MHealth Technology as a Tool to Promote Blood Donation

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Abstract: The blood donation scenario and its effect on the treatment of patients with hematological diseases and in emergency situations is a constant concern in the health area, requiring guided actions that allow improvements in the donor recruitment and retention processes, and therefore, the increase and maintenance of blood donation. To meet this social demand, an exploratory, qualitative study was carried out with the objective of creating a cell phone application that supports blood donor recruitment and fidelization through prevalent and interactive communication and technological resources, generating social engagement. The new information technologies have been increasingly disseminating in the several social settings as a way of collecting, recording, producing, processing and sharing data and information. A research was carried out to identify the existence of applications that support the activities of the Brazilian blood donation units, integrated to the database and with gamification resources, with none being identified with these characteristics. The proposed tool has differential characteristics in relation to the applications available in the market and may be effective in blood donor recruitment and in supporting health promotion. The application has a deadline of November 2017 to start being used.

1 INTRODUCTION

Blood donation is discussed worldwide as a social strategy for the maintenance of collective health. It must be exercised voluntarily, altruistically and anonymously to minimize the risks of contamination and transfusion reaction in patients assisted by the health system.

According to the World Health Organization-WHO (Brasil, 2016), only 1.8% of the world's population donates blood, whereas the ideal would be 3 to 5%. In Brazil, this percentage was 1.73% in 2014 and showed a decrease of 0.15% in 2015, showing a percentage of 1.58%. These calculations were based on the demographic projection of the Instituto Brasileiro de Geografia e Estatística - IBGE (Brazilian Institute of Geography and Statistics) for the period of the year 2000 to the year 2030 (IBGE, 2016).

Accentuating this scenario, data from the Ministry of Health-MH declare that between 2003 and 2013 there was a 84% increase in the number of organ transplants in the country (Brasil, 2014). Some indexes of concern focus on diseases such as cancer, which require blood infusion as part of the treatment. According to global estimates by the International Agency for Research on Cancer (IARC / WHO), in 2012 there were 14.1 million new cases and a total of 8.2 million cancer deaths worldwide (Brasil, 2014). By 2030, the projected global burden is 21.4 million new cases of cancer and 13.2 million deaths worldwide due to the disease. The MH points out an increase of 6.89% in the number of transfusions in 2014 in relation to the previous year (Brasil, 2015).

Other relevant data are related to the health care network in the country, which includes the increase in the number of hospital beds, resulting in an increase in the high-complexity number of procedures and, consequently, of transfusions. Between 2003 and 2013, the number of emergency and elective surgeries

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in the country increased by 619%, going from 12.3 million to 88.9 million, and emergency care increased from 898.2 million to 9.1 billion procedures, corresponding to an increase of 627% (Brasil, 2014).

The problematic of hemotherapy assistance increases as the population increases and grows older, and morbidity cases increase. It is necessary to increase investments in the blood donation promotion area, to stimulate the habitual practice of this voluntary gesture. Additionally, more effective communication is required, aiming to promote the citizens' awareness and engagement in the process of maintaining the stock of blood supply in the blood banks.

Some technological resources have become important in the field of communication and started being used as strategies of social engagement, such as applications for smartphones.

It is believed that the implementation of the mobile (mHealth) technology in the health area can increase its dissemination in the population within the context of blood donation, favoring the recruitment of blood donors and the fidelization of the donor public; in addition to meeting the users' wishes and needs, which include health care directives, social involvement, citizenship promotion and humanitarian campaigns (Online publisher, 2016).

A balanced blood supply guarantees the prevention of mortality and clinical complications. It is also the achievement of collective health actions, through the promotion of blood donation, both consciously and effectively.

Considering the information above, the present study aims to design a smartphone-type mobile application that can support blood donation and the promotion of public health through innovative resources and database integration.

2 METHODS

This is an applied, exploratory study that used the qualitative approach. The implementation of this research was held in four stages.

The project started in September 2015 and has already completed the first three stages, of the four stages predicted for the delivery of the technological artifact: (1) design and development of the application in the laboratory; (2) application usability testing with users; (3) in-app adjustments, design and (re) design; (4) validation test with hemotherapy specialists.

The first phase, carried out at the Information Technology Application Center - NATI, of the

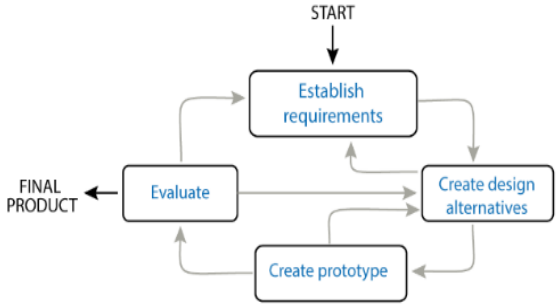

Figure 1: Life cycle of the Interaction Design. Source: Rogers, Sharp and Preece (2013).

Universidade de Fortaleza - UNIFOR (University of Fortaleza), in the city of Fortaleza, Ceará, Brazil, had weekly meetings of a group consisting of a multidisciplinary team that comprised undergraduate students from the medical and software engineering areas, a master's degree student in the area of public health, an information technology doctorate student, plus the support and help of a professional from the public blood bank of the city of Fortaleza-Ceará, currently responsible for the care of all 284 municipalities of the state, assisted by the Sistema Único de Saúde - SUS (Brazilian Unified Health System). Throughout the process of the application creation, the team could count on the guidance of professor doctors from both areas.

Set up as an information-gathering process for the tool design, the initial stage of the project utilized the brainstorming technique for surveying the requirements, as well as searching for similar applications in the Android and iOS application stores using the following descriptors, in Portuguese and English: donation, donation of blood, blood, donor, blood donor and its equivalents in Portuguese. Finally, the literature review was carried out by the master's degree student, and a rich scenario of possibilities for the tool design was identified.

The Human-Computer Interaction (HCI) methodology focused on User-Centered Participatory Design (Rogers et al., 2013) was adopted, aiming to contemplate users' needs and desires, as well as offering interactivity throughout the application development process, to improve it for personalized use and compatible with institutions and society.

This process is characterized as iterative because the product cannot become ready for use immediately, requiring comings and goings, exchange of experiences, assessments and tests to complete the cycle and allow for continuous improvement.

Also, according to Rogers, Sharp and Preece (2013) the Interaction Design is divided into four

Table 1: Comparison of mobile technologies available on the market *versus* necessary requirements.

APPLICATIONS	REQUIREMENTS															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Blooder	x				x		x			x			x			
2. BloodConnect	x				x		x			x			x			
3. Blooddonor	x	x								x		x	x			
4. Blooddonor +	x						x			x			x			
5. BloodHero	x									x			x			
6. Doação de sangue reminder			x	x									x			
7. Doe +	x	x								x			x			
8. Don duSang 2.0	x		x	x	x					x		x				
9. Eu curto doar	x															
10. Hemoliga	x		x	x	x					x			x			
11. Heroes	x				x		x			x			x			
12. I amDonor	x						x			x			x			
13. MyBlood for you	x						x			x			x		x	
14. Sangue do bem	x												x			

Legend: The "x" symbol specifies the existence of the function in the application. Source: The researcher.

activities (Figure 1): identification of the user needs and establishment of requirements, creation of the solution design and (where necessary) redesign, creation of an interactive version (app prototype) and evaluation by users.

The Participatory Design (Rogers et al., 2013), as a methodology, was also applied in 2016 in another research entitled "mHealth Technology as a Vocal Health Promotion Tool", through which an application (VoiceGuard) was conceived and developed, with the objective of assisting teachers in effective care with vocal health. It is noteworthy that this project was coordinated by some researchers who are also involved in the design and development of the application DoeSangue.

The evaluation of VoiceGuard by speech-language specialists was very positive and demonstrated their interest and expectation for the developed tool. This application was considered as an innovative resource for the vocal health promotion due to its unique approach, gathering knowledge, technology and social participation in favor of the monitoring and management of vocal health in real time by the teachers and other professionals who use voice as a work tool (Carlos et al., 2016). In addition, VoiceGuard has been awarded and recognized by national and international institutions and is available in mobile application stores for smartphones, in both Android and iOS platforms.

All this allows us to believe that this methodological approach to design and develop new technologies focused on the user´s view and settled on a triangular model - knowledge, technology and society - can be an effective strategy for the creation of new solutions aimed at health promotion. Based on this and other experiments, the researchers found support to proceed with the creation of DoeSangue application.

The usability test was applied in the second stage, which aims to evaluate the application efficiency regarding its functionality: easy to use, understand and interaction (Barbosa and Silva, 2010). Ten volunteer blood donors from the public blood bank of Fortaleza-Ceará participated of this stage.

The usability test was carried out in November, 2016, in the NATI/UNIFOR laboratory, an adequate environment to guarantee the effective participation of volunteers, as recommended by Rogers, Sharp and Preece (2013). The test was applied by the application development team and accompanied by the project researcher.

Each participant received a smartphone with the installed application and, through an activity script, recorded their impressions about the application in a standard form. All participants signed the Free and Informed Consent form to ensure total appropriateness during the process.

In the third stage of the study, we evaluated the relevance of the participants' considerations, captured during the usability test, to meet the proposed requirements. Also, considering the Symbolic Interactionism (Blumer, 1969), the analysis of the expressions, the gestures and the phrases recorded through the filming performed throughout the test was also carried out.

A new scenario was established based on the data analysis, suggesting the implementation of improvements in the application interface, thus

corroborating the User-Centered Interaction Design (Rogers et al., 2013).

The adjustments were implemented until May 2017 by NATI / UNIFOR. After the adjustments are made, the application will be validated again by the multidisciplinary team and will continue onto the fourth and last step of the research.

The research ethical and legal procedures follow the norms contained in Resolution 466, of December 12, 2012, of the National Health Council, which indicates the Guidelines and Norms Regulating Research Involving Human Beings (Brasil, 2013). It is noteworthy that the project has already obtained approval from the Ethics Committee of the Universidade de Fortaleza - UNIFOR (University of Fortaleza) under opinion n. 2.110.185.

3 RESULTS

The first result obtained in the research was the conception of a technological apparatus that will meet the needs of the identified problem, which was denominated "DoeSangue" ("DonateBlood"). This idea, conceptually and methodologically supported by the Participatory Interaction Design and brainstorming meetings with the multidisciplinary team (health, technology and communication) generated the list of the requirements to be implemented to meet the needs of donors and public blood banks.

Here are some of these requirements (application only): 1) register the donor; 2) schedule the blood donation; 3) identify unfitness for donation and report cessation of unfitness to the donor; 4) calculate and remember the date of next blood donation; 5) show the collection site closest to the donor; 6) make an invitation to donate blood, by blood type, by locality and in situations of rare phenotypes; 7) allow the donor to send an invitation to friends to be donors; 8) provide continuous communication with the citizen in the area of social responsibility, campaigns and events through short messages; 9) allow posting of awareness videos and in-app testimonials; 10) provide information about the blood bank (location, contacts, opening hours); 11) allow registration in the Blood Bank Relationship Programs; 12) use gamification resources in the application (points, badges, among others) and persuasive design; 13) offer notification resources; 14) provide reports of serological test results (negative results) after donation; 15) offer information on automated donation, special donations (autologous) and clarification on myths and frequent questions; 16) integrate the application to the blood bank database.

Based on the definition of the functional requirements for the application being created, it was possible to develop the project and obtain the second research result, through a comparative study of the mobile technologies available in the market versus the requirements necessary for the study object (Table 1). This analysis identified a favorable scenario for the application creation, as some requirements were identified as absent in 14 evaluated applications, among them:

- make an invitation for specific donation of blood, in situations of rare phenotypes;
- engage citizens in blood bank campaigns on social networks;
- allow posting of awareness videos and in-app testimonials;
- allow registration in the Relationship Programs of the blood bank;
- make results of serological tests available (negative results);
- offer automated donation information;
- offer information on special donations (autologous);
- integrate the application with the blood bank database.

Another relevant data obtained in the research is that there is no application that offers integration with the blood bank database in this market niche, allowing access to the donor's history, news and messages from the blood bank itself. Additionally, the existing applications do not include the gamification features and persuasive design that comprise strong strategies to encourage the effective use of the tool.

As a third result, based on the literature review in world databases, 3,497 articles on blood donation were identified. Many articles focus on public policies related to hemotherapy services, including reports of mild technologies and strategies for improving service in several countries.

Regarding the use of mobile technology in the context of blood donation, publications about applications were identified, but the tools' interactivity is an aspect that needs to be better described.

None of the identified publications deals with gamification and integration with the information systems of the blood banks, which are innovative concepts of this research.

The fourth and final result of this study, obtained through the usability test carried out with donors, consisted in identifying the level of overall

Table 2: Interfaces of the *DoeSangue* application, year 2017.

1 - Login

2 - Registering

3 - Main menu

4 -Where to donate

5 - Donation guide

6 - Did you know?

7 - Scheduling the donation

8 - Donor's user menu

9 - Donor's history

10 - Donor's goals

Source: The researcher.

satisfaction of the test participants, whose objectives were: (1) to evaluate whether the indicated tasks were performed; (2) measure the time each donor took to complete the tasks; (3) identify whether users were able to understand each of their accesses to the system; and (4) identify the problems that donors experienced while using the tool.

The usability test consisted of performing eight tasks of greater relevance, obeying the script pre-defined by the researchers, which are: (1) access the application as an anonymous "user"; (2) learn how the blood donation process works; (3) verify what the main information on blood donation is; (4) visit the application doubt clarification area; (5) create an account in the application; (6) schedule a donation at a blood bank of the city; (7) find out the nearest donation site; and (8) exit the application.

The tasks that showed better performance by the users were: making the login (90.9%), accessing the application anonymously (81.8%), finding the main information about blood donation (72.7%), visiting the application doubt clarification area (72, 7%), identifying the nearest donation site (63.6%), exiting the application (63.6%) and scheduling donation at a blood bank of the city (54.5%).

However, 45.5% of test participants had difficulty finding information about the registered user and 54.5% asked for help to complete this task. When trying to access the area with information about the blood donation process, only 36.4% did not have any difficulties; 27.3% asked for help; 18.2% were slow to perform this task and 18.1% were unable to perform the task.

Regarding the application design, 9.1% of the participants indicated that they did not like the design and approximately 90% thought the design was beautiful and pleasant. Regarding the information contained in the application, 72.7% of the users approved the content and, finally, it was verified that all participants were able to perform the task of accessing the application as an anonymous "user" and only 18.2% found difficulty performing this task.

4 DISCUSSION

According to eMarketer research (2014), citizens spend six times as much time on mobile applications as on mobile sites, and it is estimated that 56% of people who use mobile phones have smartphones, the technology needed to use apps. Regarding Internet

access, data from the Instituto Brasileiro de Geografia e Estatística - IBGE (Brazilian Institute of Geography and Statistics) (PNAD, 2016) indicate that 57.8% of households have Internet access, and of these, 92.1% access the Internet through cell phones.

Regarding the health area, it is worth emphasizing that the health care practice, as well as educational and intervention actions that seek to promote health care, exceed the technical knowledge. Health programs need to understand the meaning and the sense of "being healthy" for the individual (Brasil, 2015).

Within this approach, mHealth technologies have offered a range of possibilities for interaction with the population that can facilitate actions to encourage health care, according to the Symbolic Interactionism approach (Blumer, 1969), considering the meanings and senses attributed to the health issues by the public to be dealt with.

Only by identifying the universe of meanings of the human being and of the different population groups, it is possible to sponsor effective health promotion actions, internalizing healthy habits. These actions can be optimized through mHealth technology.

Regarding the application of the User-Centered Interaction Design methodology, it can be observed that the multidisciplinary team worked scrupulously, respecting all stages of the life cycle represented in Figure 1, guaranteeing the use of continuous improvement in the processes of creation and development of the laboratory application.

The results found in the literature review and information survey stages with the multidisciplinary team and blood bank professionals reinforce the need to create new communication media that are more adequate to the current reality of social relationships and that generate interest in the cause of blood donation, mobilizing the population for this purpose.

The tool was developed using the principles and objectives of Google's Material Design, with a visual language of its own for users of the Android platform. Material Design synthesizes the classic principles of good design, with innovation and the possibility of linking technology and science (Google, 2014).

The creation of the high-fidelity technological artifact was completed, with prototypes that already include the typography, iconography and color palette that will be used in the final version. The application consists of ten main interfaces, as shown in table 2.

Meeting the requirement for implementation of gamification resources and persuasive design, the application illustrates on screen 9 (Donor's history) the effective participation of the user in the blood donation process, which, prior to the existence of this application, could only be accessed through the donor's social security number at the Blood Bank. This interface reinforces the donor's interest in acquiring information from the collection center and staying connected. Still on this screen, the users can track their badges and share them on social networks.

As for Screen 10 (Donor's goals), it shows the elements that stimulate the donor's participation in blood donation promotion, control of donations per semester and the measurement of their participation in the blood bank's campaigns. Another interesting persuasion feature is the possibility to keep track of how friends are engaged and how many friends the user has convinced to embrace this cause, positively stimulating people's change of posture toward blood donation.

Finally, the users will always have the information on the time remaining until their next donation, providing their empowerment and involvement with blood donation.

5 CONCLUSION

The overture of this research is based on the scientific evidence available in the databases and the imminent need to generate interactive communication strategies with the mobilization power that strengthens the engagement of blood donors. Additionally, it intends to reinforce global trends regarding the growth of mobile health technologies.

In the context of health communication strategies, the use of the mHealth technology is recommended to achieve these objectives, based on the high potential of social engagement that this type of tool provides.

Based on the premise that blood donation is essential for public health promotion and maintenance, it is presumed that the creation of the application will result in new strategies that can boost blood donation and support collective health promotion. The artifact shows great monitoring potential and can facilitate the understanding of scenarios, contributing to strategic management.

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