ARTIGO ORIGINAL

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SILVA, Rafael Henrique. Et al. Development of mobile application for safe surgery checklist. Revista Científica Multidisciplinar Núcleo do Conhecimento. Year 05, Ed. 08, Vol. 10, pp. 25-38. August 2020. ISSN: 2448-0959, Access Link: <https://www.nucleodoconhecimento.com.br/health/surgery-checklist>

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SUMMARY

Communication and information technologies are increasingly influencing health actions, as well as patient safety. Thus, this study aimed to develop an application for conference and control of all stages of the Safe Surgery checklist suggested by the World Health Organization improving the safety of patients submitted to surgery. The problem of research lies precisely in the absence of mobile applications capable of meeting the need for patient safety. This study is applied in the technological development of an application with the possibility of deployment in any health service and easy installation on mobile devices. The app was built based on the Safe Surgery checklist established by the World Health Organization. The application allows patient identification through three identifiers. Later it contemplates all the items of the three stages of the checklist of safe surgery: Before anesthetic induction, Before

the Surgical Incision and Before the Patient Leaves the Room. At the end of all the steps of the application, it calculates the risk to patient safety. The application developed is a tool that can be implemented in health institutions and used by professionals working in the operating room.

Keywords: Patient safety, surgical procedures, smartphone.

INTRODUCTION

Contemporary society consists of individuals, companies and the State operating in a local, national and international field in a structure defined as Network Ed Society. The functioning of this new social structure is dependent on digital communication and information technologies (CASTELLS; CARDOSO, 2005). After the innovation caused by the Internet, the popularization of smart phones (smartphones) is considered the most impactful technological revolution in recent years (TIBES *et al.*, 2014; IDC, 2013).

The popularization of smartphones has changed the relationship with technology, since these devices play the function of pocket computer, since it allows a variety of possibility due to its great diversity of applications. This computer-like functionality is due to the development of advanced operating systems for smartphones (SOUZA, 2016).

Bilotti *et al.* (2017) states that currently, the smartphone allows easy access to the internet at a relatively low cost. It allows access to applications that address the most varied topics, including can be an alternative to improve the population's access to health, as well as promotion and prevention.

The health area is certainly one of the most influenced by the growing use of communication and information technologies. Over the years, the use of mobile devices has grown and gained more and more space in this area, giving rise to the concept of mobile health (mHealth) defined as medical and public health practices aided by portable devices, such as mobile phones, patient monitoring devices, digital personal assistants and other wireless devices (WHO, 2011).

The applications, for the most part, are created by private developers and are not linked to

research projects, in this way, despite the popularization of applications and their importance for the health area, research in this medium is still incipient (TIBES *et al.*, 2014). Often health applications are idealized by professionals and implemented by information technology professionals, however, without necessarily going through an appropriate methodology and linked to research projects (OLIVEIRA; ALENCAR, 2017).

According to Souza *et al.* (2013) in recent years there has been an increase in the number of health professionals using smartphones in their work activities. This fact illustrates a new reality in the provision of services, where applications through mobile devices facilitate the consultation of guidelines, protocols and monitoring of patients.

Among the current protocols, the world highlights are those focused on the safety of surgical patients, with guidance for it to be instituted as a health policy that should be implemented and monitored rigorously in all health services, both public and private. For the patient who needs surgery, it is essential that anesthetic and surgical procedures occur with quality and that the patient's safety culture allows possible errors to be minimized through the application of the Protocol for Safe Surgery of the World Health Organization (WHO) (CORONA; PENICHE, 2015).

Who used three principles to develop the Checklist, simplicity, wide applicability and possibility of measuring impact. It allows teams, by efficiently following critical safety steps, to minimize the most common preventable risks that endanger lives and compromise the well-being of surgical patients (ELIAS *et al.*, 2015).

The Checklist consists of 19 items divided into three distinct moments: before anesthetic induction, before the surgical incision and before the patient leaves the operating room (OLIVEIRA *et al.*, 2018; AMAYA *et al.*, 2015; PAIVA *et al.*, 2015; SORIA-ALEDO *et al.*, 2012).

Before Anesthetic Induction: The patient is verbally confirmed with the patient the identity of the same, the procedure and the place of surgery, and whether the consent to the procedure was signed. It checks whether the correct side of the surgery has been signaled and the proper functioning of the pulse oximeter. The anesthesia team should verbally review whether the patient has difficult-to-access airways, risk of blood loss or allergic reaction (WHO, 2009).

Before Starting Surgery: Professionals present themselves with name and function. Aloud, the identity of the patient, the procedure and the location of the body to be operated are checked. Later, the surgeon, anesthesiologist and the nursing team verbally review the critical points for surgery. Next, the prophylactic use of antibiotics in the last 60 minutes and the availability of imaging tests are confirmed (WHO, 2009).

Before the Patient leaves the Operating Room: Before the patient is referred to the anesthetic recovery room, the team analyzes the procedure performed, checks the amount of surgical compresses and instruments, identifies the anatomical parts, checks for possible damage to the equipment and problems to be solved, and outlines care plans in relation to the patient's postoperative period (WHO, 2009).

In the area of health the use of checklist is a relatively recent practice, however, in areas such as aviation, nuclear energy sector and civil construction is already part of the routine of the work process, because it allows the verification of important items that could be forgotten by the team. These areas use technology in the structuring and implementation of this process, a practice that could be incorporated for patient safety (FREITAS *et al.*, 2014).

Thus, the objective of this study was to develop an application for conference and control of all stages of the Safe Surgery checklist suggested by the World Health Organization improving the safety of patients submitted to surgery.

Methods

This study is applied in the technological development of an application with the possibility of deployment in any health service and easy installation on mobile devices.

The development of the application involved a constructivist proposal and consisted of the intentional action of planning, developing and applying specific situations, incorporating mechanisms that favor contextualization.

The app was built based on the Safe Surgery checklist established by the World Health Organization. The WHO allows each institution to adapt the Safe Surgery Checklist to its reality, however, as the intention is that the application can be used in the most diverse

institutions and realities, it was decided to use the standard Checklist recommended by the WHO.

The development occurred through the author's own work with a programming team. This moment comprised the definition of how checklist steps would be presented in the application, the definition of the navigation structure, the application tools, and the planning of the configuration of environments.

The mobile app is available on a website with download link on smartphone or tablet with Android operating system. After its development, the application was tested during surgical procedures in a Teaching Hospital.

The study was carried out after approval by the Ethics Committee on Research in Human Beings of Sagrado Coração university – Bauru/SP.

Results

The initial presentation of the application was developed so that the professional can insert the data regarding the procedure that will be performed.

Figure 1. App home screen

Source

18:52

Checklist de Cirurgia Segura

Nome do Paciente

Data de nascimento

Nome da mãe

Nome do cirurgião

Nome do procedimento

AVANÇAR

18:53

Checklist de Cirurgia Segura

Teste1

01/01/2000

Teste2

Teste3

Teste4

AVANÇAR

e: Author himself.

Subsequently, the questions of the WHO Safe Surgery checklist will be presented so that each stage is performed during the procedure and subsequently answered. If the step is performed correctly and the item is filled, the application automatically goes to the next step, as presented below:

Figure 2. Screen for patient identification, location and procedure.

18:54

Checklist de Cirurgia Segura

Antes da indução anestésica

Confirmação sobre o paciente

Foi realizado a identificação do paciente?

SIM

NÃO

18:54

Checklist de Cirurgia Segura

Antes da indução anestésica

Confirmação sobre o paciente

Foi confirmado o local da cirurgia e o procedimento?

SIM

NÃO

Source: Author himself.

In the case of the stage Before anesthetic induction, in the item confirmation about the patient, application questions whether the place of surgery and the procedure to be done has been confirmed, if the professional does not respond as directed by the WHO, the application will bring an alert, stating that this attitude will entail a risk to the patient and questions whether the professional wishes to continue. If the professional responds that they want to continue, the application will move on to the next item. If the professional informs that he/she does not want to continue, the application returns to the previous screen requesting confirmation of the place of surgery and the procedure to be performed.

As long as the professional does not perform the step correctly or does not inform that he/she intends to go to the next step, even being aware of the risk to patient safety, the application will remain questioning the professional.

Figure 3. Questioning of the application in front of the action that poses a risk to the patient

Checklist de Cirurgia Segura

Antes da indução anestésica

Confirmação sobre o paciente

Essa ação representa um risco ao paciente. Deseja continuar?

NÃO

SIM

Checklist de Cirurgia Segura

Antes da indução anestésica

Confirmação sobre o paciente

Foi confirmado o local da cirurgia e o procedimento?

SIM

NÃO

Source: Author himself.

In the sequence, the application continues with the questions of the step before anesthetic induction. In the following screen, the application questions the professional about the surgical consent form, then about the surgical site demarcated, later on the check of the surgical equipment and about the pulse oximeter installed and functioning.

On the screen referring to the item where the professional should question the patient about some allergy, if the answer is negative, the application will proceed to the next step. However, if the patient informs that he has some type of allergy, the professional will answer yes and the application will open a field to be informed what is the patient's allergy, be it some medication, material or food.

By finalizing the items that must be performed before anesthetic induction, the application will question the risk of difficult airway and the risk of blood loss.

Following the steps of the Safe Surgery Checklist, the questions refer to the "Before starting surgery" step. Similarly, if the answer is appropriate the application goes to the next item, if the answer is inadequate, the application alerts the professional about the risk to patient safety and if, still, it wants to continue.

At this stage, also known as time out or surgical pause, the application acts assisting professionals with all necessary questions. An application screen questions whether all team

professionals confirm their names and professions, the following screen asks the surgeon, anesthesiologist and nurse to confirm the patient's identity, location and procedures to be performed. Later, surgeon, anesthesiologist and nursing are asked by the application if there is relevant information that needs to be shared. Finally, the safe surgery application questions about antibiotic prophylaxis in the last 60 minutes before the incision and the availability of imaging tests in the operating room.

The third stage of the Safe Surgery Checklist is "Before the patient leaves the operating room". The application also includes all the items of this stage, in a screen requests the confirmation of the procedure performed, in the following the counting of compresses, instruments and needles, on the next screen if the biopsies are identified, later the application questions the professional if there was any problem with the equipment used, and in the next screen, if surgeon, anesthesiologist and nurse analyze the most important points in the post-anesthetic and postoperative recovery of the patient.

At the end of the process, the application presents a calculation of the percentage of steps performed correctly in accordance with the steps of the Check-list: Before anesthetic induction, Before the surgical incision and Before the patient leaves the operating room. With the percentages calculated, the application performs a final calculation and informs the patient's risk during the procedure according to the Check-list of Safe Surgery recommended by the WHO.

Figure 4. Calculating the risk of the patient generated by the applicati

18:56

Checklist de Cirurgia Segura

Antes da indução anestésica
83% dos itens realizados

Antes de iniciar a cirurgia
86% dos itens realizados

Antes do paciente sair da sala cirúrgica
80% dos itens realizados

Geral
De acordo com o Check-list de Cirurgia Segura da OMS o risco desse paciente durante o procedimento é de 17 %

RESUMO

INÍCIO

on
Source: Author himself.

The app will present the Summary and Start options. In the START option the application returns to the first screen to start the Check-list again. The professional can choose the SUMMARY option where the application generates a report with all check-list questions and their answers.

There is also the print option that allows you to print the report to a configured printer or save the PDF file to your Tablet or Smartphone.

Discussion

The safe surgery application was developed considering that the health applications aimed at safe surgery served only as a consultation of the who checklist steps. The functionality of this application allows the professional to interact with all stages of the WHO checklist, promoting patient safety and encouraging professionals to correctly follow all stages.

In addition to improving communication in the operating room, the checklist is a tool to ensure patient safety. There is a difficulty in verbalizing information on the part of some professionals, so the checklist provides opportunities for professionals to share any concerns with other team members (PANCIERI *et al.*, 2014; CUNAT *et al.*, 2011; HAYNES *et al.*, 2011; PAUGAM-BURTZ, GUERRERO, 2011; RATEAU *et al.*, 2011).

In relation to the patient, three identifications were chosen: name, date of birth and mother's name. More than one identification favors patient safety and the chosen identifiers allow the patient to respond more easily. Next it is necessary to fill in the name of the surgeon and the procedure that will be performed.

The correct identification of the patient is valid and necessary so that the entire surgical team does not perform erroneous procedures. (ALPENDRE *et al.*, 2017; FREITAS *et al.*, 2014). This confirmation ensures that the surgery is performed on the correct patient. Identifying the patient is essential to ensure that care is provided to the correct patient, considering the possibility of patient change. Given this possibility, the identification of the patient, according to the protocol, is recommended by the Ministry of Health for all institutions that provide health care. (AMAYA *et al.*, 2015; MINISTÉRIO DA SAÚDE, 2013).

The application is a digital tool, its commitment is to patient safety, however, the time used to respond to all the steps of the application should not burden the procedure time, so the application was designed to expedite the checklist, with this, on average, the time used in all stages of the application was 144 seconds , i.e. 2 minutes and 24 seconds.

It is estimated that the time required to apply the three steps of the checklist is three minutes. The guidance is that its completion is easy, fast and that a single professional is responsible for conducting its application. (SOUZA *et al.*, 2016; PANCIERI *et al.*, 2013).

The computerization of the process, through mobile applications, allows information to be recorded in a shorter time and reducing the possibility of mistaken records. (LEE *et al.*, 2018).

The application developed calculated that a single item not performed increases the risk of the patient by 7%, thus, it is expected that the professional when viewing this information can review his/her conduct.

Results of national and international studies expose that non-conformities in the safe surgery procedure do not occur exclusively due to limitations of resources or infrastructure of surgical centers, needing a much more complex approach. Identifying factors related to checklist adhering and evaluating effective implementation methods are essential actions to better understand the phenomenon and advance the patient safety process. (ALMEIDA, RODRIGUES, 2018; CULLATI *et al.*, 2013; PICKERING *et al.*, 2013).

One study observed that the use of the checklist was performed in 80% of the surgeries, however, the registration of unconfirmed items showed problems related to the reliability of the recorded information. It is necessary to highlight that the filling without verification incurs ethical and legal aspects for all professionals of the surgical team. This practice generates an important reflection on patient safety, since when not verified, each item puts the patient at risk of suffering adverse events. (MAZIERO *et al.*, 2015; SORIA-ALEDO *et al.*, 2012).

WHO advises that institutions can add items to the checklist so that it can meet their reality. However, in this adequacy, the orientation is that the items are only included according to the reality of the institutions and never exclude items already recommended and with favorable scientific evidence. (RIBEIRO *et al.*, 2017; HAYNES *et al.*, 2009).

In the development of the application, we chose to keep the verification items exactly as the *checklist* of safe surgery of the WHO protocol. This decision was made so that the application can be used in all health institutions and meets the general need to promote patient safety. Later, if necessary, institutions or professionals may request that items be added to meet their particularities.

Who warns that adding too many items can make the checklist too complex, making it difficult to incorporate into the work process and organizational culture. (RIBEIRO *et al.*, 2017; FREITAS *et al.*, 2014; WHO, 2011).

The application was elaborated in a simple and intuitive way, focusing on agility and thinking about patient safety. All professionals who come to use the application should be instructed how it works and about the importance for the safety of the patient and the professionals involved in the surgery.

The implementation of a new instrument needs to go through a process of training of the entire team and provoke individual perceptions among the members of the surgical team explaining the importance of each item of the checklist. (ELIAS *et al.*, 2015; CARNEY *et al.*, 2012; CONLEY *et al.*, 2011).

Implementing the safe surgery protocol is a challenge to be faced by professionals and institutions. A surgical assistance safely is more than just performing the steps of the anesthetic-surgical procedure and applying a checklist. A change in the patient safety culture is necessary and health care managers and surgical team professionals need to understand the challenges and benefits of the protocol. (SOUZA *et al.*, 2016; CORONA; PENICHE, 2015).

CONCLUSION

The application developed is a tool that can be implemented in health institutions and used by professionals working in the operating room. After the tests performed in surgical procedures, it was found that it meets the patient's safety needs. The application allows interaction with all steps of the *safe surgery* checklist and automatically calculates the risk to the patient at each step not performed. It is expected that the use of the application promotes actions aimed at patient safety and that the safe surgery protocol is spread among

institutions and professionals.

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Sent: July, 2020.

Approved: August, 2020.