REVIEW ARTICLE

Viability of mobile applications for remote support of radiotherapy patients

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SUMMARY

BACKGROUND: *Technological advances of the 21st century have provided greater communication, regardless of socioeconomic class and age group. Actions to promote the development of health applications are emerging around the world.*

OBJECTIVE: *To provide a perspective on the viability and usability of mobile applications dedicated to radiotherapy patients for remote support to health professionals proposing solutions to encourage Brasil in the development of these digital tools.*

METHODS: *Cross-sectional exploratory study by systematic review and literature review. We searched the PubMed, BVS, IBGE, and WHO databases, from 2014 to 2018.*

RESULTS: *6 articles were found with topics related to the use of mobile applications in the health area, two of which were published in Portuguese and four in the English, on oncology, from 2014 to 2018.*

CONCLUSIONS: *We did not find an expressive number of works on this subject in Brasil. Mobile applications have the potential to assist in the remote support of radiotherapy patients. The latest studies suggest the need for a regulation of data protection protocols to be deployed.*

KEYWORDS: *Telemedicine. Mobile Applications. Radiotherapy. Oncology.*

INTRODUCTION

Technological advancements in the 21st century have provided greater communication among all, often regardless of socioeconomic status and age. In this sense, new horizons for health through mobile technologies have been highlighted by the World Health Organization (WHO) who, in 2011, published a book with the definition of the term *mHealth*: mobile health or mobile health as medical and public health practice supported by mobile devices, such as phones, devices for monitoring patients, personal digital assistants (PDAs), and other wireless devices[1]. More recently, in 2018, the WHO published a classification of digital interventions in health in order to categorize the different ways in which digital and mobile technologies are being used to support the needs of the health system[2]. Proposals for and practical experiences with the use of smartphone or tablet applications with dedicated resources to healthcare professionals or patients have

been described and encouraged by other health institutions worldwide. One example is the Department of Radiation Oncology of the Heidelberg University Hospital in Germany, who published, in 2018, a study on the feasibility of the use, by patients, of an application that contained the QLQ-C30 questionnaire of the European Organization for Research and Treatment of Cancer (EORTC) to evaluate health-related quality of life in oncological patients[3]. The assessment of the quality of life through the application was widely accepted by patients, and individuals were willing to use it in clinical routines, provided the privacy and security of data were guaranteed.

In a national context, the Brazilian Institute of Geography and Statistics (IBGE), through their Continuous National Household Sample Survey, found that 94% of the population 10 years of age or older, in rural and urban areas surveyed[4], have accessed the internet for sending or receiving text, or voice messages, or images using different e-mail applications. This suggests a fertile landscape for developing applications for mobile devices, such as smartphones and tablets, for the remote systematic support of oncologic patients who undergo radiotherapy treatment.

A recent review paper (2014) identified the research involving mobile technology applied to health in Brasil[5]. In this review, a total of 319 studies were found; after applying the exclusion criteria, 27 were included in the study. The topic most often discussed was professional support, and the area that benefited the most from it was multi-professional teams. The studies highlighted a gap in our country regarding the development of applications for patient support, which needs to be further explored. Finally, they have concluded that mobile applications may represent an important aid in adherence to treatment, emphasizing the importance of investing in this field of research[5]. None of the studies was targeted at radiotherapy patients.

OBJECTIVE

This work aims to offer a perspective on the feasibility and usability of smartphone and tablet applications targeted at oncologic patients for remote support of radiotherapy professionals. Through these, the radiotherapy team could acquire important data about the treatment from the patients themselves and, if possible, inform them about the possible symptoms and courses of treatment.

METHODS

This is a cross-sectional study of exploratory nature through the systematic review and analysis of the literature. We conducted searches in the PubMed, BVS, IBGE, and WHO databases using the English and Portuguese keywords: mhealth, mobile, health, oncology, radiotherapy, smartphones, *saúde, móvel, aplicativos, radioterapia, oncologia.* Six papers were selected in both languages, from 2014 to 2018, which served as the basis for the development and discussion of this study.

RESULTS

We found six articles with topics related to the use of mobile applications in the area of health; two Brazilians published in Portuguese, and four from other countries and published in English, of which the latter applied to oncology. All date from the period of 2014 to 2018. The summary of the results of these studies is presented in Table 1.

DISCUSSION

An indication of the importance and tendency of the development and evolution of digital tools applied to health can be perceived in the example by the WHO, who published, in 2018, a Digital Health Interventions Classification that categorizes the different ways in which digital and mobile technologies are being used to support the needs of the health system[2]. Actions to promote the development of applications are emerging around the world, such as the one by the United Nations Children's Fund (Unicef), who awarded the WHO in 2016 for the *OpenSRP* software.

A review article published in 2017 reported the existence of a relevant number of applications in a systematic search performed in 2015 on the Play Store (Android, Google) and App Store (iOS, Apple) platforms[7]. In general, the authors found around 195 applications, being: 19 to manage articles; 25 focused on the patient; 12 created by hospitals to organize meetings; 34 with topics not only in oncology; two for using the Aria software; 11 with learning techniques for students testing; 11 targeted at chemotherapy alone; 11 about Congress schedules; 31 tools for medical and multidisciplinary professional, and 39 others. This review article aimed to characterize and provide scientific support only to applications designed for professionals in radiology and oncology. In particular, we obtained

the following characteristics: goals, list of features, consistency in results, and usability. Lastly, those classified as dose calculators (seven applications), clinical calculators (four), titration tools (seven), polyvalent (7), and others (6). The authors found that the most recommended applications were not necessarily the most expensive, and highlighted three applications that contain wide content for radiology and oncology professionals: RadOnc Reference (in English), Easy Oncology (in German) and iOncoR (in Spanish).

Regarding applications targeted at the patient, recently, Kessel et al.[3] tested the usability by patients of an application for applying the QLQ-C30 questionnaire of the EORTC to assess health-related quality of life in oncological patients. The study involved 81 patients with a mean age of 55 years and found an average time of 4 minutes to complete the questionnaire on an iPad. 84% of patients (68/81) had a mobile device and preferred this version of the questionnaire to the traditional paper model.

Another article also published in 2018 in the form of trial by the same institution of Kessel et al.[3] intends to prospectively evaluate the feasibility of using a mobile application to provide systematic support to oncology and radiology patients throughout the future course of their radiotherapy, with the specific objectives to monitor the patients' symptoms and facilitate the exchange of relevant information between patients and physicians. Finally, El Shafie et al.[8] intend to research the general performance, quality of life, and need to see a doctor in person of patients undergoing curative

TABLE 1. PUBLICATIONS ON THE USE OF MOBILE APPLICATIONS RELATED TO THE HEALTH SELECTED FOR ANALYSIS.

No.	Publication data		Main results
1	Title	Aplicativos móveis desenvolvidos para a área da saúde no Brasil: revisão integrativa da literatura	The final sample consisted of 27 papers. The topic most discussed was professional support. For future work, they suggest the development of apps to support the patient.
	Authors	Tibes CMS, Dias JD, Zem-Mascarenhas SH	
	Year	2014	
	Reference	5	
2	Title	Smartphone applications for cancer patients; what we know about them?	One hundred and sixty-six applications have been downloaded associated with oncologic patients: 75 for Android, 59 for iOS, and 32 on both platforms. There is limited evidence from studies that analyze the content of apps for patients with cancer.
	Authors	Collado-Borrell R, Escudero-Vilaplana V, Ribed-Sánchez A, Ibáñez-García S, Herranz-Alonso A, Sanjurjo-Sáez M	
	Year	2016	
	Reference	6	
3	Title	Apps for radiation oncology: a comprehensive review	A systematic search was performed on mobile platforms, iOS, and Android, and retrieved 157 apps. Excluding those whose purpose did not correspond to the scope of the study, 31 apps were methodically analyzed.
	Authors	Calero JJ, Oton LF, Oton CA	
	Year	2017	
	Reference	7	
4	Title	Mobile app delivery of the EORTC QLQ-C30 questionnaire to assess health-related quality of life in oncological patients: usability study	Eighty-one oncology patients with a mean age of 55 years took, on average, 4 minutes to complete the questionnaire on an iPad; 84% (68/81) of participants had a mobile device and preferred this version (mobile) of the questionnaire instead of the traditional paper template.
	Authors	Kessel KA, Vogel MM, Alles A, Dobiasch S, Fischer H, Combs SE	
	Year	2018	
	Reference	3	
5	Title	Oncologic therapy support via means of a dedicated mobile app (Optimise-1): protocol for a prospective pilot trial	The study will enroll 50 patients for a period of 12 months and will be completed after 18 months. The publication of results is expected 24 months after the beginning of the study and will serve as a basis for studies that aim to innovate in mobile apps for radiotherapy. Suggests regulation in relation to data security.
	Authors	El Shafie RA, Bougatf N, Sprave T, Weber D, Oetzel D, Machmer T, et al.	
	Year	2018	
	Reference	8	
6	Title	Aplicativos móveis para a saúde e o cuidado de idosos	They found 25 applications on three subjects: elderly health, elderly care, and information on elderly care and health. These apps aim at the practice of physical exercise, prevention or detection of falls, cognitive stimulation, search of professionals or services, and providing information on health, diseases, and treatments.
	Authors	Amorim DNP, Sampaio LVP, Carvalho GA, Vilaça KHC	
	Year	2018	
	Reference	9	

Source: Prepared by the authors (2019).

FIGURE 1. SCREEN CAPTURE OF THE OPTMIZE-1 APPLICATION FOR SUPPORT OF CANCER PATIENTS [5]
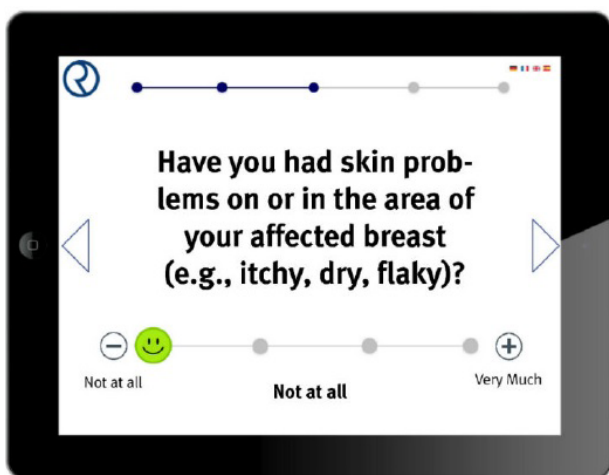
Source: Radiation and Oncology Department of the Heidelberg University Hospital in Germany (El Shafie et al, 2018) [5] .

radiotherapy for thoracic or pelvic tumors, by means of a digital tool (Figure 1). The study will enroll 50 patients for a period of 12 months. The monitoring will be completed after 18 months, and the publication of results is expected 24 months after the beginning of the study. They conclude that the results will serve as a basis for future studies that aim to explore the constant innovation in mobile medical applications and integrate innovative concepts centered on the patient, in the context of radiotherapy. In addition, to prevent these applications from becoming a security issue rather than a useful tool for the patients, they suggest a regulation to be implemented[8].

It is a system that provides support to frontline health professionals to electronically register and monitor the health of patients/clients. Using mobile phones or tablets, the system frees health professionals from bureaucracy and helps ensure that each individual receives essential health interventions. Even though there is no study that demonstrates this practice in Brasil, the Continuous National Household Sample Survey (IBGE, 2016)[4] suggests potential for good acceptance, since it revealed that 94.2% of the population 10 years of age or older, in rural and urban areas surveyed, have accessed the internet for sending or receiving text, or voice messages, or images using different e-mail applications. This percentage remained above 92% even when the five regions of the country were evaluated separately (Figure 2).

In relation to the elderly population, even in Brasil, researchers reported, in 2014, what has been developed in scientific research in the country related to mobile applications for health and care of the elderly in the period from January 2006 to July 2013. After searching the databases chosen, they obtained 319 studies, of which 27 were selected for a detailed analysis. No theses were found, only articles (13), dissertations (seven) and course completion papers (seven), demonstrating a huge gap on the subject. All studies identified were classified

FIGURE 2. PERCENTAGE OF PEOPLE WHO HAVE ACCESSED THE INTERNET FOR EACH END, AMONG THE POPULATION 10 YEARS OLD OR OLDER WHO USED THE INTERNET DURING THE REFERENCE PERIOD OF THE LAST THREE MONTHS, PER GREAT REGIONS, ACCORDING TO THE PURPOSE OF THE INTERNET ACCESS - BRASIL - 4TH QUARTER OF 2016.
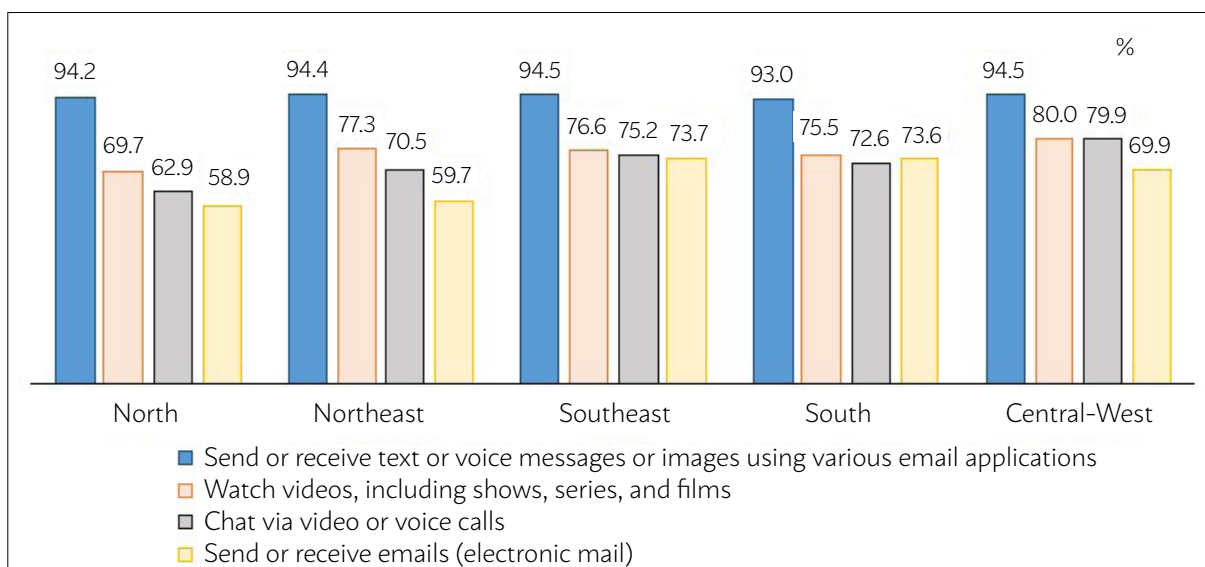
Source: IBGE, Research Department, Secretary of Work and Income, Continuous National Household Sample Survey.

with the evidence level 4, based on the categorization of the Agency for Healthcare Research and Quality (AHRQ), because they had a non-experimental design with descriptive, applied, or correlational research. They also found that smartphones are among the technological resources in which the elderly are interested due to the combination of computer features, internet connection, and use of applications. They consider there is a growing trend in the use of new technologies in the area of health and that the expansion of the use of smartphones among the elderly population grants mobile applications a remarkable potential for the area of aging. They also indicate that such applications can be used as a tool for monitoring, information, promotion of healthy habits, and prevention of diseases and disorders in the elderly. Finally, they highlight that, in spite of the benefits presented, these technological resources need further studies and investigations, because, in addition to technical knowledge, it is necessary to have theoretical knowledge to develop interfaces that meet the needs of the elderly, minimize barriers for technology access, and facilitate digital inclusion[5].

Thus, for the researchers in the Department of Oncology and Hematology-Oncology the University of Milan, in partnership with the European Institute of Oncology, Department of Pediatric Oncology and Hematology, Institute of Experimental Medicine (these last two in Germany), and the Computational Laboratory of Biomedicine in Heraklion, Greece, who published an article about the search for a common regulation for telemedicine and mHealth applications[10], the autonomous management in health by citizens is being made possible by innovations in information and communication technology that already affect the field of health and which also provide resources for professionals, improving the effectiveness of service delivery by hospitals. However, they indicate that the data protection law was introduced to bring uniformity among the European countries, but the guidelines shared for mHealth still need to be developed. They also noted that the development of new regulations is complex because there is a series of health-related ethical issues that must be properly addressed. They conclude that, in relation to applications, the European Commission published a document that evaluates some generic regulations for applications covered by the definition of a medical device, but the European legal framework is still not sufficiently adapted to the regulatory needs arising from mobile health[10].

In 2016, researchers from the pharmacy service of the University General Hospital Gregorio Marañón, of the city of Madrid, Spain, analyzed the characteristics of applications available on the App Store (iOS) and Google Play (Android) platforms targeted at cancer patients[6]. In this study, the objective was to evaluate the reliability of the information in terms of scientific evidence. Although the results have shown numerous benefits from the applications, they identified the lack of validity of information relating to the treatment, as well as outdated data, resulting even in therapeutic injury[6].

PROPOSALS FOR APPLICATIONS

Based on the WHO Classification of Interventions[2], we listed several solutions that could be provided by mobile applications for the remote support of radiotherapy patients. 1) Send alerts for health events targeted at specific groups of oncologic patients in treatment or already treated. 2) Provide information about the disease, diagnosis, progression, and treatment to patients based on the demographics of patients treated. 3) Send alerts and reminders of weekly consultations with physicians and multidisciplinary teams. 4) Send diagnostic results or availability of results. 5) Communication among patients via networking groups, coordinated by the institutional staff. 6) Access by patients to their own medical chart, technical characteristics, and schedule of radiotherapy treatment. 7) System of patient response to the institution. 8) Exploitation and guidance to reduce or limit the effects of radiation. Applications that can identify potential risks of a greater chance of radiation effects, compare changes between tissues irradiated or not, in addition to classifying and categorizing these changes may be of value to obtain great adherence of patients to radiotherapy treatment.

CONCLUSION

Mobile applications are important tools that can be developed, tested, and validated in our country with having great potential to support and digitally include health professionals and patients, in addition to allowing access to information, reducing bureaucracy, increasing patient safety, facilitating communication

between the parties involved (team/doctor/patient), and assisting in data acquisition for various studies. We have not found a significant number of studies in Brasil on this subject. It is necessary to recognize the needs of these users and test them in research so they can be implemented. Recent studies suggest the need for regulations of protocols that protect data transmitted to prevent these applications from becoming a security issue, rather than a useful tool for professionals and patients.

RESUMO

INTRODUÇÃO: *O avanço tecnológico no século XXI tem proporcionado maior comunicação entre todos, independentemente da classe socioeconômica e da faixa etária. Ações de fomento ao desenvolvimento de aplicativos para a área da saúde estão surgindo ao redor do mundo.*

OBJETIVO: *Oferecer uma perspectiva sobre a viabilidade e usabilidade dos aplicativos móveis dedicados aos pacientes radioterápicos para suporte remoto aos profissionais da saúde propondo soluções a fim de incentivar, no Brasil, o desenvolvimento dessas ferramentas digitais.*

MÉTODOS: *Estudo transversal de caráter exploratório por revisão sistemática e análise da literatura. Foram utilizadas buscas nas bases de dados: PubMed, BVS, IBGE, OMS, por publicações citadas de 2014 a 2018.*

RESULTADOS: *Foram encontrados cinco artigos com temas relacionados ao uso de aplicativos móveis na área da saúde, sendo dois nacionais, publicados em língua portuguesa, e três internacionais, no idioma inglês, dos quais esses últimos aplicados à oncologia no período de 2014 a 2018.*

CONCLUSÕES: *Não foi encontrado um número expressivo de trabalhos com este tema no Brasil. Aplicativos móveis têm potencial para ajudar no suporte remoto de pacientes radioterápicos. Os últimos estudos sugerem a necessidade de uma regulamentação de protocolos de proteção de dados transmitidos a ser implantada.*

PALAVRAS-CHAVE: *Telemedicina. Aplicativos móveis. Radioterapia. Oncologia médica.*

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