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Mobile applications on the safety of elderly patients in the surgical environment: a technological prospecting*

Aplicativos móveis sobre segurança do paciente idoso no ambiente cirúrgico: uma prospecção tecnológica

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ABSTRACT

Objective: To describe applications focused on the safety of elderly surgical patients in the pre- and postoperative periods. **Method:** Technology prospecting with a qualitative approach in the Apple Store, Google Play virtual stores, and web application. As a search strategy, the following terms were used: 'elderly self-care', 'preoperative', 'postoperative', 'patient safety', 'elderly patient safety'. **Results:** 12 applications were identified in the Apple Store, 17 in Google Play, and a web app, which focused on the gamification of health and population professionals; educational applications to health professionals and health system users; related applications as a work tool for health professionals; applications as a self-care tool for health system users; and, post-operative applications for health system users. **Conclusion:** Technologies aimed at self-care and the safety of elderly patients were not found in the pre- and postoperative periods.
Descriptors: Mobile Applications; Patient Safety; Elderly.

RESUMO

Objetivo: Descrever os aplicativos voltados para a segurança do paciente idoso cirúrgico nos períodos pré e pós-operatório. **Método:** Prospecção tecnológica com abordagem qualitativa realizada nas lojas virtuais *Apple Store*, *Google Play e* aplicativo *web*. Como estratégia de busca utilizou-se os termos: 'autocuidado idoso', 'pré-operatório', 'pós-operatório', 'segurança do paciente', 'segurança do paciente idoso'. **Resultados:** Foram identificados 12 aplicativos na loja virtual Apple Store, 17 na Google Play e um web app, os quais estavam voltados a gamificação de profissionais da saúde e da população; aplicativos educacionais aos profissionais de saúde e usuários do sistema de saúde; aplicativos relacionados como ferramenta de trabalho para os profissionais de saúde; aplicativos como ferramenta de autocuidado para usuários do sistema de saúde; e, aplicativos voltados para pós-operatório de usuários do sistema de saúde. **Conclusão:** Não foram encontradas tecnologias voltadas para o autocuidado e segurança do paciente idoso nos períodos pré e pós-operatório.
Descritores: Aplicativos Móveis; Segurança do Paciente; Idoso.

INTRODUCTION

The aging process in populations is a remarkable fact in this century in the world scenario. In Brazil, the increase in the elderly population triggered a population transition, reflecting the demographic profile. Due to the demographic transition linked to the epidemiological transition, there is a need to understand these facts and develop actions aimed at the health care of the elderly population, especially in health services[1-3]. In parallel, it is known that aging is a continuous, gradual physiological process and that it becomes a challenge for health services and professionals since it is linked to psychosocial, genetic, and biological changes, such as the increase in chronic-degenerative diseases, that generate an important impact on the lifestyle of individuals[1-2].

According to the World Health Organization (WHO), a number of 3.1 billion elderly people are expected for the year 2100 and, in this sense, it is necessary

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to promote gerontotechnologies and develop products that meet the needs and capabilities of the elderly population, allowing successful aging[4]. Therefore, it is important to create strategies that allow the person and their caregivers to be protagonists in their care process, providing a technological contribution that improves the daily life of the elderly, taking into account their aging, the health-disease process, the co-responsibility and co-participation of the actors involved[1].

Health technologies favor maintaining patient safety, a goal sought worldwide to improve practices that optimize the quality of health care services. WHO refers to the importance attached to patient safety and, in Brazil, the National Program for Patient Safety (PNSP), which has existed since 2004, aims to improve health care quality[2]. In addition, studies addressing patient safety and using technologies for improvement demonstrate that they can organize information more appropriately and provide barriers to errors related to health-disease care[5].

To promote the development of these new technologies, which help and improve care for the elderly given the patient's safety requirement, there is a need to direct efforts that favor the performance and use of studies that contribute to the advancement of health technology.

For technological development in health, it is necessary to take care of several stages, and technological prospecting is one of them. This step appears as a possibility to evaluate the panorama of technological productions in the health area, identifying the types of technologies developed and made available in the market, as well as their potential and weaknesses[6].

Furthermore, healthcare, teaching, and research institutions must use this prospecting tool to guide their decisions regarding the development of technologies, focusing on user satisfaction and safety and the impact of the quality of care. Therefore, recognizing the viability of the technology and its application to the user and developing the product from this design reinforces and strengthens the application of the technological prospecting methodology[6].

Therefore, research in this field has been disseminated in the health area with different aspects, such as evaluation and application use. This is the case of ePATH, an application used to support self-care activities after prostate cancer surgery[7].

However, there is not so far a synthesis of evidence of the application of the methodology in question, specifically involving the safety of elderly surgical patients, which justifies this prospection since the field of research is expanding in terms of the need for care of this specific population. The study aims to describe the key features of the applications available in the Apple Store and Google Play virtual stores and web applications aimed at the safety of elderly surgical patients in the pre- and postoperative periods.

METHOD

Type of study

This is a four-step technological prospecting study, as suggested by the literature: 1) preparatory work: in which the scope of the research was defined to clarify the objectives of prospecting; 2) pre-prospective: where the detailed methodology was carried out, specifying in a protocol all the steps that involved the data collection and analysis strategy; 3) prospective: in which the collection, treatment and analysis of the results was performed, according to the protocol validation developed in the previous stage; and, 4) post-prospective: where the findings were discussed with evidence from the literature and the communication of the results was structured in the form of a scientific article[8].

Considering that one of the purposes of technological prospecting may be the search for what has been produced from applications aimed at a given situation and/or population, as well as that of future technologies for the same purpose, it has been defined as a research issue: 'What are the main characteristics of the applications available for patient safety in the surgical environment in the virtual shops?'

Data collection

Data was collected between July 6th and July 20th, 2022, through Apple Store, Google Play, and web applications via Google Chrome. These data sources were chosen to encompass distinct operating systems and to be prevalent in smartphone configurations. The search was carried out individually and with the support of the following devices: a smartphone with an Android operating system for Google Play search and an iPad with an iOS operating system for searching the Apple Store.

The following keywords were used in the virtual stores: 'elderly self-care', 'preoperative' 'postoperative', 'patient safety', 'elderly patient safety', 'gerontology surgery', 'patient safety',

'preoperative and postoperative ',' preoperative and postoperative', 'preoperative and postoperative safety elderly', and self-care elderly individually in each operating system. For the search of web applications, the combination of terms 'technology, elderly, surgery' was used. It should be emphasized that, as it is a question of searching for technologies made available in virtual shops – and not of an integrative or systematic review study – this type of research uses keywords whose scope includes the studied theme and not descriptors controlled according to the review studies.

Eligibility criteria

As inclusion criteria for this research, we defined: applications focused on surgical patient safety; applications focused on the safety of elderly patients; and applications that approach pre- and postoperative. Applications that did not have descriptions of the subject covered were excluded; applications that presented surgical procedures but were not patient safety-oriented; specific content newspapers for medical updates; repeated applications in the same virtual store; applications that were not self-care in the hospital environment; and paid application with a free trial.

Data analysis

As this is a descriptive type of research, it was opted for using content analysis in three stages[9], with the pre-categorization strategy. In the first step, referring to pre-analysis, the indicators were elaborated according to the question and objective of the research. To organize the results, an Excel spreadsheet was prepared, containing the following information available in the search bases: Application name, category, acquisition (paid or free of charge), characteristics, user evaluation (grade), user comments, and product description. The information was fed as an individual search was made by keyword in each virtual store.

In the second step, regarding exploring the material, we worked with the data organized in the Excel spreadsheet specifically designed for this research, these categories being pre-defined. In order to ensure compliance with the eligibility criteria according to the prospecting protocol, two researchers worked independently to apply the inclusion and exclusion criteria of the applications that would make up the final sample of the study. In the third and last step, referring to the treatment of results, the applications selected to compose the final sample were analyzed based on the categories previously defined for the search of applications, and the information was discussed with evidence from the literature and contextualized according to the study object. This research is part of the thesis entitled Gerontotechnology aimed at the safety of elderly surgical patients for self-care stimulation. It was approved in the Research Ethics Committee (RES) with CAAE: 2 5338921.6.0000.0121 for software production.

RESULTS

The results found in the searches and the selected articles are shown in Figure 1.

At the *Apple Store*, gaming applications aimed at health professionals and the general public have been identified primarily; educational applications for health professionals and health system users; and related applications as a work tool for health professionals; applications as a self-care tool for health system users; and post-operative applications for health system users. However, it should be noted that no applications were found for the elderly within the proposed theme, that is, to describe the main characteristics of the available applications aimed at the safety of elderly surgical patients in the pre- and postoperative periods.

In the self-care applications of health system users, the following applications were detected, and only one of them was paid, all of which were made available free of charge, accompanied by the specification: 1. eMediplan: it assists the patient in the management of medications, being indicated for those who make polypharmacy-specific use of the eMediplan brand; 2. Emento: it is a communication tool for the Danish health system user, with whom the user can follow the activities that they must perform for their treatment, with a notification system. One can contact the health team by a messaging system to take courses related to his or her treatment;

3. Assistance now: designed to function as an intelligent watch for the elderly with notifications of falls, monitoring of vital signs, and allowing the identification of the elderly by health and family professionals; 4. *Tokiwa- para o mood e-health*: it is an application focused on care and sharing with family and friends of the mental health condition of the user and monitoring of his physical health, with meditation actions, recording of the state of humor of the day, monitoring the

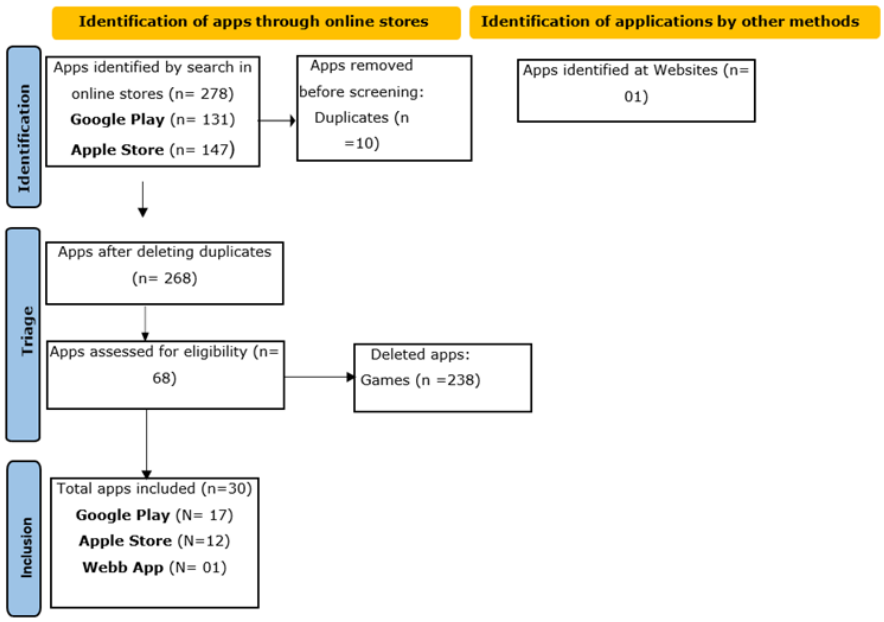

Figure 1 – Quantity of applications found and selected in the Apple Store and Google Play and web applications. Florianópolis, SC, Brazil, 2022

diet, calories, and mood check with goals among family and friends; 5. Medit: communication for health: application to manage daily moods, tasks, sharing data with family and friends. And record contact information for hospitals; 6. IHealth screen: it allows elderly, caregivers, and professionals to perform physical and mental health screening tests for the elderly through mobile devices; 7- *Info plástica*: it provides information on plastic surgeries for users; 8: *Academia da pele*: it explains a skin esthetic self-assessment method; 9: AesCare: it is a social network for those who have an interest in esthetic procedures, beauty and self-esteem. One can search for physicians and check photos of those who have already done some procedure. Patients who have already performed their surgery can tell their stories, detailing the choice of the specialist, telling them about the postoperative period and evaluating their doctor or surgeon-dentist. Those who want to search for more information can use the messages to ask questions to other users or use the plastic surgery assistant; 10: Barilife: application of the Brazilian Society of Bariatric and Metabolic Surgery to assist in the follow-up of bariatric surgeries.

As for the postoperative-oriented applications of the health system users population, the applications were found: 1. After discharge outpatient surgery: it was created for post-operated patients in outpatient procedures of vesicle, thyroid, hernia, anal region, sacrococcygeal cyst, skin, lipoma or sebaceous cyst. In this application, people can find useful information about what to do in the event of pain, nausea, vomiting, side effects of medications, diet, and general care guidelines; 2. *Pósop*: it captures and stores home information to measure pain level and drains' volume control. It also provides guidelines and tips for postoperative recovery.

Regarding the application category, they were classified as: medicine (Emediplan), health and fitness (Emento, Assistance now, Medit: communication for health, Ihealth *Info plástica*, Barilife), monitoring and management (Tokiwa- for mood and health), esthetic self-evaluation (*Academia da pele*), plastic surgery results (AesCare). On the other hand, two were compatible with iPhone iOS 7.1 or later, six with iPhone iOS 11 or later, two with iPhone iOS 12 or later, one with iPhone iOS 14 or later, and one with iPhone iOS 15 or later. About the way of acquisition, it was noticed that one application is paid and 11 are free.

Of the applications, 9 did not receive a user an evaluation of their usability. Evaluations are quantified from 1 (lowest grade) to 5.0 (best grade). The application "Info Plástica" received evaluation grade 5.0, "Academia da pele" 5, "AesCare" received a grade 2.8, and "Barilife" grade 1.8.

Of the 19 applications captured in Google Play, two were repeated, with 17 applications remaining, and of these, games applications were identified mainly for health professionals and general population; educational applications for health professionals and health system users; and related applications as a work tool for healthcare professionals; and applications as a self-care tool for health system users. Again, no applications were found for the elderly within the proposed theme. Of these applications, 10 were paid, and 7 were free.

In self-care applications for health system users, the availability of applications that address health management using schedules and encourage health promotion and prevention practices was again verified. Health management applications, accompanied by their specification, were: 1. Surgery App: it helps users manage their health and connects with the family doctor when needed; 2. *Portal do Paciente HC*: Patient portal developed for the hospital of the Clinics Faculty of Medicine of the University of São Paulo so they can see results of exams, reports, and appointment schedules; 3. *Portal do Paciente ICR*: Patient Portal of the Children's Institute for the visualization of results of exams and reports. 4. *Famesp com você*: application for patients attended by the Health units Foundation for Medical and Hospital Development to view exams and schedule consultations; 5. *Dr. Consulta: o meu médico*: consultation and examination appointments tool; 6. *Lembrete de remédiOS e pílula*: tool that works as a reminder schedule for medications; 7. *Cuidador online-lembrete de medicação:* it works as a schedule with medication reminders and appointment schedules; 8. *Terceira idade*: it works as an agenda for the elderly to organize their event schedules and contains mini-games; 9. *Meu cronograma capilar*: quiz questions and tests to check the condition of the hair; 10. *Rotina de cuidados com a pele*: it works as an agenda that is suitable for the person to arrange skin care.

Applications aimed at encouraging health promotion and prevention practices, accompanied by their specification, were: 1. *Idoso Ativo*: a program of functional exercises developed by physiotherapists for the elderly; 2. *Big laucher- por. brasileiro*: this is an initial smartphone screen for elderly people or people with vision problems; 3. *Fabulous: rotinas e motivação*: developed to motivate fitness improvement and help achieve goals; 4. *ExercíciOS para idosos em casa*: exercise for the third age to do at home; 5. *Self: melhore seus hábitos*: developed to encourage changes in habits and stimulate healthy habits; 6. *Cingulo: terapia guiada:* guided therapy to control anxiety, stress, self-esteem, and increase focus; 7. *ExercíciOS para idosos*: aimed at stretching exercises for the elderly.

As for the category of applications, they were classified as: medicine (*Surgery App, Portal do Paciente HC, portal do Paciente ICR, dr.* Consulta: o meu médico, lembrete de remédiOS e pílula), *health and fitness* (*cuidador online-lembrete de medicação, lembrete de remédiOS e pílula, fabulous: rotinas e motivação, exercíciOS para idosos*), sports (Idoso Ativo), tool (*Famesp com você, self: melhore seus hábitos, terceira idade*) Productivity (*fabulous: rotinas e motivação*), communication (*big laucher- por. brasileiro*), beauty (*meu cronograma capilar, rotina de cuidados com a pele*).

About compatibility, one was compatible with Android 4.0 or higher, one with Android 4.0.3 or higher, one with Android 4.1 or higher, two with Android 4.4 or higher, eight with Android 5.0 or higher, two with Android 6.0 or higher, one running Android 7.0 or higher and one running Android 8.0 or higher. Of these applications, fourteen received users' evaluation: a) 4.9; 4.8; 4,7; 4,6; 4,4; 4.3 respectively *(Cingulo: terapia guiada, Meu cronograma capilar, Fabulous: rotinas e motivação, Lembrete de remédiOS e pílula; Portal do Paciente ICR, Rotina de cuidados com a pele, Dr.* Consulta: o meu médico, Famesp com você); b) 3.8; 3.7; 3; respectively *(Portal do Paciente HC, ExercíciOS para idosos em casa, Big laucher- por. Brasileiro*, Self: *melhore seus hábitos, ExercíciOS para idosos*); c) 2.8; 2.3; respectively (*Terceira idade, Idoso Ativo*).

Opinions have been expressed: 1. Portal do Paciente HC: simple, practical, described, informative, efficient and very important application. Difficulty updating; 2. *Idoso Ativo* the idea is interesting , but it presents many errors to open; 3. Portal do Paciente ICR: easy to use, problems in the shape of scheduling; 4. Famesp com você: good application, complaints are to print exams and register; 5. Dr. *Consulta:o meu médico*: good interface, fast search, but lack of information on covenants and covers; 6. *Lembrete de remédiOS e pílula*: it's simple, functional, complete and practical, the negative point is that you can't customize the touch of the reminder; 7. *Big laucher- por. brasileiro* application easy and intuitive, however, presents some difficulties

for use; 8. *Fabulous: rotinas e motivação*: very good the application, however, it's bad it cannot change habits, can only select existing ones; 9. *ExercíciOS para idosos em casa*: the application is in English; 10. *Self: melhore seus hábitos*: translation is bad, hangs a lot, it is not possible to create custom habits; 11. *Cingulo: terapia guiada*: easy and intuitive application; 12. *Meu cronograma capilar*: good, but it does not allow to remove the alarms; 13. *Terceira idade*: some people classify as horrible and others as excellent; 14. *Rotina de cuidados com a pele*: very good for organizing skincare routine.

On the Google Chrome search site, a free result was found that is targeted as a self-care tool for health system users, which encourages health promotion and prevention practices. 1. Techbalance: It is able to measure the predisposition for falls, evaluate the postural balance and motor autonomy of patients aged 60 years or over. With a kit containing a strap, a cell phone, steps and treadmill, the elderly and makes some movements that are captured by smartphone sensors and analyzed by the application algorithm. At the end of the test, the elderly receives in the e-mail a report with guidelines that can help manage fragility and minimize the risk of falls, as well as support for the physician to propose treatments and make the best clinical decision.

Regarding the category of the web site, it was classified in: medicine and the compatibility was not informed by the platform, besides, no opinions or evaluations were displayed.

DISCUSSION

Attention is drawn to the fact that applications do not specifically address the safety of elderly surgical patients in the pre- and postoperative periods since the elderly population is living more, healthy life expectancy increased globally between 1990 and 2013, being 5.31 years for men and 5.73 years for women[10]. Linked to this, Brazilian research pointed out that 97% of Brazilian elderly people access the Internet daily, the main means of access being the smartphone itself and of these 54% use the mobile phone to search for information about products and services[11].

Considering that the increase in life expectancy has been accompanied by a series of chronic conditions that may lead to morbidity and consequently to a surgical procedure. And that the elderly population has a limited physiological reserve, with functional alterations in the organic systems that influence its recovery capacity mainly in the postoperative period. In addition to this condition, comorbidities such as hypertension, arrhythmia, heart diseases and emphysema may also be present in the preoperative period. This can cause severe postoperative complications directly impacting the prognosis of this period. When surgery occurs without complications and the patient has a stable condition, they often still need to use devices such as gastrostomy, parenteral nutrition to meet their nutritional needs[12-10]. Such elements reinforce the need for technologies aimed at this public and period, since digital inclusion is part of the social inclusion of this elderly, corroborating for active aging, which is increasingly using technologies, as a result of the coronavirus pandemic[13].

Initially, it was believed that the low number of applications for this audience could be related to the low adherence of this age group to mobile technologies. However, the literature points out that the elderly population increasingly uses mobile technologies for health purposes, nine out of ten elderly people report using mobile technologies to initiate communication, obtain traffic news, among others. The use was even more marked with the advent of a pandemic, in which various services, including health services, were carried out in digital format. In relation to the technology ownership rate, four out of ten elderly people have smartphones. Although the elderly have and use these physical and mental health-oriented applications, they need guidance on the choice and use of an application that will actually benefit them[14].

The largest number of applications were found on Google Play, compared to those on the Apple Store, the same for reviews and comments, most of the applications found in Google Play were evaluated and received user feedback. It is believed that this may be related to the high values of the devices with the iOS operating system, in Brazil, which reflects the amount of evaluations and comments of the applications they receive. In addition, research by Bain & Company[15] pointed out that Android technology available on smartphones using Google Play is the gateway to the Internet for a larger number of users, since the prices of smartphones have constantly reduced, driven by the gains in production scale and the reduction in the costs of their components, attracting greater demand, there has also been an improvement in the signal of mobile technology companies[15].

The evaluation, most of the applications available on the Apple Store were not evaluated, and those that received the notes were widely divided ranging from two low-grade applications (1.8 and 2.8) and two applications with the maximum grade[5]. While the applications found in Google Play most received evaluation, with more focus on the new ones above 4.

Although few applications have been evaluated, the evaluation tool based on the user's opinion on the usability of applications, mainly health-oriented applications, is necessary for their adequacy and dissemination in society. Since these tools have repercussions on the life of users, which lead them to changes in attitudes and behaviors, and which can enhance care for the development of a healthier life with a higher quality of life[16].

As for user feedback on the applications available on the Apple Store, only three comments were identified, two of which were positive, referring to the application as good and a negative, saying that the application was bad. Comments from Google Play users also evidenced different user experience and usability of the technology, and most applications received positive and negative reviews where users report difficulty updating. errors to open, scheduling problems and printing exams, lack of information, lack of customization, English language with the exception of the applications *Cingulo e Rotina de cuidados com a pele,* that received only positive assessments. The evaluation of applications is very positive and should be encouraged, as it helps in identifying the technology that can be disseminated to society as a technological tool to assist in health care.

The limitations of the investigation are due to difficulties in the collection of applications that address the issue of the safety of elderly patients in their perioperative period; applications that are aimed at the care of elderly people who encourage their care in the surgical practice.

CONCLUSION

At the end of this Article, it is concluded that the elderly population is more likely to perform a surgical procedure and has its safety exposed since it is often unknown to the elderly. However, technologies aimed at self-care and the safety of elderly patients were not found in the pre- and postoperative periods, although this population has and increasingly uses the Internet.

Therefore, applications directed to the elderly aiming at their self-care in the surgical process are a disruptive tool and necessary for the care of this population, thus, future studies aimed at the development of technology in this area are suggested.

*Paper extracted from the PhD thesis "Gerontotechnology Cuid@r for the stimulation of the self-care of the elderly in the preoperative and postoperative period of elective surgery: a strategy for patient safety", presented to the Federal University of Santa Catarina, Florianópolis, SC, Brazil.

CONFLICT OF INTERESTS

The authors have declared that there is no conflict of interests.

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