Prototype of a motivational mobile application for people with hypertension

Protótipo de aplicativo móvel motivacional para pessoas com hipertensão arterial sistêmica

Prototipo de aplicación móvil motivacional para personas con hipertensión arterial sistémica

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Abstract

Objective: To describe the prototype production process for a smartphone application to motivate people with hypertension to adhere to medication treatment.

Methods: This is a study of technological production of the prototyping type, with building based on the contextualized instructional design model, which followed the analysis (survey of beliefs), design (selection of icons, media, graphic interface and content validation), and development (prototype building) steps. The motivational content for textual composition was based on the beliefs of individuals with hypertension in compliance with the Theory of Planned Behavior.

Results: The prototype was composed of motivational video containing concepts, statistics and persuasive appeals related to the beliefs issued; preferred contacts; medication control with targeted schedules and alarms, information about the medications in use; control of blood pressure values; persuasive positive and negative messages; user profile.

Conclusion: The prototype is a technological innovation with the potential to motivate adherence to medication treatment and decrease blood pressure levels in individuals with hypertension.

Resumo

Objetivo: Descrever o processo de produção do protótipo de um aplicativo para smartphone para motivar pessoas com hipertensão arterial sistêmica a aderir ao tratamento medicamentoso.

Métodos: Estudo de produção tecnológica do tipo prototipagem, com construção baseada no modelo *design* instrucional contextualizado, que seguiu as etapas de análise (levantamento de crenças); *design* (seleção de ícones, mídias, interface gráfica e validação de conteúdo) e desenvolvimento (construção do protótipo). O conteúdo motivacional para composição textual baseou-se nas crenças dos indivíduos com hipertensão arterial sistêmica em observância à Teoria do Comportamento Planejado.

Resultados: O protótipo foi composto por vídeo motivacional contendo conceitos, estatísticas e apelos persuasivos relacionados às crenças emitidas; contatos preferenciais; controles de medicamentos com horários e alarmes direcionados, informações sobre os medicamentos em uso, controle de valores da pressão arterial; mensagens persuasivas positivas e negativas; e perfil do usuário.

Conclusão: O protótipo é uma inovação tecnológica com potencial para motivar a adesão ao tratamento medicamentoso e diminuição dos níveis pressóricos dos indivíduos com hipertensão.

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Conflicts of interest: nothing to declare.

Resumen

Objetivo: Describir el proceso de producción del prototipo de una aplicación para smartphone para motivar a las personas con hipertensión arterial sistémica a adherir al tratamiento medicamentoso.

Métodos: Estudio de producción tecnológica de creación de prototipo, con elaboración basada en el modelo de diseño educativo contextualizado, que consistió en una etapa de análisis (recopilación de creencias), una de diseño (selección de íconos, comunicación, interfaz gráfica y validación de contenido) y una de desarrollo (construcción del prototipo). El contenido motivacional para la composición textual se basó en las creencias de los individuos con hipertensión arterial sistémica en cumplimiento con la teoría del comportamiento planeado.

Resultados: El prototipo está compuesto por un video motivacional que contiene conceptos, estadísticas y llamadas persuasivas relacionadas con las creencias expresadas; contactos preferenciales, control de medicamentos con horarios y alarmas específicas, información sobre los medicamentos en uso, control de valores de la presión arterial; mensajes persuasivos positivos y negativos; y perfil del usuario.

Conclusión: El prototipo es una innovación tecnológica con potencial para motivar la adherencia al tratamiento medicamentoso y la reducción de los niveles de presión de los individuos con hipertensión.

Introduction

Hypertension (HP) is considered a public health problem, considering a prevalence of 32% of the adult population living with this pathology, in the Brazilian context.[1] It is one of the most important causes of premature mortality in the world, and also one of the most preventable risk factors for cardiovascular disease, which can be easily detected and effectively treated with low-cost medications and changes in lifestyle.[1,2]

Among the remaining challenges of HP medication treatment are low adherence to treatment and uncontrolled blood pressure (BP) levels,[3] that reverberate in disease complications and in personal, family and health sector socioeconomic burden.[4] It is assumed that increasing patient participation in managing the behavior of taking the prescribed antihypertensive pills is a viable strategy, facilitated by new intervention technologies,[5] and a promising path, by reducing the focus on reactive measures and encouraging proactive measures, with the purpose of supporting individuals' disease self-management, with a consequent reduction of non-adherence.[6]

Mobile health technology, often referred to as m-health, encompasses the use of smartphones, tablets or personal computers in managing chronic diseases.[7] These technologies are proven to help HP self-manage by setting alarms, reminders for patients to take their medications and sending motivating messages;[2,4] linking patients' BP measurement reports to their electronic medical records for analysis by health professionals;[2,4,5] providing feedback to patients on their BP and motivating healthy behaviors;[4-6] and functioning as BP sensors.[7]

Social theories are used in the field of health to understand phenomena whose aim is to understand individuals' motivation to execute them. In this context, the Theory of Planned Behavior (TPB) stands out.[8,9] For TPB, intention (motivation) is considered an immediate predictor of behavior and is modulated by attitude (behavioral beliefs) in relation to behavior, subjective norms (normative beliefs) and perceived behavioral control (control beliefs).[8]

An intervention carried out based on TPB, which used an application for cell phones to send messages in order to motivate individuals with HP to adopt a healthy lifestyle, showed favorable behavior modulation, reverting negative and positive beliefs to control BP levels and self-management HP after six weeks of follow-up.[6] The messages of this intervention were structured based on the repertoire of beliefs and determining factors present in the researched population; therefore, they considered the socio-cultural and behavioral aspects of the group to which the messages were addressed, which explains their power of influence according to TPB.

It is learned that low-cost, acceptable and sustainable interventions to prevent and effectively treat HP and control BP levels are essential and should be the focus of new technologies to improve treatment adherence and, consequently, reduce complications and the prevalence of disease.[7]

In Brazil, in the last five years, building applications focused on nursing care management in different areas of assistance and teaching stands out;[10-12] nursing worker health;[13] and direct accessibility for self-care with autonomy by patients.[14,15] However, none of them addresses aspects related to

HP and individuals' motivation to take antihypertensive medications.

The interactive support and self-management system, provided by cell-type technologies, and its concrete visual resources can favor the active involvement of people with HP. The system has the potential to support the current transformations of individuals as beneficiaries of health care, in addition to promoting autonomy in relation to their own well-being, related to treatment.[2]

The success of behavioral interventions for patients with chronic conditions is generally improved, encouraging patients to be actively involved in their care.[7] In this sense, the cell phone is the ideal terminal to provide health services that improve patients' self-management behaviors in daily life, since it is an individual equipment and personal support that can be accessed whenever a person needs it and according to the settings chosen by users.[6]

Given these considerations, it is relevant to the contemporary context to develop new care technologies that can assist the conventional strategies offered to this population, with a focus on efficient and adequate therapeutic self-management.

Thus, as an innovative proposal to care for people with HP, this study aims to describe the process of producing the prototype of a smartphone app to motivate people with hypertension to adhere to medication treatment.

Methods

This is a technological development study[16] of an application (app) prototype that presents the features for self-management of health and communications and persuasive messages to motivate people with HP to take the pills prescribed for disease control.

To develop the app, we opted for the concept of prototyping, which consists of building a software model that will later be implemented and assessed by the customer and then will be implemented.[17] This happened according to the Contextualized Instructional Design (CID) method, which is composed of analysis, design, development, implementation, and assessment.[18,19]

1) Analysis: Recognized the low adherence to antihypertensive treatment[3,20] and according to the precepts of TPB, which directs interventions to motivate the change and/or strengthening of attitudes, social norms and perceived control based on the primary beliefs that guide behavior performance, a study was carried out to analyze the beliefs of individuals with HP in relation to taking antihypertensive medications.[21] Twenty-eight people in continuous use of antihypertensive medications participated in this step of surveying beliefs in outpatient follow-up. Content analysis was used to group the most frequent beliefs (behavioral, normative and control) in the pollution under study, in order to compose the modal game that supported the elaboration of audiovisual communication and persuasive messages. Then, the content was defined, the technological infrastructure was analyzed and a diagram was created to guide the tool building.

2) Design: It involved the definition of the content of persuasive audiovisual communication, message production (with images and in the format suitable for smartphones) based on the beliefs identified in a previous study,[21] icon definition, media selection, and layout design. Adobe Photoshop® (prototyping of the app screens with persuasive messages and animations of the video illustrations), Adobe Illustrator® (vectorization process of the illustrations and video screens) and Sony Vegas PRO® (assembly, video editing and finishing) were used. For these procedures, we counted on the collaboration of a design professional specialized in art and media to create illustration and animations of audiovisual resources. After building the audiovisual resources, content and appearance were validated by a committee of experts. An intentional sample of 13 specialists (eleven nurses, a physiotherapist and a visual media professional) were recruited from *Plataforma Lattes*, who presented at least one of the following criteria: experience in the health field in caring for patients with HP and/or research in the area of HP, TPB and Health Information and Communication Technologies. Each participant was informed about the purpose of the study and received, through google forms, a script and a four-point Likert scale: 1 = Totally disagree (not relevant/

not representative/not clear); 2 = Disagree (needs revision to be representative/unclear); 3 = Agree (representative/clear); 4 = Strongly agree (relevant/representative/very clear). After the judges completed the validation process, Content Validity Index (CVI) was applied.[22]

Assessed items were assessed in a single round showing CVI ≥ 0.80.[22] Experts' suggestions for improving audiovisual resources were analyzed and accepted and, at the end, the content of audiovisual communication and messages were adequate, clear, relevant, comprehensive and persuasive to motivate individuals with HP to take anti -hypertensive.

3) Development: It was made on the Android® platform, with Java language. This platform was chosen due to the easy access to a Java library provided by Google. One of the predetermined parameters was the use of free software so that the cost did not interfere with the system building.[23] This step comprised building the app prototype, with the help of a systems analyst with experience in programming and software development, based on the previous phases.

The prototype building (content and functionality validation) for implementation in smartphones of users with HP was then completed. Subsequent research is being developed involving implementation and assessment phases, the results of which will be released in due course.

The study respected national and international research standards. Its development took place between July and October 2019, after approval by the local Research Ethics Committee (CAAE (*Certificado de Apresentação para Apreciação Ética* - Certificate of Presentation for Ethical Consideration) 79671317.3.0000.5182). Regarding image copyright, Law 9,610, of February 19, 1998, was obeyed.

Results

The app received the initial name "Quali +", abbreviation for 'quality', in association with the mathematical symbol '+', which represents quality of treatment, resulting in more benefits and improvements for well-being.

An app was created with tools to remind patients of the time taken for prescribed oral antihypertensives, as well as providing motivating messages and video for treatment, with information about the disease and the medications in use.

A motivational video, built based on beliefs about the pharmacological treatment of 3 minutes and 58 seconds, was inserted on its main screen, so that the app users can better understand the disease as well as feeling motivated to take their medications based on the beliefs that emanated from the context in which they belong and that included the advantages and disadvantages of taking the pills, the people who support and do not support treatment and the facilities and difficulties to do so,[21] using appropriate language to the target audience. The final version of the video produced can be accessed on Youtube® on the channel of Care Technologies Laboratory - *TecSaúde*, access link: https://youtu.be/85aF_JcDqHU.

Associated with the video, 29 messages with persuasive content, illustrated and in an app screen format (15 positive and 14 negative) were also inserted. These are presented through notification at the time established by patients and, according to medical guidelines, to take the medications, where one of them is selected at random. Time scheduling can be performed by users according to the medication prescription.

The messages were inserted to serve as reminders, to motivate medication use (positive) as well as to alert if the behavior is not being carried out according to recommendations (negative). All messages can be accessed by users at any time. The final version of the messages, in app screen format, can also be accessed on Youtube® on the channel of Care Technologies Laboratory - *TecSaúde*, available on the access link: https://youtu.be/dTGlCgpC0l8.

To assist in self-management of HP-related health, the app features the resources: contacts; medications in use, which include alarms for taking moments, managing pills (by counting and warning that more needs to be purchased) and recording the latest BP measurements; home screen with access to persuasive video and visualization of the time for the next dose of the medication; persuasive positive

and negative messages; user profile information. The "Initial Screen" shows the information of the next time the medication is taken. This schedule generates an alarm to remind you to take and, by turning off the alarm, patients can inform the system about their intention to perform the task. This feature also allows access to the persuasive video, when users wants (Figure 1).

The "Contacts" screen stores emergency telephone numbers as well as numbers of specialist medical cardiologist or other health professional, as a reference nurse; and five positive referring people for the individual (close people, family and/or friends) as well as help can be requested via messages with the creators of the app.

The "Control" screen stores the name of the medications in use for HP, the count of these medications, with a warning feature when days are left (programmable) to purchase the medications, information about each medication, schedule of intake times with alarm, and visualization of the last 10 BP measurements. It should be noted that this information may be inserted by users, some social referent or health professional in line with the prescribed therapy.

By clicking on the name of the medication in use, it is possible to obtain important information about the medication, structured in a conceptual map format and simple language, as shown in the image below, which presents the app's 'control' screen and an example of medication information Losartan Potassium 50 mg (Figure 2).

The "Messages" feature stores positive and negative messages with motivating and persuasive content, built and validated based on the beliefs of individuals with HP. This resource comprises 15 positive messages (blue screen background) and 14 negative messages (red screen background). A single message is displayed at a time and switches to another, randomly, by dragging the current message to the direct (positive) or left (negative) (Figure 3).

Users' personal data is stored in the "Profile" (photo, name, date of birth, sex, blood type, skin color, marital status, number of children, with whom they live, where they live, occupation, education, and medication allergies).

Aimed at the target audience of this app, consisting of individuals with HP attended by the public health system with low income and education, ease of use and access were important requirements

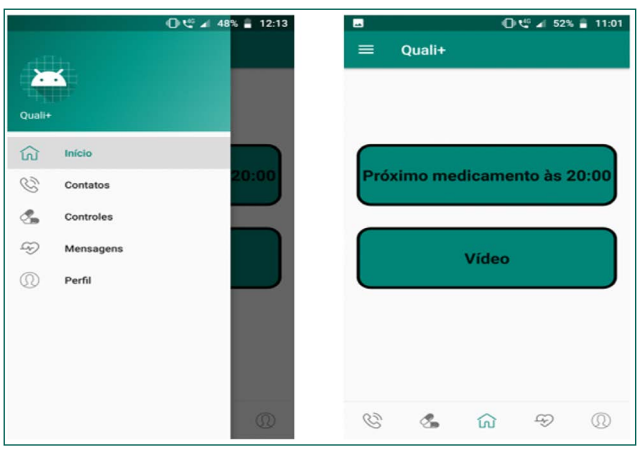

Figure 1. Home screen layouts, accessed via toolbar and full screen

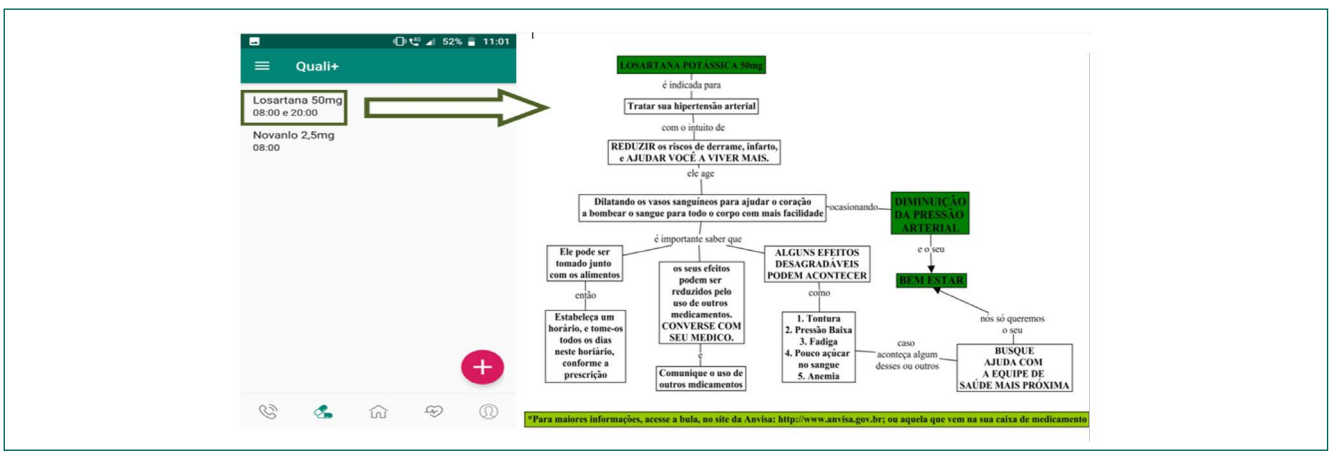

Figure 2. Control screen layout with information about the medications in use, associated with information about the medication

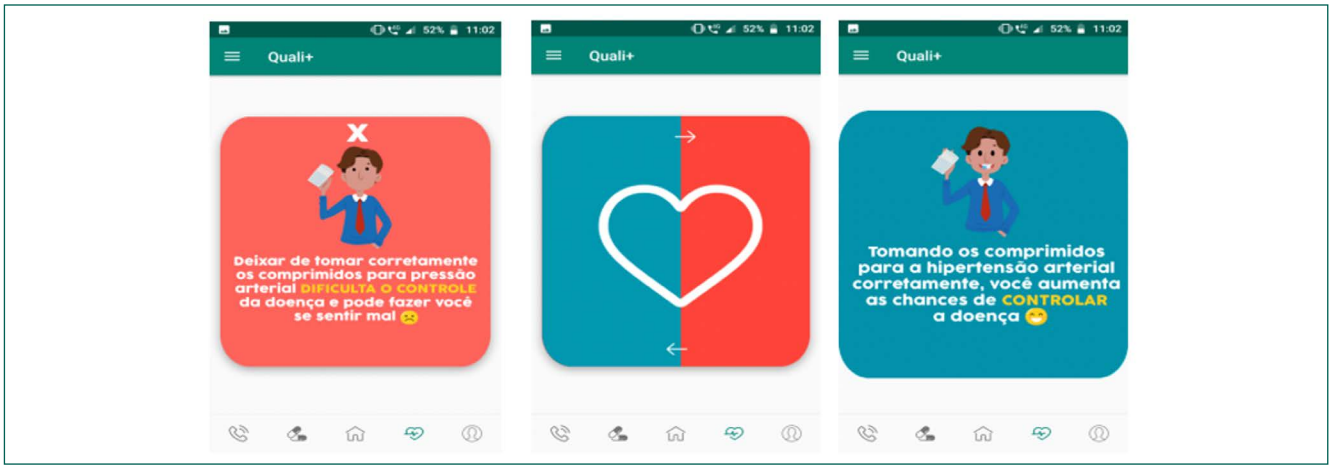

Figure 3. Layouts of negative message screens, message access screen and positive message

for this building. The app enabled an effective integration between the tool and users, with its predictable and comfortable use, in order to obtain the proposed objective: to help this public in relation to antihypertensive medication treatment.

This app was projected so that it can be installed on a mobile device (smartphone) through Google Play®. At this time, Internet access will be necessary, but its daily handling will take place offline, without the need for connection. We opted for the development for the Android® platform, as it is compatible with most smartphones available on the market and the population of different social classes. This is the most accessible and frequent mobile app platform for the target audience.

Access to information will be through direct manipulation of objects on the screen through MultiTouch, which requires objects to be more committed to their tasks, facilitating the understanding of their purposes, as well as assisting in the app control by users, as allows them to confirm their intentions or cancel actions before making them happen (settings). Despite the possibility that the app may suggest actions, the decision must be made by users so that they feel more confident and self-assess their care decisions individually.

Discussion

This is the first motivational app built to be used on smartphones of patients undergoing antihypertensive treatment in Brazilian Portuguese. The features of this technology include information about medications in use, reminders, medication control and BP values, contact with developers, in addition to other features that imply motivation for self-management of medication treatment for disease control.

The choice of app functions considered other studies of software development,[4,7,24] in order to also foster the behavior of taking antihypertensive medications and controlling BP levels.

It is considered that this motivational self-management software can be a useful tool in clinical practice to help people with HP to self-manage the disease. Associated with an encouragement for taking the medications, people can still self-measure BP with their own equipment or at the health unit, register this control and monitor the behavior of BP levels, associated with the correct medication use, in addition to having a record of their actions in relation to medication use, which can be passed on to health professionals at times of care.

A study carried out in Sweden found that the use of an app with a similar objective significantly reduced the high BP levels of users after eight weeks of implementation, in addition to considering that the change in focus from adherence to self-management may have been the reason for the success.[5]

Thus, it is essential to implement this technology in future longitudinal investigations, with the objective of assessing the effect of the app on motivation to adhere to the studied behavior and, as a

consequence, to consider its contribution in reducing BP levels by improving treatment adherence.

It is identified that interventions that aim to motivate healthy behavior to adhere to treatment aim only at pro-adherence beliefs, neglecting more implicit processes, as reasons for non-adherence.[2,25] In this sense, and with the main purpose of motivating healthy behavior, it was decided to insert both positive and negative messages in the app, considering that the reasons for non-adherence need to be worked on more clearly and comprehensively, so that negative beliefs can become positive and that actually motivates treatment.

It is understood that living with a chronic disease such as HP can cause negative expectations about adoption and change in lifestyle essential for maintaining health.[26,27] Thus, it was decided to present negative persuasive arguments in order to provoke an assessment of the consequences of not using antihypertensive medications. It is noteworthy that the approach used was not intended to punish, but to alert to possible complications resulting from low or non-adherence to the prescribed therapy and improve the performance of behavior. This approach corroborates with a study that used positive and negative messages in the intention of performing self-care in people with diabetes, being successful with the negative.[28]

It is believed that persuasive communication inserted in the audiovisual format, positive and negative messages, in addition to information about the disease, medications in use, offer reflection and opportunity for people with HP to understand their health conditions, as well as promoting changes in the behavior of taking medications.[4,9] Using the app can provide proactive treatment, autonomy, security and self-confidence to self-manage health according to the settings that users chooses. Access to content in an attractive way, with resources of images and sounds, facility for programming the therapeutic regime will allow users to expand knowledge about treatment, and encourage healthy behavior to take antihypertensive medications as prescribed.

It is important to note that in the control button there is the flexibility to edit new information about the prescribed medication therapy, times of use and records of BP measurements, which can be performed by users. To mitigate possible low education biases, the initial configuration can be made by the health professional in consultations for clinical management of HP. In the future, other advances can be incorporated to enhance the records and better meet the specifics of users, as new versions are being tested and demands are arising during use.

Although low adherence to antihypertensive treatment is a worldwide problem and there are other apps available in international literature,[2,4,6,7] the app of those in the local context becomes unfeasible, since language and cultural adaptation would not be adapted to the reality experienced, since it is a technological product designed for contextual reality. Thus, we sought to build an app in Brazilian Portuguese that is similar to those in relation to some functions that were successful in treatment in that context, in order to meet the local beliefs of this target audience.

Absence of technologies of this type in the Brazilian scenario results in difficulties in comparing contextual developments. This study is a pioneer in the field of nursing and care for people with arterial hypertension through self-management of HP, based on beliefs about treatment and building of an app for cell phones that provides autonomy to assisted users.

It should be noted that prototypes of apps recently developed in Brazil that target users of the health system focused specifically on the education of people with peripheral arterial diseases[15] and educational guidelines for orthognathic perioperative procedures.[14] These systems were also developed based on the CID model[18,19] and had the purpose of making the disease and postoperative care known to these audiences, not including the self-management of a chronic disease with specific behaviors, as in the prototype developed.

As limitations of this study, the absence of steps to implement and assess the prototype is pointed out. Due to the aspects related to the time spent in the preliminary steps for building (content validation of audiovisual communication and messag-

es) and the financial costs, it was not possible to proceed immediately with the subsequent steps. It should be noted that this study must be perfected and analyzed by specialists in systems in relation to its interface and that subsequent research will be conducted in order to proceed with the steps to validate the prototype's functionality and usability by the target audience.

It is expected that, after implementation and assessment, the app can be used in clinical practice as an adjunct strategy to care supported by prescribed HP therapy. For nurses, the tool represents an innovation of particular importance for nursing consultation. Images and animations present in persuasive communication provide greater clarity to information about the disease, how the medication acts and further strengthens and clarifies the beliefs that seek to motivate and/or discourage medication use.

Throughout treatment, users can use the app to review communications and messages as well as adjust it according to changes in treatment, in order to encourage self-management of medication use, based on qualified, attractive, easy to use and understandable to the target audience.

Conclusion

The prototype of the app built to motivate people with hypertension is an innovative technological resource that allows individuals using antihypertensive pills: access to messages and video with validated content of a motivating nature; more knowledge about the disease and medications in use; alarms with reminders of the time of taking the medications; individualized control, and care.

Collaborations

Almeida TCF, Sousa MM, Gouveia BLA, Almeida AAM and Oliveira SHS collaborated with the study design, data analysis and interpretation, article writing, relevant critical review of intellectual content and approval of the final version to be published.

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