Viability of mobile applications for remote support of radiotherapy patients

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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. 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. 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. 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, 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 Brazil. 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. 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.
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.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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            | 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            | 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            | 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            | 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            | 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            | 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).
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.

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) 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 email 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...
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.

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, 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.

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. 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.

**PROPOSALS FOR APPLICATIONS**

Based on the WHO Classification of Interventions, 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.

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