Review Article

Mobile apps for disadvantaged societies

Aplicativos móveis para as sociedades menos favorecidas

Aplicaciones móviles para las sociedades menos favorecidas

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Abstract

Objective: To describe the impacts of mobile applications directly in favor of the health of disadvantaged communities living in low-income or developing countries and, indirectly, through healthcare professionals providing assistance in these areas.

Methods: This is an integrative literature review in the PubMed, SciELO and LILACS databases of original evidence-based research, published between 2010 and 2019, available in full and in Brazilian Portuguese and English, through the guiding question: "What is the impact of mobile applications on direct and indirect health care in low-income and developing populations?". The following descriptors were used: biomedical technology, health information and mobile applications, the latter being present in all intersections. The strategy of search, selection and categorization of studies was performed by the reading of a researcher.

Results: The applications demonstrated benefits regarding the diagnosis of diseases, users' treatment adherence, patient follow-up by health professionals and self-care, constituting an important tool for monitoring and managing diseases.

Conclusion: Mobile technology has the potential to improve primary care services through qualification of health care promoted by professionals and direct access of users, especially in low-income countries, whose health indicators are worrisome.

Resumo

Objetivo: Descrever os impactos dos aplicativos móveis diretamente em favor da saúde das comunidades menos favorecidas que vivem em países de baixa renda ou em desenvolvimento e, indiretamente, por meio dos profissionais de saúde que prestam assistência nestas áreas.

Métodos: Revisão integrativa da literatura nas bases de dados PubMed, SciELO e LILACS de pesquisas originais baseadas em evidências, publicadas entre 2010 e 2019 disponíveis na íntegra e em português e inglês, mediante a questão norteadora: *"Qual o impacto dos aplicativos móveis no cuidado direto e indireto em saúde em populações de baixa renda e em desenvolvimento?"*, a partir dos descritores: tecnologia biomédica, informação em saúde e aplicativos móveis, sendo este último presente em todos os cruzamentos. A estratégia de busca, seleção e categorização dos estudos foi realizada pela leitura de um pesquisador.

Resultados: Os aplicativos demonstraram benefícios quanto ao diagnóstico de doenças, adesão dos usuários ao tratamento, acompanhamento dos pacientes pelos profissionais de saúde e autocuidado, constituindo uma importante ferramenta para o monitoramento e gerenciamento de doenças.

Conclusão: A tecnologia móvel tem o potencial de melhorar os serviços de atenção primária por meio da qualificação dos cuidados em saúde promovidos pelos profissionais e acesso direto do usuário, sobretudo em países de baixa renda, cujos indicadores de saúde são preocupantes.

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Conflicts of interest: nothing to declare.

Resumen

Objetivo: Describir los impactos de las aplicaciones móviles directamente a favor de la salud en las comunidades menos favorecidas que viven en países de bajos recursos o en desarrollo e indirectamente a través de los profesionales de la salud que atienden en estas áreas,

Métodos: Revisión integradora de la literatura en las bases de datos PubMed, SciELO y LILACS de estudios originales basados en evidencias, publicados entre 2010 y 2019, con texto completo disponible en portugués e inglés, mediante la pregunta orientadora: ¿Cuál es el impacto de las aplicaciones móviles en el cuidado directo e indirecto de la salud en poblaciones de bajos recursos y en desarrollo?, a partir de los descriptores: tecnología biomédica, información en salud y aplicaciones móviles, este último presente en todos los cruces. La estrategia de búsqueda, selección y categorización de los estudios fue realizada mediante la lectura de un investigador.

Resultados: Las aplicaciones demostraron beneficios con relación al diagnóstico de enfermedades, adherencia de los usuarios al tratamiento, seguimiento de los pacientes por parte de los profesionales de la salud y autocuidado, lo que constituye una importante herramienta para el monitoreo y gestión de enfermedades.

Conclusión: La tecnología móvil tiene el potencial de mejorar los servicios de atención primaria mediante la cualificación de los cuidados de la salud promovidos por los profesionales y el acceso directo del usuario, sobre todo en países de bajos recursos, cuyos indicadores de salud son preocupantes.

Introduction

There is undoubted ly the power that technology exercises in contemporary society. Recent advances in information technology have enabled the transformation of the Internet into a common means of information, entertainment, and communication, allowing the connection of data in several ways. In this scenario of technological advances, mobile devices such as smartphones and tablets stand out, whose popularity permeates the lives of users of all ages.[1]

The growth in smartphone use has also directly influenced the routine of Brazilians. In 2014, Android (89.1%) was the most used operating system, followed by iOS (5.2%), and Windows Phone (3.8%), reaching 107 million users, which accounted for 53% of the national population, placing it in the fifth place in the list of countries that most access the network, after China, united states, India, and Japan.[2] In 2017, about 67% of the Brazilian population made use of the Internet, access with preference via computer, when compared to smartphones or tablets; however, the trend is that in the coming years smartphones will surpass computers.[3]

The applications, through non-portable and non-accessible mobile devices, have facilitated people's lives, expanding the impact of technology on society and allowing the expansion of portability and flexibility for various types of relationships as a means of automating various tasks, until then performed manually, arousing the interest of many for the development of applications capable of solving everyday problems, increasing the investment by companies in solutions and tools that facilitate the development process.[4]

Considering the solution of everyday problems, actions developed in solid situations of life are universal requirements for development and health changes. Self-care is in this context, which corresponds to the practice of activity developed by people for their own benefit based on the maintenance of life, well-being and health.[5] Self-care can be established as the practice of activities that benefit the improvement and maturation of the people who initiate and develop it within specific time periods, in order to promote life and personal well-being.[6]

For this reason, the reduction of mobility limitation is the main characteristic of mobile devices, a fundamental quality for resources used in health care, considering the peculiarities inherent to the work performed by professionals in this field[7] and the autonomy intended for patients in the development of self-care.

These considerations allow a reflection on how mobile applications have been used directly in favor of the health of disadvantaged communities; therefore, this study aims to describe the impacts of mobile applications directly in favor of the health of communities living in low-income or developing countries and, indirectly, through health professionals who provide care in these areas.

Methods

This was an integrative review, through identification, analysis and synthesis of results of studies on

the same subject. This type of review allows synthetisize and analyze the research developed and published on a given subject, both by quantitative and qualitative method, enabling a more comprehensive understanding of a given phenomenon, capable of supporting decision-making based on scientific evidence.[8]

The stages of this review were based on a previously established protocol, aiming to maintain scientific and methodological rigor, namely: 1) research question preparation; 2) definition of the inclusion criteria of studies and sample selection; 3) representation of the selected studies in table format, considering all the characteristics in common (data collection); 4) critical analysis of the included studies, identifying differences and conflicts; 5) interpretation/discussion of results; 6) presentation of results with exposure of the evidence found.

To answer the follower question of the review "What is the impact of mobile applications on direct and indirect health care in low-income and developing populations?", we conducted a bibliographic search for publications indexed in the PubMed, SciELO and LILACS databases, based on the following descriptors: mobile applications, biomedical technology, and health information. The strategy of search and selection of studies was carried out by a researcher.

Original studies published between 2010 and 2019, based on evidence in Brazilian Portuguese and English and available in full were included. Duplicates, case studies and studies outside the theme addressed and time frame were excluded. After reading the material, data was grouped by category.

The data from the studies selected for analysis were synthesized through year of publication, author, type of study, object of study, objective and study considerations, described in a dedicated session.

Results

Description of study characteristics

A total of 557 articles was found. Of these, 239 (43%) were repeated in the databases and 300 (54%) did not correspond to the theme, remaining nine articles, one (10%) from MEDLINE and eight (90%) from PUBMED, as illustrated in Figure 1.

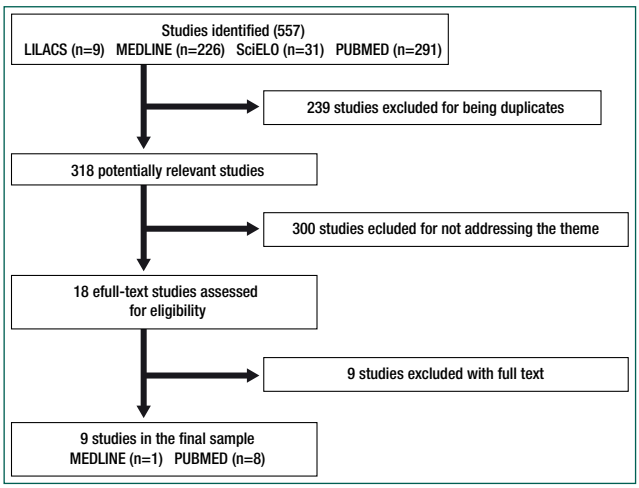

Figure 1. Flowchart of the selection of articles included in the integrative review

All articles were categorized by similarity in the study objectives and themes: benefits of applications to users' health due to ease-of-access to health information (n= 5) and benefits of applications that support health professionals who provide care to low-income populations and in developing regions, with precarious conditions (n= 4).

The publications selected with the description of the impacts of mobile applications on health in disadvantaged societies according to year of publication, authorship, study objective, method used, population studied, considerations and influence of applications are summarized in Chart 1.

In general, it can be inferred from the results presented in the selected studies that using applications can serve as a technological resource, bringing a direct positive impact to health, especially in low-income populations or with difficult access to the Internet or indirect through professionals who provide health care in these regions.

Discussion

The applications present in mobile devices, specific to the fields of health, also called mobile health ap-

Chart 1. Integration of publications that portray the use of mobile applications focused on health care in disadvantaged societies

Year	Author	Study/reference	Type of study	Study subject	Objective	Study considerations	Application influence
2019	Menezes et al [9]	Use of a Mobile Phone App to Treat Depression Comorbid With Hypertension or Diabetes: A Pilot Study in Brazil and Peru	Experimental study	Patients with signs of depression	Exploring the potential efficacy of a mobile health intervention to help people with depressive symptoms and comorbidity hypertension or diabetes	The mobile application proved to be viable to help treat patients with comorbid depressive symptoms in low- and middle-income countries.	An important reduction in depressive symptoms of diabetic and hypertensive patients.
2019	Rajbhandari et al[10]	Epilepsy field workers, a smartphone application and telephone telemedicine: Safe and effective epilepsy care in rural Nepal.	Experimental study	Patients with signs and symptoms of epilepsy	Proposing a new model of care, from the development of a smartphone application for diagnosis of epilepsy from seizures	The application provided considerable assistance in the diagnosis of epilepsy, as well as in the interruption and reduction of seizures caused by epilepsy, receiving the preference of patients to this service offered, avoiding displacement scans to medical services for diagnosis.	Agility in diagnosis; Significant reduction in patient displacements for access to medical services.
2017	Carroll et al[11]	Who Uses Mobile Phone Health Apps and Does Use Matter? The Secondary Data Analytics Approach.	Almost experimental, cross-sectional, data association study	Application users	Describing the social and demographic characteristics associated with the use of health applications in a recent representative sample from the USA; assessing attitudes and behaviors of users of health applications for health promotion; assessing the association between the use of health-related applications and the recommended guidelines for fruit and vegetable intake and physical activity, informing populations more and less likely to use health applications.	Despite the lack of evidence of clinical efficacy and integration with the health system and the need for formal assessment and review, and potential threats to safety and privacy, applications can improve users' health, and provide information about populations more and less likely to use health applications to guide clinical interventions through commercial and public health programs.	Valuable progress in the health of application users.
2017	Uddin et al[12]	Impact of mobile phone-based technology to improve health, population and nutrition services in Rural Bangladesh: a study protocol	Experimental study	Women from a rural Bangladeshi community	Developing, testing and assessing the impact of a mobile health strategy mechanism on improving reproductive health and family planning, maternal, neonatal and child health, integrated child disease management, vaccination program and other primary health services of communities in rural Bangladesh.	Cell phone-based technology has the potential to improve primary health care services by speeding up access to information and strategies for the care of maternal and child health services in low-income countries.	Significant improvement in the coverage of primary health care services in a country of extreme poverty, reducing the search for medium-complexity health
2013	Blank et al[13]	Quality of prenatal and maternal care: bridging the know-do gap" (QUALMAT study): an elecronic clinical decision support system for rural Sub-Saharan Africa)	Randomized controlled experimental study	Health professionals in rural areas	Improving the performance and motivation of rural health workers and the quality of care services developed at the primary level of maternal health care in Ghana, Burkina Faso, and Tanzania.	The computerized system of clinical decision support was introduced in rural centers where health professionals of different educational levels work, due to the underdeveloped scenario of the country, with significant improvement in its performance.	Enrichment of the quality of health care in primary care promoted by professionals working in underdeveloped places.
2013	Mitchell et al[14]	Using electronic technology to improve clinical care - results from a before-after cluster trial to assess assessment and classification of sick children according to Integrated Management of Childhood Illness (IMCI) protocol in Tanzania)	Experimental study	Health professionals	Estimating the impact of electronic technology on adherence to integrated care protocols for prevalent diseases in childhood, compared to current paper-based protocols in Tanzania	The study demonstrated the benefit of technology in providing a proven standard of care in a rural and semi-urban area of Tanzania, a country of extreme poverty, based on the quality of care of the professionals who used it.	Qualification of clinical care of professionals working in low-income countries.
2012	Mitchell et al[15]	Perceived improvement integrated management of childhood illness implementation through use of mobile technology: qualitative evidence from a pilot study in Tanzania)	Experience report	Health care providers and caregivers of the Integrated Electronic Management of Childhood Diseases	Assessing caregivers' and health professionals' perception about treatment of childhood diseases when compared to conventional paper forms through qualitative interviews.	Health care providers' perception of receiving more information made the use of digital personal assistants, expanding their knowledge about treatment of childhood diseases in a country of extreme poverty.	Agility in access to information about the treatment to be performed, offered more quickly, especially in low-income places.
2012	Pellegrini et al[16]	A smartphone supported weight loss program: design of the ENGAGED randomized controlled trial	Experimental study	People with obesity	Examining the feasibility and effectiveness of a smartphone-supported weight loss program.	There was a significant reduction in obesity in patients who used the technology.	Change of habits and behaviors of users through the goals of the application.
2011	Florez-Arango et al[17]	Performance factors of mobile rich media job aids for community health workers	Randomized controlled experimental study	Community health worker	Studying and analyzing the possible performance benefits of community health agents using out-of-care clinical guidelines implemented as interactive rich media work aids on small-format mobile platforms.	Widespread acceptance of this resource by community health agents with lower educational levels and serving populations with very poor literacy indicating encouraging prospects for mobile health technologies in general and the use of clinical guidelines on mobile phones in particular	Improvement of health care due to the ease of access to information of professionals who serve a population with low level of education in underdeveloped places.

plications or mHealth, attribute significant relevance as tools for both researchers and health professionals when considered monitoring and management of chronic diseases, who use wireless communication in clinical practice and health support.[18]

These devices have benefits over traditional computers, especially in developing countries, due to their lower acquisition cost and ease of use even for users with little experience.[19]

Considering assistance in diagnostic work, a study developed with residents of a rural district of Nepal, a low-income country where 50% of epilepsy cases do not receive treatment and there are few doctors, aimed at training residents of this area as "epilepsy field workers", providing them with epilepsy awareness and its consequences in their communities, guiding them to use a smartphone app capable of determining the likelihood of an episode being epileptic by contacting an epilepsy specialist over the phone.[10]

Another study, conducted with low-income women living in communities in the Midwest and eastern and western coasts of the United States of America (USA), aimed to understand the extent of adoption and use of digital health tools and to identify the main psychological factors perceived in the use of technology. As a result, the majority obtained access to health information. Evidence indicates that individuals who experience difficulties accessing health care for reasons unrelated to their social status are more likely to report using the internet for health information. It has been confirmed that the benefits of using digital tools provide benefits to individuals with the resources and skills to use technology effectively.[20]

Both mobile phones and tablets have a higher market entry in developing countries when the comparison is performed with computers. Price reduction in mobile devices and internet-access carriers has produced a considerable increase in the number of users connected to the mobile network. At the end of 2014, 56.2% of mobile phones were accessible to mobile broadband in the country, making up more than 148 million connected devices. Such data justifies the efforts in the migration of web services to Android and iOS platforms as an experience of expansion and diversification of the affected public, and equipment based on the Android system has a lower cost.[21]

By providing, through technology, pregnancy tracking and reminders for visits and childbirth, a study developed with the population of Bangladesh applied the use of mobile phone-based technology to health in order to increase people's access to care. During childbirth, the technology was used for remote consultations at the place of care, facilitating not only referral, but also access to health services, promoting agile and opportune contact with community health workers (CHW) in their respective work areas,[12] optimizing time and bringing parturient women to the care needed at that moment.

In the Brazilian context, universal access to health services, a flag of struggle of social movements guaranteed by the 1988 Constitution, was one of the fundamental rights of citizenship. This access does not portray the mere use of the health service, but rather the opportunity to have the services in circumstances that allow the proper use of them in a timely manner to achieve good health outcomes from equity and integrality;[21] however, it still constitutes a great challenge in disadvantaged societies.

In Kenya, an African country, malaria case management practices of health workers often differ from national guidelines. In this scenario, sending text message reminders to health professionals' mobile phones to improve and maintain adherence to outpatient pediatric malaria treatment guidelines has been tested, showing that in resource-constrained environments text messaging can improve health management practices health worker cases.[22]

In Colombia, a study developed by the University of Antioquia using clinical guidelines presented through text, audio, images and video on cell phones for CHW indicated encouraging perspectives for mobile health technologies in general and the use of clinical guidelines on mobile phones in particular to support global health,[17] due to easy access to information of professionals with low educational level who assist the population in precarious conditions of instruction, compromising

the interpretation of the information received for health care.

Different bottlenecks mark specialized attention when considering access to health. The difficulty in guaranteeing access to specialized services depends on the model of care in force, the resolution of primary care, improvement of the resolution of primary care, especially where there are not enough health professionals, in addition to dimensioning and organizing the provision of services.[23]

In Tanzania, a study aimed at estimating the impact of electronic technology on compliance with integrated care protocols for prevalent childhood diseases compared to current paper-based protocols demonstrated its benefit in providing a proven standard of care in a rural and semi-urban area, qualifying clinical care in low-income countries.[14]

In order to control the weight of adult people through a program called SmarDiet developed by researchers, the technology provided regularity in the diet of users, as well as increase in the practice of physical exercise and decrease in body composition, which stated that such type of tool is easy to use and access as well as the interesting and motivating form of its content.[24]

Another program developed for weight loss through a strategy called E-Networks Guiding Adherence to Goals in Exercise and Diet (ENGAGED) established goals for self-monitoring of your goals and behavior modification using smartphones. The program demonstrated that this innovative weight loss intervention integrates theory with emerging mobile technologies, reaffirming its effectiveness and feasibility as a support for weight loss programs, enabling the reduction of program costs and maintaining effective results.[16]

QUALMAT, a research project funded by the European Union that assesses the quality of prenatal and maternal care, promoted a study whose proposal was to improve the performance and motivation of rural health workers; in addition, there has been an improvement in the quality of care services developed at the primary level of maternal health care in Ghana, Burkina Faso and Tanzania, African countries that maintain their poor quality of care as evidenced by high maternal mortality rates, despite the strong efforts to improve care. Through a program capable of being performed on any standard equipment developed based on the assessment of the health care situation, this study stated that a computerized system of clinical decision support is essential for rural centers where health professionals of different educational levels work.[13]

Another qualitative study carried out in Tanzania, whose objective was to assess the perception of health care providers and caregivers of the Integrated Electronic Management of Childhood Illnesses, when compared to conventional forms of role in the diagnosis and treatment of childhood illnesses, observed an improvement in the service provided by providers who used personal digital assistants, as they were better informed.[15]

It is notorious that all social spheres in the world benefit from the reality of technology mediating communication and information. The Internet has encouraged profound changes in social, cultural and economic dynamics, overcoming the expectation of being a means of communication, a technology or even a means of social interaction only.[25]

The ease that applications have provided for the lives of many people allows a wide range of impact in the world of technology, through portability and flexibility for various types of business, be it home automation, health and well-being, information storage on cloud, ways to expose knowledge among others;[18] however, the need for the participation of health professionals both in the development and supervision of these technological equipment are essential for quality when considering health in its broad concept.

Seeking to provide up-to-date information on populations more and less likely to use health applications to guide clinical interventions with primary objectives, a cross-sectional study revealed that health applications have limitations, such as lack of evidence of clinical efficacy, integration with the health system, need for formal assessment and review, and vulnerability of potential threats to security and privacy, despite the excessive adherence to the ownership of mobile phones, the use of health applications and their potential for health improvement.[11]

In underdeveloped, low- and middle-income countries, with insufficient investments in health, underdiagnosis of depression in primary health care is common, enhanced when the patient has chronic physical disorders, also compromising treatment due to the scarcity of financial, material and financial resources. humans. Interventions supported by mobile health technologies can mitigate undesirable developments by offering potentially viable and accessible alternatives for treatment of depression among individuals with chronic disorders.[9]

Given the evidence discussed here, the impact of health applications, developed in an appropriate manner, can be positive, contributing to different designs for improving people's lives, especially in low-income settings, in isolated regions of large centers and underdeveloped and developing countries; however, its potential still needs to be better explored both in completely connected communities, as in the case of large urban centers and in other isolated ones, either by geographic aspect, as in the case of inland cities or even for cultural issues, such as indigenous and *quilombola* (a *quilombola* is a resident of a *quilombo* in Brazil) communities.

Conclusion

The results found in this review allow us to consider that mobile technology has the potential to improve primary health care services through the qualification of health care promoted by professionals and also for direct user access to technology, especially in low-income countries, whose health indicators are of concern. Carrier-based interventions to improve the quality and coverage of services should be monitored, especially by those who use the device to achieve long-term goals, being periodically supervised by trained health professionals, aiming to verify the sustainability of changes in the search for health, i.e., of the effective actions aimed at self-care, considering the users' context. Users' needs, as well as their ability to deal with technologies, must be monitored and validated by trained professionals so that the development and application of these media are supported by scientific research and rigorous methodologies, above all because it represents a broad field of investigation based on and structured in knowledge, ethics and respect, ratifying the equity provided by them when considering the conditions of the subjects destined for it or who receive the care provided by them.

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