Applications for mobile devices in oral health: an integrative review

Aplicativos para dispositivos móveis em saúde oral: revisão integrativa

Aplicaciones para dispositivos móviles en salud oral: una revisión integradora

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ABSTRACT
The elaboration and application of new technological resources with educational strategies in the context of education and health is essential to meet current demands, promoting learning through motivating elements adapted to the contemporary context. To know what has been published about mobile applications in oral health aimed at users in general. Integrative Review that includes review and intervention articles published between 2005 and 2015 in the following electronic databases: Medline, Scielo, Pubmed, Scopus and Cochrane Library. The following descriptors have been used in the search: "oral health", "mobile devices" and "applications", being excluded repeated and they were at odds with the theme proposed. Twelve articles have been identified, these have been grouped in tables according to author, year of publication, country, type of research and action strategy. Few studies have explored applications for the prevention of oral diseases and for the promotion of oral health. Most studies on applications in oral health focus on the area of orthodontics and general practice, using features of text messaging an action strategy for reminding patients of their appointments.

Keywords: mobile devices, oral health, applications, health promotion.

RESUMO
A elaboração e aplicação dos novos recursos tecnológicos com estratégias educativas no contexto da educação e saúde é essencial para atender às demandas atuais, promovendo aprendizagem por meio de elementos motivadores adaptados ao contexto contemporâneo. Conhecer o que foi publicado sobre os aplicativos móveis em saúde oral voltado aos usuários em geral. Revisão integrativa que incluiu artigos de revisão e intervenção publicados entre os anos de 2005 e 2015 nas bases de dados eletrônicos: Medline, Scielo, Pubmed, Scopus e Cochrane Library, utilizando os descritores combinados: “Saúde Oral;” “Dispositivos móveis” e “Aplicativos”, sendo excluídos os repetidos e aqueles em desacordo com o tema. Doze artigos foram encontrados e sumarizados em forma de quadros de acordo com autor, ano de publicação, país, tipo de pesquisa e estratégia de ação. Conclusão: Poucas pesquisas exploraram os aplicativos visando à prevenção das doenças da boca e a promoção de saúde oral. A maioria foi voltada para a gestão dos serviços odontológicos na área de ortodontia e clínica geral, utilizando como estratégia recursos de mensagens de texto para lembretes de consultas.

Palavras-chave: dispositivos móveis, saúde oral, aplicativos, promoção de saúde.

RESUMEN
La elaboración y aplicación de nuevos recursos tecnológicos con estrategias educativas en el contexto de la educación y la salud es fundamental para satisfacer las demandas actuales, promoviendo el aprendizaje a través de elementos motivadores adaptados al contexto contemporáneo. Conocer lo que se publicó sobre aplicaciones móviles en salud oral dirigidas a la población en general. Esta es una revisión integradora que incluyeron los artículos de revisión e intervención publicados entre 2005 y 2015 en las bases de datos electrónicas: Medline, Scielo,
Pubmed, Scopus y Biblioteca Cochrane, utilizando las descripciones combinadas:"Salud oral;" "Dispositivos móviles" y "Aplicaciones", excluyendo repeticiones y las que estaban en desacuerdo con el tema. Encontraron 12 artículos adoptados y resumidos en tablas según el autor, año de publicación, país, tipo de investigación y estrategia de acción. Pocas investigaciones han explorado las aplicaciones destinadas a la prevención de enfermedades bucales y la promoción de la salud oral en la población en general, mientras existen muchos estudios con aplicaciones dirigidas a la gestión de servicios dentales. La mayoría de los estudios con aplicaciones sobre salud oral se centraron en el campo de la ortodoncia y la clínica general, utilizando como estrategia de acción recursos de mensajes de texto para recordatorios de citas.

**Palabras clave:** dispositivos móviles, salud oral, aplicaciones, promoción de la salud.

1 INTRODUCTION

Smart mobile technology (smartphones, mobile phones, tablets, Ipods, etc.) has revolutionized the way we communicate. This technology has made it possible to share all kinds of content, and it is now part of different sectors of society, including health care. In keeping with this worldwide trend, smartphones are becoming increasingly widespread, given its functionality which is that of a portable minicomputer, with Internet access and various applications and software, allowing immediate access to different sources of information (Bert et al., 2014).

The applications and software developed for mobile devices are constantly developing and are currently widely used by the population, with different purposes (games, communication, entertainment, business, education, health, etc.) (Deguirmendjian; Miranda; Zem-Mascarenhas, 2016), making mobile communication an increasingly promising, accessible and essential tool for health professionals and users in general.

The health sector has become one of the main sectors benefiting from the growing use of technological innovations. This is due to their increasing potential for use as a support tool in the control of diseases, such as obesity, smoking, dengue fever and chronic diseases. In addition, these technologies can stimulate the user to maintain or initiate practices of self-health promotion (Diamantidis; Becker, 2014).

These technological innovations have led to changes in the formulation of health policy strategies throughout the world. These are welcome changes and are encouraged by the United Nations and the World Health Organization (WHO), enabling medical and public health practices
to be aided by resources which contribute to improve decision-making in clinical protocols, guaranteeing quality of care for the integral care and the well-being of the population (World Health Organization, 2011).

In view of this, different educational approaches to prevention, promotion and oral health care are being tried out in order to improve the population's adherence to oral health self-care practices, including the use of mobile applications, which is still a novelty in this area (Mosa; Yoo; Sheets, 2012).

In this perspective, the area of oral health has also benefited from the development and use of specific applications for professionals and students of dentistry (Schulz et al., 2013). However, there are still few studies on the use of these applications by the population in general. Therefore, we propose a literature review to update the scientific knowledge of the actual applications of these new technologies as health education tools.

2 METHOD

The present study is an Integrative Review of the literature on oral health applications. This method of review is a tool employed in Evidence-Based Practice (EBP). EBP is characterised by a clinical care approach and by an approach to teaching which is based on knowledge and the quality of evidence. The integrative review proposes the analysis and synthesis of several studies already published on the subject, allowing the verification of new evidence which will support decision making and the applicability of significant results in practice (Melnyk, 2003).

Initially, the question which led to the study was: what has been published on the use of mobile applications in the field of oral health aimed at users of health services? The strategy used for identification and selection of the studies was the search of publications indexed in the following database: Medical Literature and Retrieval System on Line (Medline); Caribbean Latin American Literature in Health Sciences (Lilacs); Scopus (Elsevier); Cochrane Library and PubMed. The following selection criteria were adopted: Portuguese and English (languages); categories of articles (original and revisions); abstracts available in the databases listed above, and published between 2005 and 2015. The descriptors used in the search were combined with Boolean operators: Smartphone AND Oral Health OR Oral Care; Apps AND Oral Health OR
In order to allow a comparative analysis, data on the studies were summarized in table form, containing the following information: title, authors, year of publication, descriptors, study outline and focus. The analysis of the data was conducted in a descriptive way, leading to the analysis of the data extracted from the selected studies.

3 RESULTS AND DISCUSSION

In the present literature review, we have analysed articles published in the (2005-2015), with regard to applications developed for smartphones in oral health promotion. Through the search filters and taking into account the inclusion criteria, the papers were selected by both title and abstract. Those which were repeated and/or were outside the main focus of the research were excluded. The complete selected articles, 12 in total (Figure 1), were read in full and constituted the final sample used in the study.

The selected articles in the context of "oral health applications" are summarized in Chart 1, according to author, journal, year, country, and descriptors (DECS). Out of the 12 articles
selected, 5 were review articles, which mostly addressed the topic of "health" in general, its applicability and target audience. In Chart 2, the articles are classified according to the type of study and action strategy used by the authors in each one of them.

### Chart 1. Articles on oral health smartphone applications, considering the author(s), periodical(s), year and place of publication, and search descriptors

<table>
<thead>
<tr>
<th>Title of the Article</th>
<th>Periodical(s) / Year and place of publication</th>
<th>Author(s)</th>
<th>Search Descriptor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orthodontic apps for smartphones</td>
<td>Journal of Orthodontics, 2013, Oxford (England)</td>
<td>Singh P.</td>
<td>Android; Apps; iPhone; Smartphones</td>
</tr>
<tr>
<td>A systematic review of healthcare applications for smartphones</td>
<td>BMC Medical Informatics and Decision Making, 2012, EUA</td>
<td>Mosa AS, Yoo I, Sheets L.</td>
<td>CellPhones; Medical</td>
</tr>
<tr>
<td>Effects of tooth scaling reminders for dental outpatients</td>
<td>Journal of Telemedicine and Telecare, 2013, China</td>
<td>Cheng CC, Li CY, Hu YJ, Shen HC, Huang SM.</td>
<td>Cell Phones; Oral HygieneReminder Systems; Telephone; Text Messaging</td>
</tr>
<tr>
<td>Internet and social media for health-related information and communication in health care: preferences of the Dutch general population</td>
<td>Journal of Medical Internet Research, 2013, Holanda</td>
<td>Van de Belt TH, Engelen LJ, Berben SA, Teerenstra S, Samsom M, Schoonhoven L.</td>
<td>Health 2.0; Consumer health information; Empowerment; Patient Participation; Social media</td>
</tr>
<tr>
<td>Smartphone applications for pain management</td>
<td>Journal of Telemedicine and Telecare, 2011, Reino Unido (UK)</td>
<td>Rosser BA, Eccleston C</td>
<td>Cell Phones; Diagnosis; Chronic; Medical Records; Pain Management/methods</td>
</tr>
<tr>
<td>A preliminary investigation into the effect of the use of the short message service (SMS) on patient attendance at an NHS dental access centre in Scotland</td>
<td>Primary Dental Care, 2011, Escócia (UK)</td>
<td>Perry JG</td>
<td>Appointments; Patient compliance; Reminders; Short message service</td>
</tr>
<tr>
<td>Aplicativos móveis desenvolvidos para a área de saúde no Brasil: Uma revisão integrativa da literatura</td>
<td>Revista Mineira de Enfermagem, 2014 Brasil</td>
<td>Tibes CMS, Dias JD, Zem-Mascarenhas SH</td>
<td>Computação em Informática Médica; Enfermagem; Informática em Saúde</td>
</tr>
<tr>
<td>Smartphone and health promotion: a review of the evidence</td>
<td>Journal of Medical Systems, 2014, Itália</td>
<td>Bert F; Giacometti M; Gualano MR; Siliquini R</td>
<td>Cell Phones; computers; handheld; internet; health promotion, lifestyle; patients</td>
</tr>
<tr>
<td>The influence of text messaging on oral hygiene effectiveness</td>
<td>The Angle Orthodontist, 2014, Virginia (EU)</td>
<td>Bowen TB, Rinchuse DJ, Zullo T, DeMaria ME</td>
<td>Oral hygiene; Text message; Orthodontics; compliance</td>
</tr>
<tr>
<td>Improvements in dental care using a new mobile app with cloud services</td>
<td>Journal of the Formosan Medical Association, 2014, Taiwan</td>
<td>Lin CY, Peng KL, Chen J, Tsai JY, Tseng YC, Yang JR, Chen MH.</td>
<td>Cloud computing service; Dental care; Mobile app; Telemedicine</td>
</tr>
</tbody>
</table>
Influence of active reminders an oral hygiene compliance in orthodontic patients

<table>
<thead>
<tr>
<th>Title of Article</th>
<th>Type of Study</th>
<th>Action Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orthodontic apps for smartphone</td>
<td>Review</td>
<td>Orthodontic Apps available at four of the major operating systems and target at orthodontic professionals and patients</td>
</tr>
<tr>
<td>A systematic review of healthcare applications for smartphones</td>
<td>Review</td>
<td>Most applications aimed at health professionals, with a focus on diagnosis; and 15 apps for users, focusing on management of chronic diseases (diabetes and hypertension)</td>
</tr>
<tr>
<td>Effects of tooth scaling reminders for dental outpatients</td>
<td>Controlled Clinical Trial</td>
<td>Reminders (text messages, postcards and mobile phones) are effective and are associated with dental patient satisfaction on their return visits</td>
</tr>
<tr>
<td>Internet and social media for health-related information and communication in health care: preferences of the Dutch general population</td>
<td>Transversal</td>
<td>The Internet (social media) is the main source of information on health for the Dutch population</td>
</tr>
<tr>
<td>Smartphone applications for pain management</td>
<td>Review</td>
<td>Applications for self-management of pain, with messages, videos, sound, light, vibration sensors, information on causes and treatment. Mostly commercial.</td>
</tr>
<tr>
<td>Using personal digital assistants too improve self care in oral health</td>
<td>Intervention</td>
<td>Applications in PDA for patients with mild to moderate mental dysfunction using video and audio material in oral health promotion</td>
</tr>
<tr>
<td>A preliminary investigation into the effect of the use of the short message service (SMS) on patient attendance at an NHS dental access centre in Scotland</td>
<td>Intervention Observational</td>
<td>Dental appointment reminder messages (SMS) for patients using the public health service</td>
</tr>
<tr>
<td>Aplicativos móveis desenvolvidos para a área de saúde no Brasil: uma revisão integrativa da literatura</td>
<td>Review</td>
<td>Applications focused on patients, with the objective to assist in the adherence to pharmacological treatments; attitudinal and mobility of the visually impaired in urban environments. Strategies: SMS reminders</td>
</tr>
<tr>
<td>Smartphone and health promotion: a review of the evidence</td>
<td>Review</td>
<td>Most health promotion apps for the general population belong to the categories: nutrition, fitness and physical activity, lifestyle and the health of the elderly. Strategies: diet, reminders, video-lessons, health education</td>
</tr>
<tr>
<td>The influence of text messaging on oral hygiene effectiveness</td>
<td>Randomized Controlled Clinical Trial</td>
<td>Dental hygiene guidelines by mobile text messaging</td>
</tr>
<tr>
<td>Improvements in dental care using a new mobile app with cloud services</td>
<td>Intervention</td>
<td>Applications designed to provide a platform for direct communication between dentists and patients, through messaging – arranging appointments, sending photos for diagnosis, emergency prosthetics care, time management; optimization of material resources</td>
</tr>
</tbody>
</table>

Source: Authors
Influence of active reminders on oral hygiene compliance in orthodontic patients

Prospective, randomized, controlled clinical trial

Types of mobile messages sent to patients undergoing orthodontic treatment to verify if they had any influence on the patients’ oral hygiene, measuring SG, IPV and MBA rates at the beginning and end of the research

Source: Authors

The growing number of publications on mobile technology and health available in the scientific literature is surprising, creating new perspectives in health care. However, despite the numerous health applications available for smartphones and the growing interest in using them to improve health behaviour, there are few studies which cover the area of dentistry under the theme of oral health promotion/oral health care intended for users in general (Bert et al., 2014; Bowen et al., 2014; Cheng et al., 2013; Eppright et al., 2014; Lin et al., 2014; O’Hara et al., 2008; Perry, 2011; Rosser; Eccleston, 2011; Schulz et al., 2013; Singh, 2013; Tibes; Dias; Zem-Mascarenhas, 2014; Van De Belt et al., 2013).

Our search led to several studies which addressed the use of applications in the general context of health but which were not directed to oral health, and which were therefore, to a large extent, systematic reviews. These articles discussed the applicability of mobile devices in multidisciplinary areas, where the focus was healthy lifestyle, fitness, nutrition, physical activity, adherence to pharmacological treatment and pain management (Bert et al., 2014; Cheng et al., 2013; Rosser; Eccleston, 2011; Tibes; Dias; Zem-Mascarenhas, 2014).

There is a growing number of applications intended for home care and management of chronic diseases. Currently, there is strong evidence that oral diseases are related with diabetes, and that it is possible to diagnose the disease based on clinical signs evidenced in the oral examination performed by the dentist. It is therefore important to highlight the multifactorial relationship associated with chronic diseases, which has led to further exploring the content of these applications (Diamantidis; Becker, 2014; Viana; Barbosa, 2014; World Health Organization, 2011).

Research on the development of applications for healthcare has followed a worldwide trend, respecting the epidemiological transition evidenced by the increase of chronic diseases. This has become a challenge to the quality of care provided, and to the alternative strategies to support the management of these diseases (Organização Mundial da Saúde, 2003).

Another point worth of discussion is the development of applications for the prevention and counselling of the population regarding the use of tobacco and alcohol, which has a close
relationship with oral health, due to its association with lesions and oral cancer. These harmful habits lead to diseases considered chronic and which affect a large part of the population, being responsible for high rates of morbidity and mortality and costly costs to public health systems (Marrom et al., 2010).

As for health applications for professionals and students of dentistry, there is a variety of technological innovation which focuses on this category and which is used as pedagogical support tools for undergraduate and postgraduate teaching and learning. Some studies emphasize the use of applications in the subjects of histology, prosthesis, buco-maxillofacial surgery, radiology, morphology, anatomy, replacing or complementing the existing didactic support materials (Maggio; Hariton-Gross; Gluch, 2012; Rung; Warnke; Mattheos, 2014; Schulz et al., 2013).

The results showed a very limited number of oral health applications are aimed at the general population, or focus on health promotion. Moreover, there are few studies which evaluate the pedagogical effectiveness of this tool in the learning process and in the behaviour change regarding oral health (Mattila et al., 2013). Only a few controlled and randomized studies with the purpose of "oral health promotion" for the general population allowed free access and were based on well-delineated experimental research (Bowen et al., 2014; Cheng et al., 2013; Eppright et al., 2014).

Our investigation also showed that it is in orthodontics where oral health applications are most used. It should be noted that the vast majority of the users of orthodontic appliances are adolescents and young adults. They represent the population with the greatest interest, skills, and access to this technology, which may have motivated the greater investment and development of applications in this area of dentistry (Cheng et al., 2013). The action strategy used focuses on the use of messages with reminders and alerts about appointments, and oral hygiene guidelines (Bowen et al., 2014; Cheng et al., 2013; Eppright et al., 2014; Singh, 2013). Although this strategy seems limited or simplistic, studies (Cheng et al., 2013; Eppright et al., 2014) have shown that orthodontic treatment patients, when exposed to different strategies of appointment reminders and hygiene guidelines, felt greater motivation when they made use of the applications compared to those who were instructed with brochures and/or telephone calls.

Another aspect for which applications were used was pain management. This, however, was addressed within the context of general health, with headaches and migraine being the most
commonly types of pain addressed by the applications. While, toothache, menstrual pain and pain caused by a sore throat were rarely addressed. Several other strategies were used for pain management, such as medication and consultation reminders; electronic and manual techniques related to pain reduction, information on acupuncture, acupressure tutorials, meditation, hypnosis and massage. Most of this information was based on textual information, images, video, audio and/or animations. There were, however, other specific attributes of therapy in the mobile device itself to reduce pain, such as light emitted from the device screen, supposedly providing pain relief, and vibration with a massage function (Rosser; Eccleston, 2011).

Still with regard to the area of oral health, systematization and control of the quality of information provided have been used in an application for direct communication between dentist and patient. This has shown that the scheduling and monitoring of prosthesis users can provide greater longevity of services, optimization of consultation time, minimization of delays and good interaction between patient and professional. All this promotes the proper functioning of the health management system of the public service, and positively influences its professionals and users (Lin et al., 2014).

4 CONCLUSION

There is a gap in the studies aimed at developing and evaluating the pedagogical effectiveness and the level of user satisfaction with regard to the use of applications for the prevention of mouth diseases and for the promotion of oral health for the general population. Most studies focus on the use of applications for dental services. Most studies on applications for oral health focus on the area of orthodontics and general practice, using text messaging features for appointment reminders.
REFERENCES


