MOBILE APPLICATIONS AIMED AT PREPARATION FOR SURGICAL PROCEDURES: A TECHNOLOGICAL PROSPECTING

Aplicativos móveis voltados ao preparo para procedimentos cirúrgicos: uma prospecção tecnológica

Aplicaciones móviles para la preparacion de procedimientos quirurgicos: una prospección tecnológica

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ABSTRACT

Objective: to analyze the main characteristics of mobile applications available in virtual stores, which deal with performing surgical procedures. **Method:** technological prospection, with a qualitative exploratory approach, carried out by searching for applications in the Apple Store® and Google Play® virtual stores, using the keywords: Surgical Center, Surgery, Surgery Simulator, and Surgery Games, in Portuguese, English, and Spanish. We performed a categorical thematic analysis of the findings. **Results:** 67 occurrences were classified into four categories: 'Applications intended to guide the surgical procedure,' 'Applications about working in the operating room,' 'Applications aimed at the health team,' and 'Applications related to entertainment games. **Conclusions:** the applications are aimed both at individuals seeking procedure guidance and healthcare professionals. However, there is a gap regarding specific preoperative guidelines for pediatrics, where no occurrence was recorded.

DESCRIPTORS: Mobile applications; Surgical procedures, operative; Operating room nursing; Biomedical technology; Perioperative care.

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RESUMO

Objetivo: analisar as principais características dos aplicativos móveis, disponíveis em lojas virtuais, que tratam sobre a temática da realização de procedimentos cirúrgicos. **Método:** prospecção tecnológica, de abordagem qualitativa do tipo exploratória, realizada por busca de aplicativos nas lojas virtuais *Apple Store*® e *Google Play*®, utilizando as palavras-chave: Centro Cirúrgico, Cirurgia, Simulador de cirurgia e Jogos de cirurgia, em português, inglês e espanhol. Realizou-se análise temática categorial dos achados. **Resultados:** 67 ocorrências foram classificadas em quatro categorias: 'Aplicativos destinados à orientação para procedimento cirúrgico', 'Aplicativos sobre o trabalho em centro cirúrgico', 'Aplicativos voltados à equipe de saúde', e 'Aplicativos relacionados a jogos de entretenimento'. **Conclusões:** os aplicativos voltam-se tanto para indivíduos que buscam orientações sobre procedimentos, quanto a profissionais da área da saúde. No entanto, há uma lacuna referente à orientações pré-operatórias específicas para pediatria, onde nenhuma ocorrência foi registrada.

DESCRITORES: Aplicativos móveis; Procedimentos cirúrgicos operatórios; Enfermagem de centro cirúrgico; Tecnologia biomédica; Assistência perioperatória.

RESUMEN

Objetivo: analizar las principales características de las aplicaciones móviles, disponibles en las tiendas virtuales, que tratan el tema de la realización de procedimientos quirúrgicos. **Método:** prospección tecnológica, con enfoque exploratorio cualitativo, realizada mediante la búsqueda de aplicaciones en las tiendas virtuales Apple Store® y Google Play®, utilizando las palabras clave: Centro Quirúrgico, Cirugía, Simulador de Cirugía y Juegos de Cirugía, en portugués, inglés y español. Se realizó un análisis temático categórico de los hallazgos. **Resultados:** 67 ocurrencias fueron clasificadas en cuatro categorías: 'Aplicaciones destinadas a orientar el procedimiento quirúrgico', 'Aplicaciones sobre el trabajo en quirófano', 'Aplicaciones dirigidas al equipo de salud' y 'Aplicaciones relacionadas con juegos de entretenimiento'. **Conclusiones:** las aplicaciones están dirigidas tanto a personas que buscan orientación sobre procedimientos como a profesionales de la salud. Sin embargo, existe un vacío con respecto a las pautas preoperatorias específicas para pediatría, donde no se registró ninguna ocurrencia.

DESCRIPTORES: Aplicaciones móviles; Procedimientos quirúrgicos operativos; Enfermería de quirófano; Tecnologia biomédica; Atención perioperativa.

INTRODUCTION

Performing a surgical procedure may cause discomfort, fear, and anxiety, often due to the lack of knowledge by the patient and family members about the steps that involve it.[1] However, these negative feelings can be minimized when the individual knows the procedures that will be involved during the surgical stage.[2]

Several strategies can be used to convey surgery-related information, such as real photographs, use of computers,[2] hospital visits, informative videos,[3] illustrative books4 or even puppets and therapeutic play when the audience is children.[5]

The perioperative period corresponds to the three stages related to surgery: preoperative, which precedes the surgery and is involved in adaptation, exams, and medical consultations until arrival at the operating room; intraoperative, which occurs inside the operating room and is characterized by anesthesia and surgical procedure; and postoperative, which follows the surgical procedure.[6,7]

Digital technologies are increasingly present in people's daily lives and can be used as a tool in the transmission of information, in addition to enabling the use for professional practice.[8] Thus, its use becomes very attractive, because it allows the adaptation of its format to the needs of the audience involved, being characterized as educational technologies in the form of games, simulators, virtual reality, among others.[9] Moreover, the increasing use of the internet and smartphones that are easy to use and accessible to the majority of the population, contribute to this end.[10,11]

With this, there is a growing increase in health-oriented products, and these can bring benefits to users, both as a means of distraction and entertainment, and as guidance for procedures and/or health care.[9,10,12-14]

This study aimed to analyze the main characteristics of mobile applications available in online stores that deal with surgical procedures, in order to guide the development of future technologies with the same purpose or to serve as support for health professionals in choosing the best applications to be used and/or recommended to users.

METHOD

This is a technological perspective, these studies map possibilities of future scientific and technological developments from the analysis of the present and the past and uses documentary research as a method for the explanation of primary documents (in this case, mobile applications). In this study, we seek to direct the development of future educational technologies (applications) aimed at preparing for surgical procedures.[15,16]

Technological Prospecting is usually divided into four phases: 1) Preparatory phase: definition of the scope of the study; 2) Pre--prospective phase: detailing of the chosen methodology with the elaboration of a work plan; 3) Prospective phase: collection, treatment, analysis and consolidation of the information obtained;

and 4) Post-prospective phase: evaluation and dissemination of the results.[16]

Initially, a detailed protocol was prepared with the study steps, namely: objective, study design, inclusion and exclusion criteria, and selection of key words for the search in online stores. The protocol was sent for validation to four experts in the area of technologies, three PhDs in Nursing and a PhD in Information Science.

After this validation step, the search for mobile applications was conducted in the Apple Store® (AP) and Google Play® (GP) virtual stores, chosen for the diversity of Android and iOS smartphone operating systems.

The data were collected between the months of July and August 2019, using the keywords 'Surgical Center', 'Surgery', 'Surgery Simulator' and 'Surgery Games' in the Portuguese, English and Spanish languages.

As inclusion criteria, we chose apps: focused on preparation for surgical procedures; educational; that presented procedures in the surgical center; aimed at patients, families, and health professionals. Excluded were those that did not contain descriptions on the theme, procedures performed outside the surgical center, outside the theme of surgical preparation, and those repeated in the same online store.

A thematic categorical analysis was used,[17] developed in three stages: pre-selection of the apps to be analyzed; careful analysis of each of the apps selected; and finally, analysis of the apps according to the items selected.

For better understanding of the data, all applications found were described in a table containing name and characteristics, then the selection was performed by a researcher and validated by another researcher.

RESULTS

From a total of 2,002 records located in the search, after applying the inclusion and exclusion criteria, 67 applications were selected to compose the analysis (table 1). The remaining apps were excluded for having content focused on emergency room, out-of-hospital environment, animal and dental surgeries, and children's games not related to surgery.

Of the 67 apps selected, seven were repeated in the online stores (Operate Now Hospital; Touch surgery: surgical videos; Knee surgery simulator – children games: simulation first aid helper game; WHO Safe Surgery Checklist; OrtogApp; AO Reference; Mi Cirugia), but were considered separately for presenting different user evaluations in the two stores.

Following the thematic analysis, the data obtained were classified into four categories: 'Apps aimed at guidance for surgical procedures' (n=17), 'Apps about working in the operating room'

Table 1 – Applications by online store. Florianópolis, SC, Brazil, 2019

Keywords	Applications by Store		Total
	Apple Store®	Google Play®	
Centro cirúrgico / Surgery center / Centro quirúrgico	51	249	300
Cirurgia / Surgery / Cirugía	398	214	612
Simulador de cirurgia / Surgery simulator / Simulador de cirugía	521	100	621
Jogos de cirurgia / Surgery games / Juegos de cirugía	217	252	469
Total found	**1187**	**815**	**2002**
Total selected	**32**	**35**	**67**

Source: Developed by the researchers

Table 2 – Category I: Apps aimed at guidance for surgical procedure, found in the Apple Store® and Google Play® virtual store (n=17). Florianópolis, SC, Brazil, 2019

Name	Features	User Evaluation	Online Store
Dr Julian de Silva MD MBBS	Eye surgery	SA (No evaluation)	AP
Info plástica	Plastic Surgery	5,0	AP
Dr. Luís	Plastic Surgery	5,0	AP
OrtogApp	Orthognastic surgery	4,8	AP
OrtogApp	Orthognastic surgery	4,8	GP
Barilife	Location of hospitals with bariatric surgeon.	2,3	AP
Mi Cirugía	Questions to discuss with your doctor and goals for recovery and pain monitoring	SA	AP
Joint Replacement Surgery	Putting together your own planning as of the surgery date with reminders and frequently asked questions	SA	GP
Cirurgia Cerebral	Neurological surgeries	2,8	GP
Eye Center of New York	Cataract surgery	SA	GP
Pacific General Hospital Visitor Guide	Hospital environment content	SA	GP
Wellington Patient Journey	Eye surgery	SA	GP

Table 2 – Cont.

Goldifinch Health	Document completion, navigation to the hospital	SA	GP
Heraeus Care	Document completion, navigation to the hospital	5,0	GP
Posita	Document completion, navigation to the hospital	SA	GP
Mi Cirugía	Questions to discuss with your doctor and goals for recovery and pain monitoring	1,0	GP
My Surgery Journey	Preoperative orientations	4,5	GP

Source: Developed by the researchers

(n=4), 'Apps aimed at the healthcare team' (n=10) and 'Apps related to entertainment games' (n=38). The categories were described below (table 2).

The 17 apps listed in the first category had as main characteristic the presentation of diverse information about some type of surgery and contemplate all phases of the intraoperative period. The applications OrtogApp, Dr. Julian De Silva MD MBBS, Wellington Patient Journey and Dr. Luis stand out for describing information about the surgical procedure, as well as the description of the technique demonstrated by images and videos.

Other apps, besides having the characteristics described above, allow the user to start a personalized planning from the registration of the surgery date, thus becoming guides for patients and families (Wellington Patient Journey, Dr. Julian De Silva MD MBBS, Joint Replacement Surgery, Goldfinch Health, HeraeusCare, Posita and Eye Center of New York).

Of the 17 apps in this group, only six (35.2%) received rating comments, of these six, four (66.6%) were positive, one (16.6%) negative, and one (16.6%) positive and negative. As for the category, 10 (58.8%) were classified as "Medicine" and seven (41.1%) as "Health Fitness".

The applications included in this category had information related to the intraoperative period and were intended for professionals working in surgical procedures. They are based on the Surgical Safety Checklist (SRSL), created by the World Health Organization (WHO) with information for safe surgical care.

Of the four apps in this group, two received comments (WHO Safe Surgery Checklist, repeated in both online stores), referring to the fact that the app does not allow interaction, only visualization of the list, and has system problems during use. In addition, the use of cell phones is generally not allowed in the operating room.

The apps in this group, category III, are intended mainly for surgical professionals and physicians, as they present surgical techniques by means of simulation, images, and videos. Of the 10 apps, five (50%) (Touch Surgery, surgical videos, Gymine, cataractMobile, SurgBook) are aimed at training, teaching, and updating knowledge in surgeries.

Of the remaining apps, two (20%) featured videos of laparoscopic and orthopedic surgical techniques. The AO Surgery Reference app presents an online repository of surgical treatment of fractures of a given anatomical region, from diagnosis to post-treatment.

Of the 10 apps in this group only six (60%) had comments and they were positive.

The category IV apps were aimed at different age groups, from free to over 17 years old. All applications found united the performance of surgeries and interactive games, allowing the user to simulate a surgery while playing. In the games it is possible to identify the use of specific materials for surgery, such as tweezers, scissors, scalpel, among others. The applications presented surgeries of various specialties, including: orthopedic, heart, face (nose, eyes, etc.), abdomen (liver, stomach, etc.).

About the users' assessment, it was found that of the 36 apps, 16 (44.4%) had no comments, 16 (44.4%) had both positive and negative comments, one (2.7%) had only positive results, and three (8.3%) had only negative results, such as: configuration errors (stops working, goes off the screen and returns to the initial screen, etc.), repeated surgeries, few characters, few levels in the game, many ads, short time to perform activities, English version only, among others.

As for the category, 14 (38.8%) were classified as "Games", 11 (30.5%) as "Simulation", four (11.1%) as "Casual", three (8.3%) as "Entertainment", and four (11.1%) fit into other categories.

DISCUSSION

There is a growing number of technologies applied to health and developed both for patient care and for the training of professionals who work in this area.[18] Several applications have themes focused on surgery and can influence the patient's knowledge on the subject, such as content focused on information about the WHO LVSC that show the patient's entire path during the pre-, intra-, and postoperative periods.[19]

Table 3 – Category II: Apps about work in the operating room found in the Apple Store® and Google Play® virtual stores (n=4). Florianópolis, SC, Brazil, 2019

Name	Features	User Evaluation	Online Store
SensAppLite	WHO Surgical Checklist	SA	AP
Checklist Cirurgia Segura OMS	Adapted LVC	1	AP
Checklist Cirurgia Segura OMS	Adapted LVC	2,4	GP
Surgery Safety Checklist Free	WHO LVC	4,2	GP

Source: Developed by the researchers

Table 4 – Category III: Apps aimed at the health team found in the Apple Store® and Google Play® virtual store (n=10). Florianópolis, SC, Brazil, 2019

Name	Features	User Evaluation	Online Store
Touch Surgery: surgical vídeos	Surgical technique, 3D simulation and videos	4.3	AP
Touch Surgery: surgical vídeos	Surgical technique, 3D simulation and videos	4.3	GP
Gymine	Teaching minimally invasive surgery and endometriosis.	5.0	AP
cataractMobile	Stages of cataract surgery.	SA	AP
SurgBook	Didactic videos with surgical learning content.	4,7	AP
Videoatlas Laporoscopia Lubeck	Video laparoscopic surgical techniques	2,9	AP
Artherx Surgeon App	Surgical techniques in orthopedics	5	AP
AO Surgery Reference	Surgical treatment of fractures	4.4	AP
AO Surgery Reference	Surgical treatment of fractures	4.8	GP
Osteotrauma	Surgical planning of long bone fractures.	5	AP

Source: Developed by the researchers

Table 5 – Category IV: Applications related to entertainment games, found in the Apple Store® and Google Play® virtual store (n=36). Florianópolis, SC, Brazil, 2019

Name	Features	User Evaluation	Online Store
Operate Now Hospital	Hospital and Surgery Management	4,7	AP
Operate Now Hospital	Hospital and Surgery Management	4,2	GP
Hospital Surgery: Jogo médico	Surgery Simulator	1	AP
Arm Surgery	Arm Surgery	SA	AP
Jogo de simulador de cirurgia do louco cirurgião cardioligista	Cardiac surgery	3,5	AP
Pulmões cirurgia médico – cirurgia simulador	Emergency Lung Surgery	SA	AP
Malabarismo simulador de cirurgia racer – jogo virtual cuidados hospitalares por pouco cirurgião	Knee surgery	1	AP
Joelho cirurgia simulador – crianças First aid Helper jogo	Knee surgery, X-ray, skin antisepsis	SA	AP
Air Hostess Maternidade doutor & cirurgia	Surgeries	SA	AP
Simulador de cirurgia de cérebro de cirurgião malu	Brain surgery	SA	AP
Mega cirurgia médico simulação	Surgeries	SA	AP
Cirurgia renal: cirurgião louco e jogo hospitalar médico para crianças	Pre-operative exams and surgeries	1.0	AP
Cirurgia de estômago louco – executar a operação de barriga neste jogo médico virtuais	Surgeries	SA	AP
Cirurgia do joelho – crazy médico cirurgião e feridos game tratamento perna	Surgeries	SA	AP
Cérebro Cirurgia Médico Clínica	Emergency patient care	SA	AP
Santa Resgate cirurgia do nariz – Jogo Doctor For	Nose surgery	SA	AP
Ambulância de emergência de celebridade	Surgeries, checking vital signs and anesthesia	5.0	AP
Hospital Fever: Gerenciar e decorar Doctor jogo	Hospital management, use of hospital supplies, treatment of diseases and surgeries with guidance	3,6	GP
Simulador Cirurgia Doutor Jogo	Surgery Simulation	3,6	GP
Heart Surgery Hospital Game	Cardiac surgery	3,9	GP
Arm Doctor Game – Kids Arm Care Simulator 2019	Arm Surgery	SA	GP
Cirurgia de médico – Simulador de hospital	3D game simulating a hospital environment.	2,6	GP
Open Heart Surgery Doctor Game	Cardiac surgery	3,7	GP
Hospital Surgery: Jogos de Operar e Cirurgia 2018	Surgery Simulator	3,3	GP
Lesões esportivas médico jogos	Surgery performed in sportsmen	2,8	GP
Doctor Kids Hospital: Emergency Surgery Operation	Surgeries and hospital procedures	3.9	GP
Kids Doctor Game – Virtual Multi Surgery	Surgery	SA	GP
Ice Princess Heart Surger	Surgery Simulation	4,1	GP
Doctor Game Emergency ER	Emergency Surgeries	3,7	GP
ER Emergency Hospital Doctor: Jogos de Cirurgia	Emergency heart surgeries	4,1	
Live Hospital Simulator	Surgery	3,3	GP
New Virtual Multi Hospital Simulator	Simulation of surgeries using real medical surgical materials	3,1	GP
Hospital Er cirurgia cardíaca de emergência	Surgery and Emergency Room Environment	3,6	GP

Table 5 – Cont.

Surgeon Doctor 2018: Virtual Job Sim	Surgery simulation, use of surgical materials and equipment	4,2	GP
Mestre da Cirurgia	Emergency care and surgeries	4,2	GP
Hospital Surgery Game	Emergency care and surgery. Use of hospital supplies	SA	GP

Source: Developed by the researchers

In recent years there has been a considerable increase in the use of mobile technologies, probably due to the fact that they are relatively easy to handle and allow the user to use them at their convenience. Therefore, the use of technologies to prepare for a surgical procedure can be as effective as other techniques already used, because they can also help to reduce fear and anxiety generated by the need for surgery and increase knowledge on the subject.[11,20,21] It was also found that the use of mobile applications aimed at surgery guidance presents satisfactory results when related to patient compliance to pre – and postoperative care.[22]

A good surgical preparation can bring beneficial results regarding the child's postoperative memories. The use of explanatory videos, for example, is an effective method to reduce preoperative fear and anxiety, as well as the presence of positive memories related to surgery, and they can also be easily applied in mobile technologies.[23] Nursing professionals, who spend more time with patients, can be disseminators of these proposals in the various settings of

In this study, 67 applications that directly or indirectly brought information about several surgical procedures were analyzed; some of the applications found met the needs of patients who will undergo a surgical procedure with information related to the stages of surgery. However, in most cases, the apps were games with information about surgeries or even videos and content for health professionals, which is not always interesting, because they presented guidelines that do not specify the information actually needed by the patient during the perioperative period.

Thinking about the benefits of mobile technologies and the orientation for a surgical procedure, several information can be used to contemplate the concept of surgery such as the preoperative period with orientations about the type of procedure, preoperative exams, fasting, dressing, documents; postoperative: possible complications, returning to the doctor's office, hygiene, diet, dressing, pain control, as well as frequent or specific doubts of those involved, according to the surgery in question.[24]

Despite the great growth of mobile technologies for health, there is a low use of these, and the most used applications are those that have broad functionality such as agenda, association with social networks, connection with other people, which is extremely valued by patients during the phases of surgery. In addition, the most frequently used health apps cover the topics of exercise, diet, and puzzles.[25]

Thus, there is a need to promote innovation and creativity to attract the user's attention, because situations of dissatisfaction cause them to stop using the product.

In addition, several methods are used for the development of health applications, regardless of the method chosen, the steps must be well defined and structured in an appropriate way to be useful to the end user.[26]

Smartphones also allow the application of Augmented Reality (AR) which is a technology that makes the user undergo the virtual environment without replacing the real environment. One of its most common applications is to promote fun and distraction, besides aiding learning in several areas.[27-29]

In the hospital area, AR applied to children and adolescents has potential in the process of disseminating information and can generate experimentation of new feelings brought by fun, distraction and joy, improving the environment and the hospitalization period.[27] However, no applications in AR format were found in this study, indicating a possible gap to be addressed.

As a main limitation of this study, one can point to the little information that some applications presented in their descriptions, which may have made it difficult to understand their objectives and, consequently, the analysis of the data.

CONCLUDING REMARKS

Different apps treat, from different perspectives, the performance of surgical procedures, both for individuals who will undergo the procedure and for health professionals. However, there is a noticeable lack of applications with the AR format, as well as with content aimed exclusively at the children's audience.

Users are demanding as to the format and content of the applications. Therefore, aiming at the quality and usability of new products to be developed for this purpose, it is necessary to understand how the applications are being built and how they are accepted by the target audience.

The use of mobile digital technologies, such as applications available for smartphones, presents itself as a promising strategy for interaction with the patient, however, the application must be innovative, creative, and present an appropriate language for its users, working as an important tool in guiding for a more peaceful surgical procedure and consequently, a faster, efficient, and trauma-free recovery.

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