

Building a mobile application for HIV Post-Exposure Prophylaxis

Construção de um aplicativo móvel para Profilaxia Pós-Exposição ao HIV
Elaboración de una aplicación móvil para la profilaxis post-exposición al VIH

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How to cite:

Silva AP, Barbosa BJ, Camargo RF, Nichiata LY. Building a mobile application for HIV Post-Exposure Prophylaxis. Acta Paul Enferm. 2021;34:eAPE000345.

DOI

<http://dx.doi.org/10.37689/acta-ape/2021A0000345>



Keywords

Mobile applications; Post-exposure prophylaxis; HIV; Technological development

Descritores

Aplicativos móveis; Profilaxia pós-exposição; HIV; Desenvolvimento tecnológico

Descriptores

Aplicaciones móviles; Profilaxis posterior a la exposición; VIH; Desarrollo tecnológico

Submitted

February 22, 2020

Accepted

9 December, 2020

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Abstract

Objective: To describe the process of building a mobile application to support HIV Post-Exposure Prophylaxis and analyze how healthcare professionals respond to the attributes of its usability.

Methods: A technological production study, built in four phases, between 2016 and 2018: composition of the app's central content; gathering a set of tools for the prototype; prototype testing; testing usability attributes using the empirical method. The PEPtec application was built based on national and international guidelines for post-exposure prophylaxis for HIV. Healthcare professionals' responses about usability attributes (ease, utility, interface and use of the app) were analyzed using a semi-structured questionnaire applied to 28 professionals from the services for people with Sexually Transmitted Infections of a Health Coordination of the municipality of São Paulo (SP), Brazil.

Results: The application was made available for Android and iOS. It was personalized for healthcare professionals' cell phones to support decision-making in the indication of HIV Post-Exposure Prophylaxis. Regarding the application interface, the professionals considered that the colors and icons were pleasant and easy to identify. In the usability analysis, professionals reported ease of use, gained skills and were able to navigate through all screens.

Conclusion: The mobile application responds to the interests of these professionals in the outcome of indication for Post-Exposure HIV Prophylaxis through this technological tool.

Resumo

Objetivo: Descrever o processo de construção de um aplicativo móvel para o apoio à Profilaxia Pós-Exposição ao HIV e analisar como os profissionais de saúde respondem aos atributos de sua usabilidade.

Métodos: Estudo de produção tecnológica, construído em quatro fases, entre 2016 e 2018: composição do conteúdo central do *app*; reunião de um conjunto de ferramentas para o protótipo; testagem do protótipo; teste dos atributos de usabilidade por meio do método empírico. O aplicativo PEPtec foi construído baseado nas diretrizes nacional e internacional para profilaxia pós-exposição ao HIV. As respostas dos profissionais de saúde acerca dos atributos de usabilidade (facilidade, utilidade, interface e uso do *app*) foram analisadas por meio de um questionário semiestruturado aplicado em 28 profissionais dos serviços de atendimento às pessoas com Infecções Sexualmente Transmissíveis de uma Coordenadoria de Saúde do município de São Paulo (SP), Brasil.

Resultados: O aplicativo foi disponibilizado para os sistemas operacionais Android e iOS. Foi personalizado para o celular do profissional de saúde para apoio na tomada de decisão na indicação da Profilaxia Pós-Exposição ao HIV. Sobre a interface do aplicativo, os profissionais consideraram que as cores e os ícones

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Conflicts of interest: nothing to declare.

eram agradáveis e de fácil identificação. Na análise da usabilidade, os profissionais relataram facilidade no seu uso, ganharam habilidades e conseguiram navegar por todas as telas.

Conclusão: O aplicativo móvel responde aos interesses desses profissionais no desfecho da indicação à Profilaxia Pós-Exposição ao HIV por meio desta ferramenta tecnológica.

Resumen

Objetivo: Describir el proceso de elaboración de una aplicación móvil para el apoyo a la profilaxis post-exposición al VIH y analizar cómo responden los profesionales de la salud a los atributos de usabilidad.

Métodos: Estudio de producción tecnológica, elaborado en cuatro fases entre 2016 y 2018: composición del contenido central de la *app*, reunión del conjunto de herramientas para el prototipo, prueba del prototipo, prueba de los atributos de usabilidad mediante el método empírico. La aplicación PEPtec fue elaborada con base en las directrices nacionales e internacionales para la profilaxis post-exposición al VIH. Las respuestas de los profesionales de la salud acerca de los atributos de usabilidad (facilidad, utilidad, interfaz y uso de la *app*) fueron analizadas mediante un cuestionario semiestructurado aplicado a 28 profesionales de los servicios de atención a personas con Infecciones de Transmisión Sexual de una Coordinación de Salud del municipio de São Paulo, estado de São Paulo, Brasil.

Resultados: La aplicación fue ofrecida para los sistemas operativos Android e iOS. Se personalizó para los celulares de los profesionales de la salud para apoyar la toma de decisiones sobre la indicación de la profilaxis post-exposición al VIH. Respecto a la interfaz de la aplicación, los profesionales consideraron que los colores e íconos eran agradables y de fácil identificación. En el análisis de usabilidad, los profesionales relataron la facilidad de uso, adquirieron habilidades y pudieron navegar por todas las pantallas.

Conclusión: La aplicación móvil responde a los intereses de estos profesionales en los eventos de indicación de profilaxis post-exposición al VIH mediante esta herramienta tecnológica.

Introduction

Post-Exposure Prophylaxis (PEP) is a preventive measure against Human Immunodeficiency Virus (HIV) and can reduce the rate of new infection after exposure. It consists of daily use, for 28 days, of oral doses of antiretrovirals, indicated to be started, preferably, in 2 hours and, at most, up to 72 hours after exposure to the virus. It should be considered as emergency care.^(1,2)

In Brazil, this practice has been recommended since 2010. The clinical HIV monitoring report shows that there has been an increase in antiretroviral dispensations for PEP over the years, from 17,630 in 2010 to 87,251 in 2017 and 107,345 in 2018.⁽³⁾ It is inferred from these data that the population is having access to knowledge about the importance of seeking health services after possible exposure to HIV.

Support that has been developed to promote the prevention strategy expansion comes from mobile applications (*app*) built for the health field.⁽⁴⁾ They are defined as computer programs or software installed on mobile electronic devices, such as Android or iPhone (iOS) phones, with several functions.⁽⁵⁾

The proper use of this technology can lead to innovative ways of improving health, and its potential is recognized by the World Health Organization

(WHO).⁽⁶⁾ This body recognizes that using an *app* is a complementary strategy for strengthening health care, while emphasizing the importance of assessing and monitoring these resources.⁽⁶⁾ The *app* downloads for this area are significant. Data from the Food and Drug Administration, of the United States, predicted until 2018 that 50% of Americans would have downloaded it on their smartphones, including healthcare professionals.⁽⁷⁾

Studies indicate the need to analyze *apps* for usability, i.e., that they be tested before being made available in online stores. They must be built to make it easier for healthcare professionals to perform a specific and important task.⁽⁸⁻¹⁰⁾ Developers have been rethinking the central content quality of the *apps*, indicating that they should be tested in the prototype phase or in their initial versions. Usability research has gained prominence in knowledge production about the use of *apps*.⁽⁸⁻¹²⁾

This study aimed to describe the process of building a mobile application to support PEP and to analyze how healthcare professionals respond to the attributes of its usability.

Methods

This is a study of technological production aimed at building an *app* to support PEP. It is part of a

project entitled “*Protótipo de Dispositivo móvel para o apoio a PEP ao HIV*”, which was approved by the Research Ethics Committee of *Universidade de São Paulo* School of Nursing (USP) and the São Paulo Municipal Health Department according to Certificate of Presentation for Ethical Consideration (CAAE - *Certificado de Apresentação para Apreciação Ética*) 38350614.3.0000.5392.-

It was carried out with the support of the Southeast Health Coordination of the city of São Paulo,⁽¹³⁾ participating in all four phases: composition of the app’s central content; gathering a set of tools for the prototype; prototype testing; testing usability attributes using the empirical method.

In the first phase, it was carried out between 2015 and 2016, the contents of municipal, national and international guidelines on PEP were gathered. The second phase, carried out between 2016 and 2017, took place with the participation of the team from *Poli Júnior* from *Escola Politécnica da USP*, which designed the prototype. The Ionic Framework tool was used, which allows developing a hybrid app for mobile devices using the Angular JS language, which simplifies its development and helps to produce an app with a pleasant look, which uses knowledge about HyperText Markup Language (HTML), Cascading Style Sheet (CSS), and Javascript.⁽¹⁴⁾ In the third phase, a workshop was held with managers and healthcare professionals, in which six healthcare professionals participated (two nurses, an infectious disease physician and interlocutor of the Sexually Transmitted Diseases and HIV IDS program of Municipal Health Department, a social worker, a psychologist, and a dentist), in order to present and test the app’s prototype. The group was responsible for analyzing the content about PEP and the need to adapt the app’s interface, in order to be friendly to navigation. As a result, there was an indication of inclusion of content about the possible adverse effects in antiretroviral administration. There were no suggestions on the suitability of the app’s design and navigation methods. In the fourth phase, two researchers participated, who independently conducted interviews with health service professionals from December 2017 to February 2018. The researchers went to workplaces,

presented the prototype to healthcare professionals and the segment for testing to analyze usability. In this phase, 28 healthcare professionals who worked in units of the specialized network of services for people with Sexually Transmitted Infections participated in the interviews as a convenience sample.

In an analysis of usability attributes, recommendations given by the Brazilian Association of Technical Standards (ABNT - *Associação Brasileira de Normas Técnicas*) and the International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 25062: 2011 were used.⁽¹⁵⁾ They suggest the constitution of a minimum sample of eight participants at the stage of testing these attributes. Higher-level healthcare professionals who agreed to participate in the study and signed an Informed Consent Form were included. Mid-level healthcare professionals and administrative staff were excluded. This criterion is based on protocols that demand higher education professionals with competence for PEP indication in particular nurses.⁽¹⁶⁾

The interview questionnaire was structured, divided into three moments, using, for inspiration, Valentine’s study.⁽¹⁷⁾ Apps’ usability analysis was made by measuring the principles about efficiency perceived by users, in addition to the perception of accessible functions, in a simple and intuitive way, mainly because there is an intention to reach a content of extremely important. App ease, utility, interface and use in the profession were analyzed.

At first, participants filled out a questionnaire about their experience with the technological tool in health, knowledge about the use of mobile apps in health and frequency using support material for decision-making. Then, participants were asked if they knew PEPtec. If the answer was negative, the app was explained and presented, inviting them to download it. In the second moment, professionals consulted the device to answer questions about the experience regarding PEP indication. The responses of this interaction were recorded by the researcher, identifying whether professionals were successful (easy) completing the task without any problems on first attempt; success (difficult) completing the task, but with difficulties or failure, if they were unable to

complete the task or gave up. At the last moment, professionals answered the questionnaire regarding usability attributes. A Likert-type scale was used, containing the response options: strongly agree, widely agree, partially agree, strongly disagree, and widely disagree. Professionals were instructed to mark a single answer. The three moments of this analysis were stored and processed in Microsoft Excel® 2013 spreadsheets.

We opted to present the usability test results adding the “agree” and “disagree” answer options, given that the distribution in the variants showed a lot of dispersion, making analysis difficult.

Results

PEPtec has been customized for healthcare professionals' cell phones. The first version was made available for download, free of charge, since March 23, 2016, on Android and iOS. A second version was implemented in 2018 for updating, based on the publication of the Clinical Protocol of Guidelines for PEP. The app helped assessing the risks to which users were exposed regarding HIV, in order to support healthcare professionals' decision-making about PEP recommendations. Figure 1 shows the app's home page.

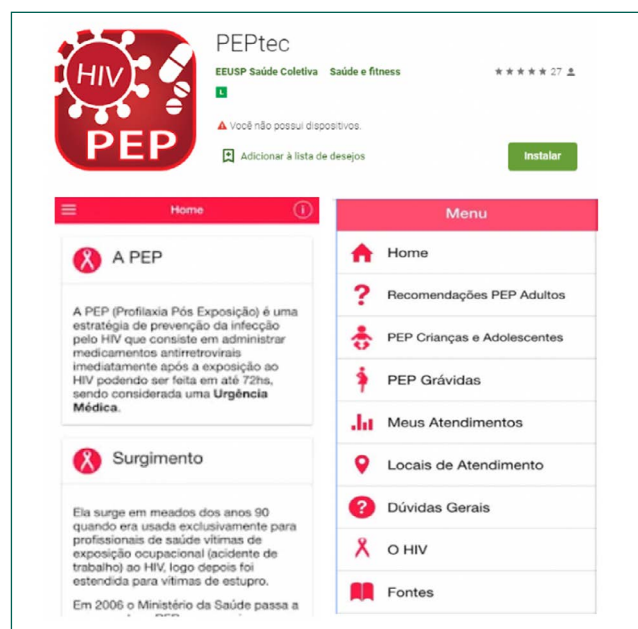


Figure 1. PEPtec app home

By selecting “Home”, a brief explanation of what PEP was, its history and information about its nomination, as well as general comments on the importance of membership, could be accessed.

The option “PEP Recommendations for adults” was the app's main focus. It was created from a decision algorithm, based on the choice of answers by healthcare professionals in consultation with users about possible exposures to HIV, which directed them to the following options: unprotected consensual sex; occupational accident, and sexual violence. The option “Time elapsed since exposure” - less than or greater than 72 hours - led to subsequent issues: sexual violence, occupational accidents, and sexual violence. Depending on exposure time, PEP was prescribed.

The “PEP child and adolescent” icon showed medication indications for a possible HIV infection and information about other infections. The “Pregnant PEP” option provided an alert about some contraindications to the use of antiretrovirals during pregnancy and interruption of breastfeeding. There was also the “My services” characteristic that provided statistics of the services. The app consolidated these services in percentage so that professionals could see the profile of patients who sought PEP. However, it did not store personal information about patients, and professionals could remove it from the “Reset statistic” icon.

Still on this screen, it was possible to view “Service locations” with Google Maps, which indicated the location where users were located and the PEP service in the city of São Paulo (SP). In other municipalities and states in Brazil, the link to STD/AIDS Reference and Training Center was redirected. There was also an icon indicating “General doubts”, which addressed solutions to possible doubts about PEP. In the “HIV” icon, there was a description about the infection. The “Sources” icon presented the main bibliographies.

Of the 28 professionals who participated in the app's usability analysis, most were female (78.6%), predominantly nurses (53.5%), had experiences with technology (28.5%) and used it frequently on all days of the week (25.0%). Regarding the use of health-related apps, more than half (60.7%) ac-

cessed material available on the internet to support decision-making (53.5%), as noted in Table 1.

In assessing the success of PEP indication through PEPtec, most professionals were successful in the steps (easy). Everyone was able to access the app and do research directed to the sexual violence profile in less than 72 hours (100%). The greatest difficulties arose when it was necessary to search for health services due to the unavailability of an internet connection, according to Table 2.

Regarding the app's usability attributes of professionals analyzed in the study, there were no very different answers in the Likert-type scale classification; therefore, we opted for the decision of the most expressive options (agree and disagree). Everyone agreed on the ease of use of PEPtec. Regarding utility, interface and use in professional practice, most professionals agreed that the app is easy to use, useful, has a friendly interface and supports professionals' practice, with more than 90% of positive responses for the app use according to Table 3.

Table 1. Distribution of healthcare professionals according to sociodemographic characteristics and experience in the use of technologies

Characteristic	n(%)
Sex	
Female	22(78.6)
Male	6(21.4)
Professional training	
Nurse	15(53.5)
Pharmacist	4(14.1)
Social worker	3(10.7)
Physician	2(7.1)
Occupational therapist	2(7.1)
Speech therapist	1(3.5)
Dentist	1(3.5)
Experience with technological tool in health	
I do not use apps	4(14.2)
I do not use apps; access is by computer	4(14.2)
I have used some health-related apps	8(28.5)
I use apps, on average, two and three days a week	5(17.8)
I use smartphone apps every day of the week	7(25.0)
Knowledge about using mobile apps	
I have never used apps like that	1(3.5)
I am aware of this type of application, but I have never used	3(10.7)
I am aware of this type of application and have already used	7(25.0)
I use apps of this type on tablets and smartphones	17(60.7)
I use support materials for decision-making	
I do not use	1(3.5)
I use only the material printed on the unit	3(10.7)
I use complementary material, made available through the internet	15(53.5)
I use complementary material all the time	9(32.1)

Table 2. Steps taken by healthcare professionals when browsing the mobile app

Navigation steps through the app	Assessment of success in HIV Post-Exposure Prophylaxis indication using the PEPtec app		
	Easy n(%)	Hard n(%)	Failure n(%)
Access the app	28(100)	-	-
Research with unprotected consensual sex profile in less than 72 hours	22(78.6)	6(21.4)	-
Research with unprotected consensual sex profile more than 72 hours	27(96.4)	1(3.5)	-
Research with occupational accident profile more than 72 hours	26(92.8)	2(7.1)	-
Research with sexual violence profile less than 72 hours	28(100)	-	-
Research: doubts about side effects of tenofovir and lamivudine antiretrovirals	26(92.8)	2(7.1)	-
Research with unprotected consensual sex profile less than 72 hours, rapid negative test, negative partner serology and is not part of the HIV increased risk group	23(82.1)	5(17.8)	-
Research: number of units offering PEP in southeastern São Paulo	21(95.4)	1(4.7)	-
Research: services offered by PEP in the municipality of Adamantina (SP)	12(57.1)	2(9.5)	7(33.3)
Research: services offered by PEP in the municipality of Umuarama (SP)	5(23.8)	6(28.5)	10(47.6)

PEP - Post Exposure Prevention

Table 3. Usability attributes of the PEPtec app

Usability attributes of the PEPtec app	Agreement	
	Agree n(%)	Disagree n(%)
Ease of use of the app		
It was easy to learn how to use it	28(100)	
I understood what happened when using the app	28(100)	
It was easy to gain usability skills while performing activities in the app	28(100)	
It was easy to remember how to use it	28(100)	
I find the app easy to use	28(100)	
I can navigate well through all screens in the app	28(100)	
App usefulness		
Useful app to improve my care practice	26(92.8)	
The app made it easier to carry out my activities	2(7.1)	
App interface		
I find the app colors and icons nice	28(100)	
I can see all the buttons and information inside the app well	28(100)	
I easily understand the app's words, nomenclatures and icons	28(100)	
Images and icons in the app are easy to recognize	27(96.4)	1(3.5)
I can see all the app characteristics	26(92.8)	2(7.1)
I can navigate well through all screens in the app	27(96.4)	1(3.5)
I use the app in professional practice		
I think the app facilitates my care practice	26(92.8)	2(7.1)
With the app, I can explore much more about PEP	27(96.4)	1(3.5)
With the app, I have greater mastery of practices related to PEP	26(92.8)	2(7.1)
With the app, I have more security to perform PEP assessment	26(92.8)	2(7.1)

PEP - Post Exposure Prevention

Discussion

The arrival of smartphones allowed cell phones to move beyond traditional phone calls. Currently,

they are considered a pocket computer, as they bring comfort to users' hands, at any time. Among the various functions, it is possible to highlight the possibility of these devices offering download of apps, ranging from entertainment to support healthcare professionals.

In the development of the PEPtec prototype, one of the phases was analysis of the app's usability attributes. The first analysis showed that nurses were the professionals who responded most to the survey.

There are Brazilian studies^(9,10) that address specific apps for this professional. An example is Oncoaudit,⁽⁹⁾ designed to assist in the consultation of chemotherapeutic drugs, as an audit tool in nursing of hospital accounts. It was assessed by nurse auditors using the System Usability Scale questionnaire, showing that the app follows users' needs. Computer professionals also assessed it using the Nielsen heuristics method for usability issues, to which suggestions were implemented.⁽⁹⁾

The Caring Tech app⁽¹⁰⁾ was developed to assist nurses in the assessment and risk classification of diabetes people's feet. Its usability was assessed by the development team following Nielsen's heuristics, and was subsequently validated by nurses as functional, reliable, adequate, and efficient.⁽¹⁰⁾

The WHO Algorithm⁽¹⁸⁾ was produced to assist nurses in assessing the level of dehydration in children and adults. Nurses show to be a professional who use apps to support their work.⁽⁸⁻¹¹⁾

PEPtec was built to assist in the assessment of risks in which users are exposed to HIV for support in decision-making based on notes about PEP. It can be used by any professional who works in the emergency room, specialty clinic, Basic Health Unit, hospital or maternity. However, it is important to emphasize that nurses, according to the Law of Professional Nursing Practice, who are part of the health team, are allowed to prescribe the medications provided for in the protocols, provided that this conduct is established in the institution's protocols, rules and routines, and technicians feel technically fit for their execution. This is a strategic professional in the perspective of expanding PEP indication.⁽¹⁷⁾

In the study, it was possible to notice that 71.3% of professionals have experiences with technological tools in the professional area, and 85.6% use resources available on the internet as support in decision-making. This experience with the technological age can generate knowledge about the use of apps, making these professionals more selective and discerning on virtual platforms, especially those that add knowledge to the profession.

In the navigation steps at PEPtec, it was identified that some of the professionals had difficulties when it was necessary to indicate a health unit outside the municipality of São Paulo, as they were directed to a website outside the app, and needed access to the internet. This difficulty may be associated with the fact that health units do not have access to wireless internet or professionals did not have mobile data on their cell phone at analysis.

Internet access in Brazilian health institutions is 91%, 83% in the public sphere and 99% in the private network. Of these, 98% of the units are located in the capitals and 89% in the countryside. However, there is a discrepancy as to the quality of internet connection.⁽¹⁹⁾

Most professionals had an easy time handling the app because, after downloading, its offline use was possible. The involvement of these professionals with the app use allows to obtain relevant data in an effective and safe way. In this regard, solutions can be suggested to minimize the difficulties experienced during their professional practice,⁽²⁰⁾ corroborating the initiative of tools such as PEPtec in assisting decision-making.

In analyzing the usability attributes of PEPtec, professionals reported ease of use. An assessment study of the PedsGuide app⁽²⁰⁾ developed to support the decision-making process in pediatric care was similar, showing the importance of an easy-to-use app with integrated care functions. Another similarity was in a validation study of the BPH app,⁽²¹⁾ built to support the decision of prostate surgery, when mentioning the relevance of an easy-to-use technological tool with the option of a probability calculator that assists in surgical indication.

Regarding PEPtec's interface, professionals considered that the colors and icons were pleasant, were

able to view all the information in the app and recognized that the images and icons were easy to identify. In a study that assessed the usability experience of a mobile application,⁽¹⁸⁾ there were differences in the responses found in comparison with the present study, because, during assessment of the usability attributes that analyzed the Swarm app, we noticed difficulties faced by users in recognizing or viewing icons on the device, resulting in them giving up to perform some activities. The difficulties faced were directed to the technology's developer, to make improvements, which emphasized that such disagreements are not related to the technical visibility of the resolution of the analyzed product.⁽¹⁸⁾ At no time did professionals in this study give up, but two improvements in PEPtec were suggested: one for medication updates on PEP and the other for adding a QR-code generator, which will allow access to a new app that is under development.

As for the app's usefulness, most professionals responded that it is effective and can improve professional practice. Literature has already shown that using an app supports professional practice: Malnutrition Management^(22,23) assists in malnutrition control management in children under and of age, and MicroGuide helps in navigating information about antibiotics.⁽²⁴⁾ However, in the present study, some professionals do not agree with the use of this technological resource in their professional practice.

PEPtec is not intended to replace healthcare professionals' technical-scientific knowledge. The app is a strategy to support professionals in decision-making, particularly nurses, in the face of patients exposed to HIV. It can contribute to the improvement of professionals' and other team members' practices to face the HIV/AIDS epidemic and collaborate to reduce the transmission of this infection. Usability analysis is a prerequisite for improving apps.

The study presented as a limitation the long period of construction and analysis of the app's usability attributes. Mobile apps can become obsolete quickly, as new knowledge is created and new technologies are developed, requiring an effort of constant updating and improvement. Despite this limitation, the results of this research may bring new contributions to the study of this topic.

Conclusion

Building the PEPtec application was carried out in four phases, representing a technological innovation developed in Brazil as it is the first mobile device to support healthcare professionals in decision-making during PEP indication. Analysis of all responses on the usability attributes of the first version of PEPtec demonstrated that there is ease, utility, interface and use in professional practice, and the application, therefore, responds to the interests in the outcome of PEP indication.

Acknowledgments

We would like to thank the Brazilian National Council for Scientific and Technological Development (CNPq - *Conselho Nacional de Desenvolvimento Científico e Tecnológico*) for financing this study (Universal Project - Process 424852/2016-0).

Collaborations

Silva APS, Barbosa BJP, Camargo RF and Nichiata LYI declare that they contributed to the study design, data analysis and interpretation, writing of the article, relevant critical view of intellectual content and approval of the final version to be published.

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