these staff about final outcome of this implementation.

Keywords: Emergency Quick Response (QR) codes; Mobile devices; Information technology; Time study; Survey; Benefit cost analysis.

Executive Summary

This summary was reported to examine if the QR code-based medical identification wristband will affect the survival rate and be useful during emergency situations, by assessing dental staff opinion and to recommend ways of designing it.

The research draws attention to the fact that miscommunication or communication failure is a prime cause of negative adverse events in healthcare institutions either inside or outside the hospital era which can lead to patient harm or death. Hence, the Joint Commission International provide some medical challenges related to medical communication error, include:

- “Inadequate handovers or transitions of care”.
- “Cultural barriers and misunderstandings”.
- “Age-related challenges”.
- “Errors in test results and medical orders”. ([https://store.jointcommissioninternational.org/assets/3/7/jci-wp-communicating-clearly-final_\(1\).pdf](https://store.jointcommissioninternational.org/assets/3/7/jci-wp-communicating-clearly-final_(1).pdf))

Life expectancy (LE) might be affected positively after a while of implementation, and it is defined as an average number of years that a newborn is expected to live if current mortality rates continue to apply*. (WHO) The highest level of mortality rate among Saudi population is 73% considered for Non-communicable diseases (NCD), complications from NCD could be affecting patients on lesser degree if the health care provider knows what is the background exactly from the patient. (Al-

Dabbagh and Gargani, 2018) The life expectancy of a country globally for example is in 70s, the average yearly gain of (LE) is nearly < 0.31 years. In which in Saudi Arabia, the annual target is nearly increased by average of 0.43 achieving vision of 2030. (Bah, 2018) Further investigations might reveal that the innovation of a customized QR code system will coincide with increase health awareness and reduce mortality rate.

Multiple suggestions were formed, one of them is performing a hand wristband printed by QR code while scanning via smartphones coding and decoding obtained, it shows all necessary medical information that is needed when emergency crisis is confirmed to a particular individual. This method was designed to introduce communication tool to the authorized personnel include: paramedics, firemen, police officers, and lastly emergency department physicians. So, mainly the aim is to increase survival and life span of the staff either in or out the working environment. By taking the staff opinion about this method of implementation. Afterward, a second survey is performed to perform a custom made QR sample involving necessary medical information and printed to a wristband and placed individually. This plan will improve the quality of life among employees who are in PNU environment rather than to increase income.

On the next level, if such method implemented to PNU dental patients in the same way, health care can be delivered, and will improve results outcomes to the patients while rewarding the employees in the accomplishment of their daily tasks. So QR code system can increase life expectancy of individual by early knowing their medical background.

Chapter 1: Introduction.

Background:

In recent years, Saudi population level of health status has been clearly increased. The Saudi vision of 2030 have made a dramatic plan transformation in approximately all sectors including the health which deeply fits “Patient First”. Saudi government now is on an ongoing processes to enhance quality and efficiency in health department. Ministry of Health (MOH) of Saudi Arabia undergoes into several changes, such as restricting and reorganizing of its units and facilities and affiliates. The MOH collaborated with external consultants to implement Performance Improvement Unit (PIU) initiatives in 4 steps: PIU Setup, PIU Capability Building, High-Impact Project Implementation, and Project Sustainability and Knowledge Transfer which is hoped to increase health status. (Hassanain, 2017)

According to the report by Saudi Organization of Economic Cooperation and Development (OECD), Saudi citizens generally increasing their satisfaction to the new rules and regulation of (MOH). Although there are much work still to be implemented to reach to the upper limit of satisfaction. So, with the innovation of smart-phones; it can be integrated to enhance healthcare in SA. Therefore, the facility of this technology allows the use of QR code, scanning and obtaining coding and decoding of codes became extremely popular tool because of developing a newly modern method of diagnosing and treating illnesses. (Lamey, 2018 and Santisteban, 2017) When used by the right authorized personnel, numerous of people globally would have a hidden background of medical disease that might be dangerous to life at certain emergency situation especially if those people were unconscious and cannot respond to health care giver. If not so, medical errors would appear or a delayed treatment amplified or any other possibilities. A huge category of illness people would benefit from such innovation, for instance: Diabetic, Anemic, allergic patients to certain medication or medical materials, and to identify blood type in case of

blood transfusion is needed,..etc. (Morton *et al.*, 2002) This is a global medical issue which need to be considered to decrease mortality rate percentages, even though Saudi Arabia's Ministry of Health and Ministry of Transportation are taking their extreme precautions to enhance survival rate locally especially when its related to accidents by all its type.

Because any error or failure to recognize the proper identification of patient will lead to an irreversible damage as a consequences of treatment provided. Ideally, identification of health status is extremely important to the course of medical services.

The world health Organization (WHO), with association of Joint Commission International, release tips for patient safety to decrease errors and adverse of health care events, published in 2007. These contributed to: correct patient identification, performance of the correct procedure on the correct body part, needle reuse and injection device safety, administration of appropriate medication throughout care, managing the risks associated with lookalike/sound-alike medication names, control of concentrated electrolyte solutions, improved hand hygiene to prevent healthcare-associated infections, handoff communication during transfer of patient responsibility, and avoidance of catheter and tubing misconnections;; and (World Health Organization 2007, 2008).(Uzun and Bilgin, 2016)

Health care information system, usually identified as a mutual interaction between living induvial, improvement of the health system promote satisfaction which is provided by improving the process and technologies that serving the health system leading to increase service quality. The meaning of informatization which defined as “use of information technology resources in organizations“, now medical informatics paradigm and perception are taking a great step globally. Some countries actively enhancing to introduce the health information technology and include it to improve treatment and patient safety in the setting of clinical management. (Seo, Kim and Kim, 2019)

Usually patient identification is utilized manually by health care provider. But this technique should be changed, because it shows that is more likely to lead marked evidence of error which might cause a sever health issue such as blood transfusion and medication complication administration. One of the method suggested to lower the risk level is through utilizing of an automated ID system and allow a time-tested, reliable and accurate patient identification which guarantee management in safety and secure manner. (García Betances and Huerta, 2012)

Now when talking about Princess Noura University(PNU)Dental Hospital is a part of health governmental sector, female based-element located in Riyadh city, Saudi Arabia. PNU received a great attention and has allowed Saudi women to make definite strides towards achieving their ambitions and unveiling their uniqueness in different fields. Hence, Saudi women has emerged in both local and international level so they can be seen in various fields of culture and specialization of research and science. Thus, it committed to achieve the objectives and missions of the nation by establishment of education, innovation, and scientific research. Specifically, the Collage of Dentistry which was established in 1433H, which lead to medical cadres in dental field to promote oral and dental health throughout the community.Specially focus on female and children candidates by providing preventive, diagnostic, and treatment services, meantime committing to a standard level of quality and continuous development in skills and knowledge and accredit the future visions according to international standards. Taking into consideration the highest level of infection control policy and safety from and to patients. Hence, various type of treatment is

provided which are: emergency and non-emergency (restorations, root canal treatment, prosthodontics, and oral maxillofacial surgery,...etc) services.(PNU Web site)Moving to PNU dental staff, they are comprehensively occupied by admirative and clinicians which include of: dentists, dental assistants, dental technicians (lab technicians and X. rays technicians), dental receptionists, engineers, human resources staff, and dental cleaners. Each and every one will be involved in this dissertation.

Recently, managing the provided services and profit gained as per standards is extremely complex process faced the business companies. All manager consultants are trying to find solutions such maintaining profitability and services viewed by consumers. Over time, these services are faced by competitors to render desired service to consumers and healthcare industry become one of the emerging industry service sector. (Bhuiyan Albarune, Farhat and Afzal, 2015)



(Leza and Emran, 2014)

Figure1: Smartphone and QR identity bracelet.

This type of medical emergency implementation can help several classes of people; infancy, children, adults, and elderly. Each category will benefit in a specific way. For example, elderly mostly have an increased level of morbidity including Non Communicable Diseases (NCD) and mental illnesses hence: unconsciousness and dementia are the two main concerns in dealing with old people.

Another shot is adult individuals; so as reported 2365 head and backbone injuries in monthly bases in Saudi Arabia, 2019 report (Saudi Gazette), in which rendering the necessity of having a movable emergency medical ID to be used as situation required. As a matter of fact, this technique will dramatically increase survival rate and on the other hand will decrease the mortality rate among young adults.

A various of health institutions inside Saudi Arabia are not aware of the importance to vest an ID medical emergency, till now no hospital provide their employee and patients to permanently wear a medical identification to save them in case of emergency. The focus of this study is to fill the gap between authorized personnel of health defenses and affected population. Also, a huge gap presented that till now still no published researches in Kingdom of Saudi Arabia implemented this type of method construction.

This method of identification is extremely useful, scene of medical emergency or inside hospital setting. Hence, allowing authorized personnel (paramedics, police, and fire-fighters) to constantly obtain vital record to save the lives' of others. In addition, this could be helpful in case of diseased personnel especially who have mental disturbances for example: Alzheimer's, and it would be beneficial to children in case they were lost, etc... Each individual is contributed with a unique QR code tag, which will be drawn to embodied on various shape such as: wristband, necklace, ID card, bracelet, or any other object to place the code hence scanned by the savers. Also, each involved person will have a full authority to update his/her medical record accordingly by given to them a custom made username and passwords to be suitable for use at any time. As it is a QR code based on technology, which is delineated as the most cost-efficient and ease of use of automatized patients identification. (Uzun and Bilgin, 2016) The importance of this proposed research is to identify dental collage staff opinion about potential benefits of using QR code if emergency situations are faced among all level of populations and utilization of this technique if the majority of staff agreed to propose it.

In regard to this study, the aim is to investigate staff opinion about the barriers and benefits of implementing and utilization of a wristband Quick Response (QR) codes into the process of documentation of PNU-dental staff medical information to allow easy scanning of QR Code system in-case of emergency attacks via utilizing technologies such as: mobile devices or scanning tools. As a result, the study objectives consist of (1) performing a literature review and an online survey to allocate staff opinion about implementing the specified method via using electronic survey; (2) conducting a time study analysis to validate the benefits in terms of life saving, lastly, (3) perform benefits of cost analysis, (4) utilize it to PNU dental patients to take its benefits. Finally, these analysis conclude with the possibility that any healthcare provider center can implement the wristband QR code to enhance life expectancy among healthcare providers. Futurity, expand it to all citizens of Saudi Arabia.

Research question:

Is PNU staff either clinical or administrative will be agreed to have wristband emergency ID which contain medical information to serve them saving their lives' outside the era of the dental hospital in emergency situations?

Author suggestions:

- 1- Female staff will have more votes to have Emergency ID than males. (because females usually more caution than males).
- 2- Lower levels of education will predict less significance of acceptance compared to higher level education staff.
- 3- Staff who had previous experience of such emergency situation either among themselves or their family will support the idea of having emergency ID as a safety measurement.
- 4- Staff who have medically compromised or physical disabled family member will look at the idea as an important measure.
- 5- The majority will be agreed to utilize QR code technique as a measure of safety in case of emergency.

Chapter 2: Literature Review.

QR code is a short cut of “quick response” which is developed in Japan 1994 by DENSO WAVE. QR code is a two dimensional pattern contain information in both horizontal and vertical dimensions, eligible for storing a huge space of record. Hence, it can be scanned and display information via mobile phones and those are nearly similar to the linear barcodes that implemented in various purposes. Once the code is completely formed, the scanning person should have an electronic device (ex. mobile phone or a standalone scanner) to code and read it then decoding is performed to obtain data content using soft-ware analysis. These data is saved on a database server so all patient information will not be missing. This method commonly used in different system of payment to serve clients with various business sectors. For example, technological advances, intellectual property and standardization, convenience, and technical superiority of QR codes over one-dimension barcodes. Per contra, barcode is a one-dimensional optical, machine-readable for impacted information that is formed as format of a dark and white linear structure containing varying width of spaces (binary code 1s and 0s) which will provide a timely information via utilizing a specific scanner representing as digits and symbols. (Telang *et al.*, 2012; Singh and Sharma, 2015; Petrova *et al.*, 2016; Ward and Rochemont, 2019)

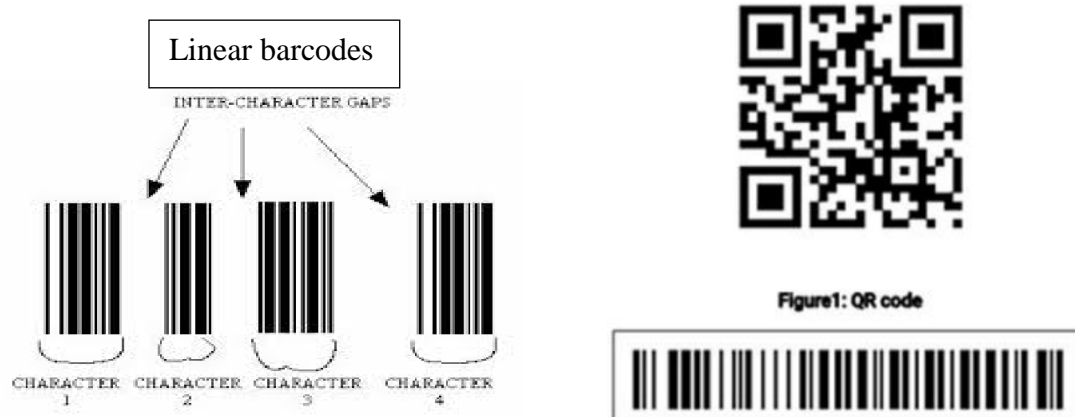


Figure2: QR code and linear barcodes. (Telang *et al.*, 2012; Singh and Sharma, 2015)

In a medical area, patient health monitoring is a prime element. A plenty of time, medical staff faces a complicated time while providing a proper treatment for endanger patients inside emergency room in hospitals and that is because some of them are comatose and some did not have an open file (especially if the hospital is a trauma center) so it will be difficult for physicians to recognize the past medical history very easily and precisely to proceed into further steps of treatment. So, this method of implementation will present a health monitoring system for people, where the person it self will enter their own medical information into a specific server which can be accessed by anyone using QR code technology at any where and any time. By utilizing this, the system helps tracking the individuals health information given an easy access to physicians to look after the records at the time of emergency and saves victim life easily and safely. So, patient complete record file can be acquired. Moreover, electronic QR code based patient record in a healthcare environment facilitate timely access of data regardless where the patient is. Also, it acquire record sharing between treating doctors hence providing a full complete information (past medical history, allergies, when needed. (Leza and Emran, 2014; Deepika *et al.*, 2016)

Numerous application of QR code in dental environment; dental education, product promotion, and practice management.

- a. **Dental education:**for this specific field of education, QR code provide a wide era for the students to get the available scientific materials via internet. A general view seen to have a clear view of topicsin conferences and workshops or having a direct access to lecture notes and presentations. Also, can scan the clinical instruments needed for a particular procedures and get an E-learning resourcesincluding training sessions. Furthermore, in conducting online surveys to assess for feedback faculty and course evaluation forms, it also can be used to follow up the student projects and portfolios and for newly registered students for showing up the maps for the dental school campus. (Telang *et al.*, 2012)
- b. **Product promotion:**QR code might be utilized to allow full access and give a detailed data for dental products for example electric toothbrush, oral hygiene aids including oral cancer kits and saliva testing kits or any other dental devices. These given information would enrich and elaborate the general population to actively use QR code easily which promoting to better understanding and responses. (Telang *et al.*, 2012)
- c. **Practice management:**In regard to dental practice QR code can be utilized in two domains: educational, positively promote patient-dentist relationship, and to provide online feedback of healthcare providers to collect the overall patients satisfaction and assessments of hospital performance. Educationally, video links for various types of clinical procedures, post-operative instructions, and patient awareness and willingness. (Telang *et al.*, 2012)

Inventory control is a another great example of utilizing QR codes inside health organization. Hence, it is an essential element to manage dental material supply in any dental society, because it act as a physical store to maintain the material exchange in use. This will lead to simplifying and categorization of item to facilitate material selection and application of statistics. Material management verified in different several techniques for example, ABC, VED, EOQ,QR coding system..etc which invented to define the prioritization of material reordering and also determine quantity needed. (Deshpande, 2016) Also, help the operation managers to apply a proper strategic plan to calculate mathematically all material supply chain and provide improvement of the process periodically. Dental material inventory management is extremely essential to determine the economic order quantity, safety stock, and lead time of supplied material. Hence, allows continuous material supply without any periodic disturbance. (Hukum and Shrouty, 2008)

Another example, is to make a lifetime accessibility of healthcare data records using QR code system leading to improve completeness of patients information by the healthcare providers.



Figure 3: wristband printed with QR code.

When comparing QR code with the linear barcodes several beneficial aspects are observed. First, it is capable to encode the characters as in phonemic writing systems. Secondly, QR code containing a huge information space due to high data-density. Moreover, it is less expensive and be more readable from any digital screen available. Regarding to the system content: measurable, provide instant information, reduces printed advertising materials, and follow ISO standards. (Telanget *et al.*, 2012; Petrova *et al.*, 2016) Furthermore, QR system promote not only business companies but also the criminal element which is exploited and develop a scarce to security. These undermining of security are made by visiting a mysterious website and scanning a code from unknown sender which render to infect the devices by viruses. Although, QR code is not dangerous by it self hence no chances are feasible to evaluate the code prior entering or scanning the code, this technique is called attagging. Such malpractice could lead to loss of sensitive personal record or damage to soft-ware system that have been involved with the scanning. However, many clients forget that QR code showed similar dangerous behavior to emails and websites. (Petrova *et al.*, 2016)

Some security insufficiency were found regarding to using QR code system:

1- Attacks caused by human being:

As known to QR code system, it cannot be decoded via human eye to extract information. Rather than this human can construct a fake code which contain electronic viruses to access people information and hack their devices and this is found in many countries globally.

2- Attacks made automatically:

These attacks assume that all contained information is safe, however changing information think to be possibly manipulated thereby attacks are launched on a particular database or perform a fraudulence. (Ward and Rochemont, 2019)

When financial issue is claimed, procurement of smartphone to scan QR code payments might be low in certain demographics within a cashless community:

- Some elderly and other living people inside community are unable to afford or are not willing to pay or learn an electronic device such as mobile phone to have QR code system in active state.
- Some rural locations lack a proper telecommunication or networking system that is needed to support the QR code application inside rural community. (Ward and Rochemont, 2019)

However, this theory does not fully explain if thus implementation would benefit the health status unless experiencing it even in small sample and follow it in a long time run. Some people think that QR code system will serve only an identified group of age, but in reality this technique is serving all community layers even children.

Medical errors can be minimized via utilizing QR code made by first responders:

The most common medical error detected globally is wrong drug prescription in the health care industry. Study done in United State (US) showed that errors in medication prescription affect more than 1.5 million of US population annually in which \$3.5 billion expend on related treatment. However, QR code can reduce these expected chances of error via promoting an accurate medical health record to the first responders who can easily engaging the victim information by smartphones or even scanning machine. On a medical era, various of medical errors can be prevented if correct communication between health care provider and the patients by improving identification methods. These inserted data are in the form that allow for numbers,

text, and photos to be saved. The main feature accounted for QR code is; its capability to re-form again in case of damaging with information still fixed, valid inside server database and can be used. (Dube *et al.*, 2015)

When referring to education inside health care, the use of QR code form thematic views:

1) Increasing participant engagement:

This method is extremely beneficial as its related to its adaptability and low cost learning resources. Also, it limits specimens damage for medical teaching such as; Anatomy and Pathology studies.

2) Just-in-time (JIT) learning:

This is a paradigm showed that a learning and training sessions are available when needed which can be accessed by staff or trainee any time. For example, QR code can contain either references or guidelines to refer into proper information, or directly contain information in form of video or pictures or even written information hence enhance accessing into data timely and easily.

3) Simulation:

An example is printing QR code inside ultrasound training room for practice, which provide limited resources and comprehensive solutions compared to traditional method that require hardware alternatively.

4) Training support:

This implemented via receiving feedback and application of individual QR code per student or trainee which could be scanned by faculty member for evaluation or other purposes. Demonstrators showed that electronic form of evaluation has superior impact rather than paper based, considering easy navigation and feeling more comfortable. On the other hand, students did not report increase effectiveness when these methods comparing.

Also in hospital domain, two medical system had been evolved with association with Malaysia University. Telemon used during emergency situation to easily accessing of patients record who are in critical condition, mainly supporting on-duty doctors. Another one is created named as Teleasis mainly for access improvement of patients record such as medical history. (Leza and Emran, 2014)

Patient Specimen and Laboratory Testing Identification Errors:

From the beginning, a false ID is coping with a mismatching of patient recognition, investigation information, or even specimen analysis. These all must be linked with correct patient identity through the all testing process. Many reasons had been confirmed causing ID errors, undertaken by the control of laboratory made via human errors. This error is caused by lacking of a standardized patient identification method, as a result reported ID outcome varied with different institutions due to diversities detected in measurement methods and how the specified laboratory and clinical staff can effectively recognized the error. So, QR code electronics unite all discrepancies and simplify identification process. (MA Gillentine, LN Berry, RP Goin-Kochel, MA Ali, J Ge, D Guffey, JA Rosenfeld, V Hannig, P Bader, M Proud, M Shinawi, BH Graham¹, A Lin, SR Lalani, J Reynolds, M Chen, T Grebe, CG Minard, P Stankiewicz, AL Beaudet and Schaaf, 2017)

Chapter 3 Research Methodology:

Inclusion and Exclusion Criteria

Data will be collected via questionnaires distributed in 2020 from the faculty of dentistry at PNU, Riyadh city. The sampling frame is convenience sampling included all Saudi and non-Saudi staff members either Arabic or English speakers regardless of age, gender, and race/ethnicity. These standardized questionnaire will be sent to all representative samples including clinical staff and administrative staff full/ part time employee via an official work E-mail.

In this type of research, we will assess the staff opinion about constructing an emergency medical ID to use in emergency critical situations. We would discuss the methodology that will be utilized to gain our aims from the study implemented. Through writing this section, we begin by introducing the staff to two questionnaires which made previously. The first questionnaire is attempted to evaluate the staff opinion about potential benefits for them in increasing their risk of survival in case of accidents or while losing consciousness at any time after wearing the wrist band. The second questionnaire is to collect all medical data required to fill up the system data base to gain a customized QR code per person.

The following populations have been excluded from the research:

- Non-Arabic and non-English speakers.
- Participants who are unwilling to participate.

The following criteria is provided to make the ID wrist band:

- Stainless-steel based (corrosion resistance) with rubber based band.
- Water-proof.
- Fire-proof.

Data Management:

The first step of this study is to give the staff the questionnaire and filled by every employee which is identified anonymously, the data will be managed by the researcher with no corresponding name identification on each survey to assess staff opinion. As a second step, the second survey is used to determine their medical health records which is identified by their name and ID. In this research, we will consider the first survey to take a cross-sectional analysis about the importance of this method to be implemented.

Procedures:

First all clinical and administrative staff addresses including: their names, contact numbers, position, and official E-mail will be collected, then the first survey will be distributed via work E-mail to participate into this research. Those who are met the eligibility criteria and agreed to participate, consent took place and designed as a part of the first questionnaire. This study required implied consent since it is a one-time survey with minimal risk. The completed surveys will be collected and identified with an ID number for each survey. The study data will be gathered via email and handled electronically. The final sample was represent 27 participants for the first questionnaire. All data will be kept confidential and de-identified. Surveys will be coded with an ID number so the answered surveys will be treated without names. Also, all data will be kept in secure database and all material will be saved and locked by one person. No information will be made in public.

Measures:*Dependent Variables*

The main dependent variable are on these questions; Do you think QR code can be used as an emergency equipment? Do you know that wrist band QR code system can increase survival risk among general population? Do you think QR code will break person confidentiality? Do you think that QR code system can be applied inside PNU either for staff or patients in case of emergencies? Do you agree that QR code system should be implemented inside our PNU hospital? Did you experience an emergency situation for you or any of your family and wished to have emergency medical ID as a safety measure? Did you have a medically compromised or physically disabled relative and wishing to have emergency medical ID for safety?

*Independent Variables**Demographic Items*

Demographic variables include gender (1=male; 2=female), age (1=under 25 years old, 2=between 26-35 years old, 3=between 36-45 years old, 4=between 46-55 years old, 5=above 56 years old), marital status (1=single, 2=married, 3=separated, 4=widowed, 5=other), education level (1=less than high school, 2=high school degree, 3=diploma, 4=bachelor, 5=Post-graduate degree {master or PhD}), job position (1=clinical, 2=administrative, 3=other), employment status at present time inside the PNU (1=full time job, 2=part time job, 3=other)

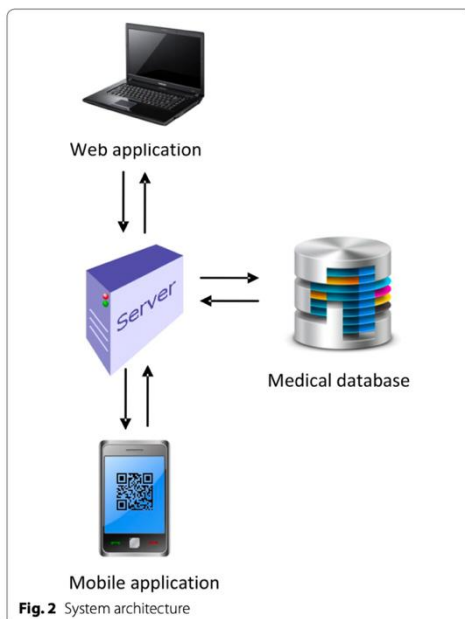
System Design (Business plan):

Figure ref. (Uzun and Bilgin, 2016)

PNU staff considered to be an outpatient in this case, to start with; mobile application is created by utilizing a username and password, two pages will be opened; one filled as a victim which will be filled by the personal medical record and another as rescuer which is released mainly to code QR code of others while needed.

All participating members should register to the QR code Identity Tag website. Each individual is asked for a strong password, after account is created, then they ask to fill all detailed medical

information of him/her include: the name, working filed, Emergency contact number, Another phone number, Address, Medical condition, Any allergy, Current medication, Any Surgical intervention before, Blood type, and Contact number of a person has the same blood type. When all completed, QR code and security code will send to the so they can modify their medical health condition as needed. Then, it can be printed on a wristband.

This system based in three main elements; mobile application, website and database. The main function of the website is to maintain patient health record and the database is to store them accordingly. For sure, mobile application to connect the previous two to be ready to use. Medical information can be accessed by scanning the code with any standard devices either by smartphones with the application uploaded or standalone scanning machines to retrieve the data. By this way, medical information is showed simply when QR code is scanned by authorized personnel are available when emergency evolved.

When a rescuer scan the QR code of the victim using mobile application, a full medical record of the victim will show so the rescuer can easily medicate and treat the victim or if the rescuer only need to get help, a share icon will appears to share current location, written or recorded of current situation of the victim to the authorized personnel (Police Officers, Civil of Defense, Red Crescent, and Paramedics) to get reached into exact location which promote a timely announcement and help the victim. Authenticating is provided by write the ID number (Saudi ID/ Iqama ID) to facilitate identification of the rescuer in case a false alarm is raised.

The mobile application will be linked with authorized personnel website to permit immediate and fast response allowing a timely medical engagement and reducing medical error. (Uzun and Bilgin, 2016)

Research Philosophy:

This philosophical research approach is based on natural observation and reality is constantly renegotiated or debated or interpreted of society entity which considered as a Pragmatism type of philosophy. So, the Epistemology of this research should be examined using the best tools to reach reality. Research approach strategy basis via data collection and hypothesis development. Hence, these hypothesis is must be tested and confirmed which later can either be used for further research or be amplified in real work situation. In which this research methodology is highly structured in order to allow facilitating the hypothesis construction. The main domain of data is a quantitative, hence statistical analysis must be obtained accordingly.

This research is conducted on the basis of how importance of individual to have an emergency medical identification to increase survival rate while crisis. For example, fire crisis, accidents, mental instability, and in case of lost especially for children. Factors must be studied: the importance of the emergency ID, increased rate of population who have the ID and future of committing this method to develop hypothesis and how it will influence our social life, influence of regular staff without ID recognition.

Research Paradigm:

- **Ontology:** It seems that the diversities are present in all population, so there is always a debate and negotiation between people thinking.
- **Epistemology:** In which, application of thesis that include research tools is considered to reach into the reality or knowledge.
- **Theoretical perspective:** A Pragmatism type of philosophy is obtained.
- **Methodology:** cross-sectional scan from PNU society.
- **Methods:** Via self-constructed questionnaires.
- **Sources:** A real time data.

Data Analysis occupied for the first survey:

- Google survey to store information as a database.
- SPSS analysis.

First Questionnaire:

A Survey Constructed to evaluate Staff opinion about potential benefits for using hand wrist band utilizing QR technique as a method of survival:

Staff Opinion Survey

Instruction: This survey will be used to evaluate staff opinion in application of QR coded wrist band as a medical emergency component to increase survival rate. Please answer each question as accurately as possible. If you don't understand any question, answer it as well as you can and note your questions in the margin. Your answer will be kept confidential and will not affect your status as an employee at our organization. When you have completed this survey please send it back to the same sender. If you have any question, you can contact 0568418070. Thank you.

DEMOGRAPHIC INFORMATION

Please circle the number next to each answer for each question that best describes you.

1. How do you identify your gender?
1=Male.
2=Female.
2. How do you identify your age?
1=Under 25 years old.
2=Between 26-35 years old.
3=Between 36-45 years old.
4=Between 46-55 years old.
5=Above 56 years old.
3. What is your marital status?
1=Single.
2=Married.
Separated.
3=Widowed.
4=Other.
4. What is the highest level of education that you completed?
1=Less than high school.

2=High school degree.

3=Diplomate.

4=Bachelor.

5=Post-graduate degree (master or PhD).

6=Other.

5. What is your Job position?

1=Clinical.

2=Administrative.

3=Other.

6. What is your employment status at presenttime inside the PNU?

1=Full time job.

2=Part time job.

3=Other.

7. Do you know what is QR code“QR code is a short cut of “quick response”. Which is a two dimensional pattern contain information in both horizontal and vertical dimensions, eligible for storing a huge space of record. Hence, it can be scanned and display information via mobile phones and those are nearly similar to the linear barcodes that implemented in various purposes..” . (Telang *et al.*, 2012; Singh and Sharma, 2015; Petrova *et al.*, 2016; Ward and Rochemont, 2019)

1=Yes.

2=No.

8. Do you think that QR code can be used as an emergency equipment?

1=Yes.

2=No.

3=I do not know.

9. Do you know that some countries utilizing QR technique on their patients inside hospital emergency department?

1=Yes.

2=No.

3=I do not know.

10. Do you think that wrist band QR code system can increase survival risk among general population?

1=Yes.

2=No.

3=I do not know.

11. Do you think QR code will break person confidentiality?

1=Yes.

2=No.

3=I do not know.

12. What is in your opinion,the most category would benefit from wrist band QR code system?

1=Babies (0 to 2 years).

2=children(3 to 16 years).

3=Young Adults (17 to 30 years).

4=Middle-aged Adult (31 to 45).

5=Old Adults (46 to 64).

6=Elderly (Above 65).

13. Do you think that QR code system can be applied inside PNU either for staff or patients in case of emergencies?

1=Yes.

2=No.

3=I do not know.

14. Do you agree that QR code system should be implemented inside our PNU hospital?

1=Yes.

2=No.

3=I do not know.

15. Did you experience an emergency situation for you or any of your family and wished to have emergency medical ID as a safety measure?

1=Yes.

2=No.

3=I do not know.

16. Did you have a medically compromised or physically disabled relative and wishing to have emergency medical ID for safety?

1=Yes.

2=No.

3=I do not know.

17. Please State any comment if needed?

.....

Second Questionnaire:

The patient is encouraged to fill an online form, this form linked with the QR code wristband identity:

This survey aims to collect all data related to PNU dental staff to transform it into QR code on a wrist band to be useful in emergency situations:

Q1: Your name?

Q2: Your working filed?

Q3: Emergency contact number?

Q4: Another phone number?

Q5: Address?

Q6: Medical condition?

Q7: Any allergy?

Q8: Current medication?

Q9: Any Surgical intervention before?

Q10: Blood type?

Q11: Contact number of a person has the same blood type?

Chapter 4 Results:

This study is formed mainly to assess staff opinion. So, this pilot study was implemented for 30 individuals there were 27 participants who answered and completed the survey. 100% of them are female, and full time job, 96.3% of them aged between 26 years and 35 years, and the rest aged between 36-45 years old. 74.07% were holding diploma as a last certificate degree, 18.52 % were categorized to have bachelor degree, and 7.41% were holding a post-graduate degree. 62.96% were working in clinical field, and 37.04 % were into the other category. Frequency test and pie chart were tested because it is a descriptive type of data.

Frequency Test:

Do you think that QR code can be used as emergency equipment?

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	20	74.1	74.1	74.1
No	3	11.1	11.1	85.2
Valid I do not know	4	14.8	14.8	100.0
Total	27	100.0	100.0	

Table 1: showed that more than 2/3 of participants know that QR system is used as an emergency.

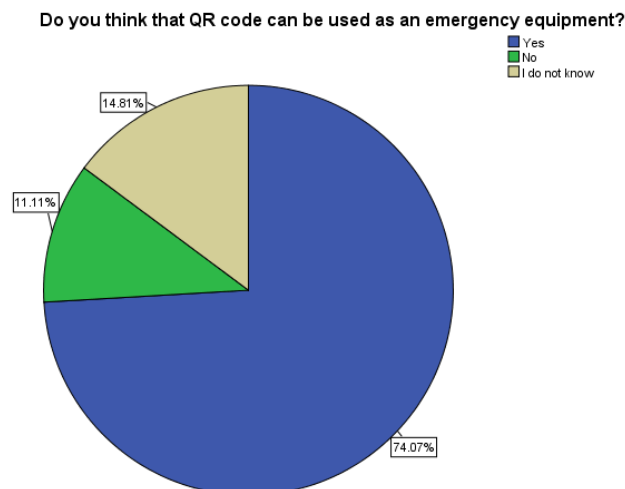


Figure 4: This pie chart showed that a three quarter of participants know that QR code utilized for emergency equipment.

As shown in Table 1, and figure 4: nearly three quarter of the percentile were thinking that QR code system can be utilized as an emergency equipment inside any organization either related to health care or not. However, a similar percentages were counted for the other two options. Advantages of this method that it is a Just In Time (JIT) which allows for immediate information extraction and error free data recording. Moreover, can engage more enrich content because it contains various type of information such as audio or video or even written data.

Do you know that wrist band QR code system can increase survival risk among general population?

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	6	22.2	22.2	22.2
No	8	29.6	29.6	51.9
Valid I do not know	13	48.1	48.1	100.0
Total	27	100.0	100.0	

Table 2: This table showed nearly similar percentage between those who think that the use of QR code can increase survival risk and reverse.

Do you know that wrist band QR code system can increase survival risk among general population?

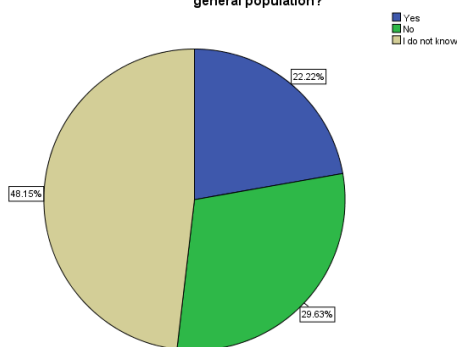


Figure 5: This illustration showed that nearly half of participants did not know that QR code technique can increase survival risk.

As in Table 2, and Figure 5: showed nearly similar percentage between those who think that the use of QR code can increase survival risk and reverse. As well as, they showed that nearly half of participants did not know that QR code technique can increase survival risk.

An example of this title is the using of QR code as an enhancement technique for diagnoses as reported its utilization in GIT system. Mainly adaptive imaging for clinical application in early recognition of cancerous lesions. When the institutional review board (IRB1010202) is evaluated the method, it showed that it can detect a minute tumor which reduce risk of cancer metastasis and increase rate of survival. (Chang *et al.*, 2015)

Do you think QR code will break person confidentiality?

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	13	48.1	48.1	48.1
No	7	25.9	25.9	74.1
Valid I do not know	7	25.9	25.9	100.0
Total	27	100.0	100.0	

Table 3: This table showed that half of the participants showed that this type of method will break personal confidentiality.

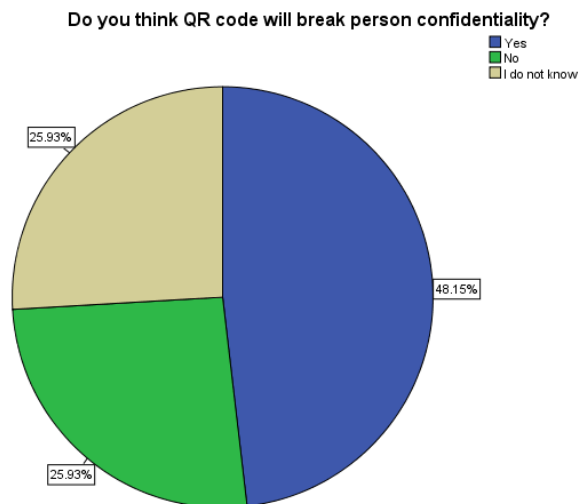


Figure 6: This pie chart showed that quarter of the participants who think this will improve health status and will not break confidentiality.

In Table 3, and Figure 6: showed that half of the participants think that this type of method will break personal confidentiality. Furthermore, quarter of the participants who think this will improve health status and will not break confidentiality. To ensure more secure QR code logistics, a Logistics Information Privacy Protection System based on encrypted QR code (LIPPS) is suggested. Which done by mapping a secret authorization key to allowed personnel and decrypt the data stored in database system.(Belguith *et al.*, 2018)

Do you think that QR code system can be applied inside PNU either for staff or patients in case of emergencies?

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	17	63.0	63.0	63.0
No	2	7.4	7.4	70.4
Valid I do not know	8	29.6	29.6	100.0
Total	27	100.0	100.0	

Table 4: This table showed that more than half of the participants think that this type of method can be applied at PNU environment.

Do you think that QR code system can be applied inside PNU either for staff or patients in case of emergencies?

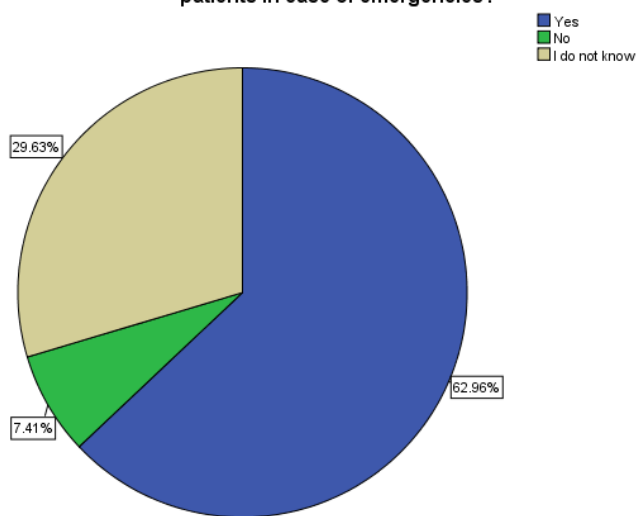


Figure 7: This figure showed that more than half of the participants think that this type of method can be applied at PNU environment.

Do you agree that QR code system should be implemented inside our PNU hospital?

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	23	85.2	85.2	85.2
No	2	7.4	7.4	92.6
Valid I do not know	2	7.4	7.4	100.0
Total	27	100.0	100.0	

Table 5: This table showed that more than 2/3 of participants agreed to implement QR system into PNU dental hospital.

Do you agree that QR code system should be implemented inside our PNU hospital?

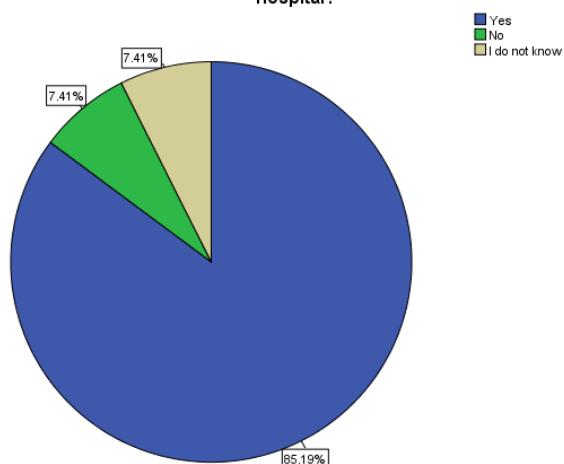


Figure 8: This pie chart showed that more than 2/3 of participants agreed to implement QR system into PNU dental hospital.

More than half of the participants think that this type of method can be applied at PNU environmental dental hospital, as illustrated in Table 4 and pie chart 7. Although, more than 2/3 of participants agreed to implement QR system into PNU dental hospital, as shown in Table 5 and Figure 8. The QR code technique can be utilized in every environment either institution of education or institution of health. The prime cause is to reach the recorded information easily and effectively.

Did you experience an emergency situation for you or any of your family and wished to have emergency medical ID as a safety measure?

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	12	44.4	44.4	44.4
No	12	44.4	44.4	88.9
I do not know	3	11.1	11.1	100.0
Total	27	100.0	100.0	

Table 6: This table showed that the participants answered exactly the same between who faced emergency situation wished to have emergency ID and who are not.

Did you experience an emergency situation for you or any of your family and wished to have emergency medical ID as a safety measure?

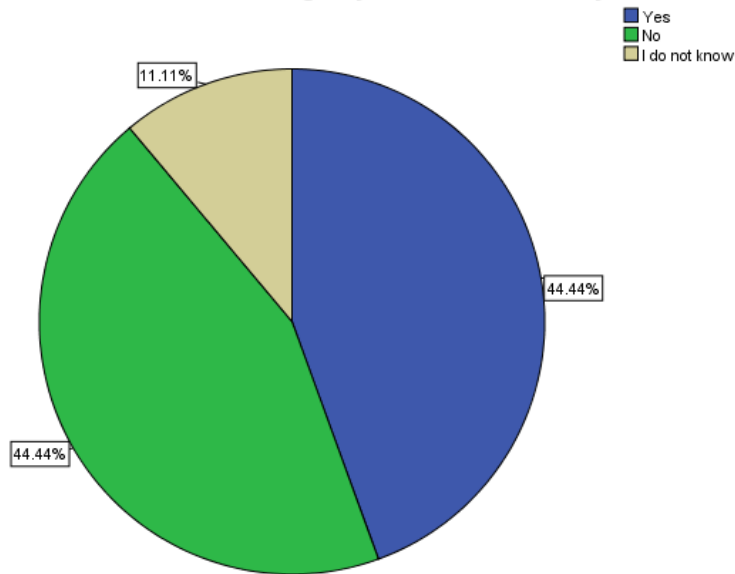


Figure 9: This illustration showed that the participants answered exactly the same between who faced emergency situation wished to have emergency ID and who are not. This indicate huge percentages of population who mandate to activate the QR code system in health organization and hospital that managing even the needed individual during crisis. By this implemented, survival rate will be enhanced.

Did you have a medically compromised or physically disabled relative and wishing to have emergency medical ID for safety?

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	10	37.0	37.0	37.0
No	15	55.6	55.6	92.6
I do not know	2	7.4	7.4	100.0
Total	27	100.0	100.0	

Table 7: This table showed that nearly 1/3 of participants did have physically disabled family member. In which, more than half of them did not have.

Did you have a medically compromised or physically disabled relative and wishing to have emergency medical ID for safety?

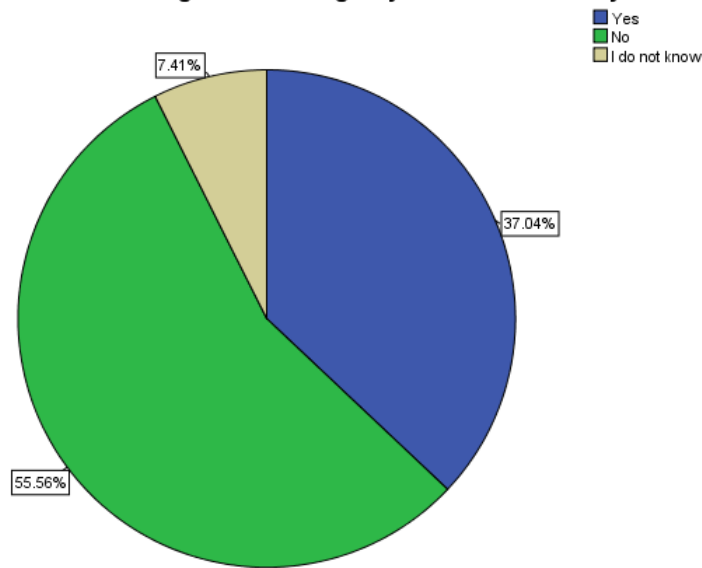


Figure 10: This figure showed that nearly 1/3 of participants did have physically disabled family member. In which, more than half of them did not have.

In Table 6 and Illustration 9, participants answered exactly the same between who faced emergency situation wished to have emergency ID and who are not. However, nearly 1/3 of participants did have physically disabled family member. In which, more than half of them did not have, as seen in Table 7 and Figure 10. Some research's, reached out to highly recommend the utilization of QR code for disabled people. For example, visually impaired people can benefit from this system technique, the holder can affixed to a specific object using a device equipped with QR scan software, to code and decode and explore the object location to an audio file which contain a verbal criteria describing that particular object. (Al-Khalifa, 2008) Hence, this system can implemented easily to cover emergency crisis.

DESCRIPTIVES VARIABLES=Gender Age Marital Education Job Employment QR Dif Equipment Application Implementation SafetyID Compromised Confidentiality Benefit Survival UtilizingQR

/STATISTICS=MEAN STDDEV MIN MAX.

Discussion

This done review showed an overview of the multiple use of QR code in healthcare institutions. However, increasing suggestions on utilization of QR code system in the subject area. The key element of using QR code in emergency situation lie in its capability to extract timely, full, and in a cost effective manner which has been studied to be positively effective as showed in education series. The main reasons suggested are: immediate respond, available, and easy utilization when compared to other traditional methods. (Karia, Hughes and Carr, 2019) Furthermore, a plenty of benefits acquired from using QR code, lies in its simplicity and adaptability. A dynamic QR code allows the scanning personnel to share the current location of

the victim, write a report or voice recording of the current situation to refer it into the desired destination, name and job position of both by clicking on share icon after scanning and dial the ID number (Saudi ID or Iqama ID) of rescuer to send it to the responsible governmental sector as needed (Red Crescent, Civil of Defense, Police officers) via linking the scanning page with those sectors. Furthermore, allowing the linked resources to be changed and updated without changing the external code so information do not mistaken. (Karia, Hughes and Carr, 2019) The big gap is the necessity to have an available network to report the issue.

There is some examples confirmed the success of QR code technique rather than for education purposes. QR code is used to access a form to record procedural events, raising the level of submission of reader participants offering them immediacy via demonstrating QR code, and it is approved to increase capacity for media presentation, huge data distribution and increase public engagement. On the other hand, gap presented on education track and inside clinical setting some patient might think that holding a smartphone while they are setting in front of the doctor seen unprofessional. Another gap is, sometimes internet coverage inside clinical areas is extremely weak which limit the usage of QR code system and this require reinforcement of technical infra-structure, in addition that a difficulty might be faced either on the way of QR code presentation or difficulty with the scanner which need more technological improvement. (Karia, Hughes and Carr, 2019)

Limitation:

Literature around the use of QR codes in emergency situation is still extremely minute, however, some countries showed evidence trying to utilize QR system on their patients. The majority of articles included in this research; explain the general usage of the QR code, how to engage the system into patient files, qualitative perception rather than quantitative data carried from questionnaires included in the literature. Moreover, the main bulk of research are from Western countries or countries who have a well-developed health care system. Majority of articles also focuses on using QR code on education, advertising, survey conduction, and industrial construction. But a big whole goes if these finding is applicable to ascertain the possibility of QR code implementation that would benefit the health care team.

The main limitation of this research is; including the convenience sample. It was the only sampling technique that I could use to collect the data. A convenience sample can lead to the under-representation or over-representation of particular groups within the sample, thus I cannot make generalizations from my sample to the whole population under study. With this limitation in mind, there are some preliminary findings. Larger samples are required to determine consistency of the tool. Similar results under consistent conditions will determine high reliability of the tool including different background participants.

Other limitation is, reasons not listed inside the questionnaire to explore staff thinking about each question; further research is indicated to cover all areas in details in the context of the questionnaire.

Chapter 5 Conclusion and Recommendations:

Overall, improving quality of life and reducing healthcare cost are part of improving healthcare system. It is vital to lower the level of medical error while emergency treatment is promoted, this system method can affect positively on patient survival and enhances easy delivery of healthcare

services. Although, Saudi Arabia's life expectancy rank is 58th however it increasing by an average of 0.193% from 2010 to 2020. (United Nations - World Population Prospects)

Usually in healthcare system, slower steps is taken regarding involving of new technologies when compared to other fields. This is truly right, because healthcare sectors concerns mostly about patients safety, record confidentiality, ethics and laws, equality of access, and many other considerations. Likely, QR code technique only depend on assessing the effect, benefits and negative for staff and patients, when this is strictly needed to be implemented; improvement of networking infrastructure among healthcare environment is highly requested to allow for more smooth adoption of the technique. Should be minded that, not every improvement must be associated with technological solutions because in some circumstances or situations, the use of smart devices would be less effective. Although, QR code can be a great opportunity to be engaged into other process regarding healthcare environment. Further studies should be focused on the reliability of studies related to QR code uses in other clinical application including emergency situations. Also, guidelines must be provided to protect staff, patients, and the trainees of this technique.

While the dataset is small, increasing sample size should benefit the research study. As certain, the majority of PNU dental hospital staff agreed to implement QR code system into their personal life. Potential predictive factors and prognostic indicators for poor outcomes related to disfigurement and body image perceptions include: being a female, lower levels of education, and other possible predictive factors were included in the tool, however, more statistical analysis were needed to make any conclusions.

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