PUBLICAÇÃO OFICIAL DO NÚCLEO HOSPITALAR DE EPIDEMIOLOGIA DO HOSPITAL SANTA CRUZ E PROGRAMA DE PÓS GRADUAÇÃO EM PROMOÇÃO DA SAÚDE - DEPARTAMENTO DE BIOLOGIA E FARMÁCIA DA UNISC

ISSN 2238-3360

Revista de Epidemiologia e Controle de Infecção

Brief Communications

Empowering Patients: Development and Validation of a Mobile Application to Prevent Adverse Health Events

Paciente Empoderado: construção e validação de aplicativo para a prevenção de eventos adversos em saúde

Paciente Empoderado: desarrollo y validación de una aplicación móvil para la prevención de eventos adversos en salud

Site doi: https://doi.org/10.17058/reci.v16i.21095

Submitted: 01/21/2026
Accepted: 04/21/2026
Available online: 06/14/2026

Corresponding author:
E-mail: andrealvim1@ufjf.br
Address: José Lourenço Kelmer Street, Juiz de Fora, Minas Gerais, Brazil.

Évilin Martins de Assis[1]
Julya Kelly Ferreira[1]
João Gabriel dos Santos[1]
Júlia Pimentel Clemente[1]
Delma Conceição Soares da Silva[1]
André Luiz Silva Alvim[1]

[1]Federal University of Juiz de Fora. Juiz de Fora, Minas Gerais, Brazil.

ABSTRACT

Background and Objectives: Patient empowerment has become a key strategy for promoting patient safety and preventing incidents and adverse events in healthcare services. In the Brazilian context, there is a lack of validated mobile technologies aimed at this purpose. Therefore, this study aimed to develop and validate a mobile application designed to empower patients in the prevention of incidents and adverse health events. **Methods:** This study was conducted in two stages: a scoping review and a methodological study focused on technological production. The application was developed for Android® and iOS® platforms, following the Dick and Carey instructional design model, and validated in terms of content, appearance, semantics, and usability by expert judges and patients. **Results:** The application achieved a Content Validity Index above 0.90, demonstrated high usability, and showed strong user acceptance, with mean scores above 4.0 in the heuristic evaluation. **Conclusion:** The application proved to be valid, innovative, and promising for patient empowerment and the prevention of adverse events in healthcare services.

Keywords: *Patient Safety. Mobile Applications. Patient Empowerment. Adverse Events. Health Technology.*

RESUMO

Justificativa e Objetivos: O empoderamento do paciente tem se consolidado como estratégia fundamental para a promoção da sua segurança do indivíduo e a prevenção de incidentes e eventos adversos em serviços de saúde. No contexto brasileiro, observa-se a ausência de tecnologias móveis validadas com essa finalidade. Assim, o objetivo deste estudo foi construir e validar um aplicativo móvel voltado ao empoderamento do paciente na prevenção de incidentes e eventos adversos em saúde. **Métodos:** Trata-se de um estudo desenvolvido em duas etapas: revisão de escopo e estudo metodológico de produção tecnológica. O aplicativo foi construído para os sistemas Android® e iOS®, seguindo o modelo teórico de Dick e Carey, e validado quanto ao conteúdo, à aparência, à semântica e à usabilidade por juízes especialistas e pacientes. **Resultados:** O aplicativo apresentou coeficiente de validade de conteúdo superior a 0,90, elevada usabilidade e alta aceitação pelos usuários, com médias superiores a 4,0 na avaliação heurística. **Conclusão:** O aplicativo mostrou-se válido, inovador e promissor para o empoderamento do paciente e a prevenção de eventos adversos nos serviços de saúde.

Descritores: *Segurança do Paciente. Aplicativos Móveis. Empoderamento do Paciente. Eventos Adversos. Tecnologia em Saúde.*

RESUMEN

Justificación y Objetivos: El empoderamiento del paciente se consolida como una estrategia clave para promover la seguridad del individuo y prevenir incidentes y eventos adversos en los servicios de salud. En el contexto brasileño, existe una ausencia de tecnologías móviles validadas con este propósito. Por lo tanto, el objetivo de este estudio fue desarrollar y validar una aplicación móvil orientada al empoderamiento del paciente en la prevención de incidentes y eventos adversos en salud. **Métodos:** Se trata de un estudio desarrollado en dos etapas: una revisión de alcance y un estudio metodológico de producción tecnológica. La aplicación fue desarrollada para las plataformas Android® e iOS®, siguiendo el modelo teórico de Dick y Carey, y validada en cuanto a contenido, apariencia, semántica y usabilidad por jueces expertos y pacientes. **Resultados:** La aplicación obtuvo un índice de validez de contenido superior a 0,90, presentó alta usabilidad y elevada aceptación por parte de los usuarios, con promedios superiores a 4,0 en la evaluación heurística. **Conclusión:** La aplicación demostró ser válida, innovadora y prometedora para el empoderamiento del paciente y la prevención de eventos adversos en los servicios de salud.

Palabras Clave: *Seguridad del Paciente. Aplicaciones Móviles. Empoderamiento del Paciente. Eventos Adversos. Tecnología en Salud.*

Patient safety refers to actions that strengthen cultures, processes, and environments that can reduce risks, prevent damage, and minimize errors. Patient empowerment to prevent adverse health incidents and events has become an increasingly present practice in this context. Despite these advances, a gap remains in the availability and validation of digital technologies to empower patients in preventing adverse events, especially in Brazil. Promoting person-centered care and patient empowerment requires the development and application of technologies (especially mobile applications) that expand access to information and foster co-responsibility in health care. Brazil still faces a shortage of validated digital technologies with this focus; such gap configures the main motivation of this study.[1-3]

This study is in line with the United Nations 2030 Agenda for Sustainable Development (especially its third goal) as it contributes to the promotion of health, patient safety, and quality of care, reinforcing the commitment to more effective, inclusive, and sustainable health systems[4]—which includes educational and communication technologies that facilitate dialogue between patients and healthcare providers and digital systems that promote transparency and therapeutic data sharing. Thus, this study aims to build and validate a mobile application to empower patients in preventing incidents and adverse events in health services.

This study was carried out in two steps, the first of which consisted of a scoping review to map evidence on the use of digital mobile technologies to promote patient empowerment and prevent adverse health incidents and events. It followed the JBI methodological recommendations for scoping reviews and a previously defined search strategy with eligibility criteria and study selection stages.[5] The second stage methodologically studied technological productions focused on the development and validation of a mobile application for iOS and Android. Construction followed the theoretical model in Dick and Carey, including analysis, design/development, implementation, and evaluation.[6]

The scoping review was carried out with MeSH and DeCS descriptors — Segurança do Paciente," "Aplicativos Móveis," "Eventos Adversos," and "Tecnologia" and "Hospitais" — that were associated with the Boolean operators AND and OR. The EMBASE, MEDLINE, Cochrane Library, LILACS, BDENF, and SciELO databases and the gray literature (Google Scholar, CAPES Journal Portal, and Open Access Theses and Dissertations, which involved the support of a librarian) were searched. Studies in Portuguese, English, or Spanish on mobile technologies related to patient safety or empowerment that were published from 2013 to 2024 and were available in full were considered. Articles were chosen by independent reviewers, who analyzed the titles, abstracts, and full text of the articles according to previously defined eligibility criteria.

The Java language was used to develop the mobile application for Android®, whereas its iOS version was constructed on Back4App® with support from Canva for the elaboration of its design.[7] Then, its content was validated by expert judges, who were selected according to criteria adapted from the Fehring model, considering academic training, practical experience, and scientific production in patient safety, technology, or health education.[8] The specialists were recruited by electronic invitations to professionals in teaching and research institutions and in research groups in the thematic areas of this study.

Implementation included content and appearance validation by a committee of 12 expert judges (chosen according to the following inclusion criteria: at least one year of care and/or teaching experience and a master's and/or PhD degree) via structured instruments based on Likert-type scales to assess the clarity, relevance, organization, and presentation of the content of the mobile application. Semantic validation was carried out with a pilot group of 10 patients. This step adapted the application content and layout to its target audience. Application usability was evaluated by tab pilot group of patients via an instrument composed of items based on Nielsen's 10 heuristics, which were adapted to facilitate understanding and evaluation by the target audience.[9]

Validation with the target audience was conducted with 30 patients hospitalized in a medical clinic and eight family members. Those aged over 18 years who had been hospitalized for at least three days were included in this stage. Participants were recruited in hospitalization units. Their sociodemographic information and familiarity with the use of digital technologies were collected to characterize the sample. The Suitability Assessment of Materials instrument was used in this stage. Note that the groups had no participant overlap[10] across stages (semantic validation, usability evaluation, and assessment with the target audience). This study was approved by the Research Ethics Committee. Participants read and signed informed consent forms.

Regarding its results, this study developed its application based on its scope review, which included the six goals by the Joint Commission International and the Brazilian National Health Surveillance Agency, made available for free (Figure 1).

Figure 1. Screenshots of the *Paciente Empoderado* application. Juiz de Fora, Minas Gerais, Brazil.

The content validity coefficient regarding appearance exceeded 0.90. The evaluation of usability by experts showed the high technical quality of the application interface. The pilot group evaluated the application based on Nielsen's 10 heuristics. All dimensions averaged above 4.0 on a one-to-five Likert scale, highlighting the correspondence between the system and the real world (mean = 4.90) and its aesthetics and minimalist design (mean = 4.70). These results indicate that the application meets fundamental usability principles.

The pilot group offered a satisfactory semantic validation (above 85%). The evaluation with end users showed great satisfaction and acceptance. This study evaluated aspects related to the organization, language clarity, content relevance, and potential of the application to promote self-care, finding total agreement (100%) regarding ease of navigation, information comprehensibility, content adequacy, and perception that it can contribute to strengthening patient safety. The variable with the lowest total agreement was related to the colors of its interface, despite its high acceptance (87%).

The results indicate robust application development and validation. The content validity coefficient showed high agreement between experts regarding content adequacy (0.91), whereas the averages above 4.0 in the usability heuristics indicate that the application interface meets fundamental interaction principles. Satisfactory semantic validation and great user agreement regarding clarity, organization, and navigability reinforce the adequacy of the language and content of the application to its target audience. Although the evaluation of its colors showed lower total agreement, its level of acceptance remained high (0.81). These findings suggest that the technology can support health education strategies and promote patient safety.[3,6-7]

This study built and validated an application that constitutes an instrumental technology to be made available in Brazil. The work of health teams and future research technology can incorporate it, serving as a reference for strategies to prevent incidents and adverse events and promote health education.

FUNDING

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001.

REFERENCES

1. Cho I. Frameworks for Evaluating the Impact of Safety Technology Use. Healthc Inform Res. 2023;29(2):89-92. doi: 10.4258/hir.2023.29.2.89

2. Eriksson CO, Bahr N, Meckler G, Hansen M, Walker-Stevenson G, Idris A, et al. Adverse Safety Events in Emergency Medical Services Care of Children With Out-of-Hospital Cardiac Arrest. JAMA Netw Open. 2024;7(1):e2351535. doi: 10.1001/jamanetworkopen.2023.51535.

3. Aires-Moreno GT, Marques LG, Ramos SF, Castro Araújo-Neto F, Oliveira Santos Silva R, Fernandes BD, et al. Improving patient safety culture in hospitals: A scoping review. Res Social Adm Pharm. 2025;21(10):765-83. doi: 10.1016/j.sapharm.2025.05.010

4. Raji SA, Demehin MO. "Long walk to 2030": A bibliometric and systematic review of research trends on the UN sustainable development goal 3. Dialogues Health. 2023;2:100132. doi: 10.1016/j.dialog.2023.100132

5. Peters MDJ, Godfrey C, McInerney P, Munn Z, Tricco AC, Khalil H. Scoping Reviews. In: Aromataris E, Lockwood C, Porritt K, Pilla B, Jordan Z, editors. JBI Manual for Evidence Synthesis. JBI; 2024. doi: 10.46658/JBIMES-24-09

6. Barra DCC, Paim SMS, Sasso GT, Colla GW. Methods for developing mobile apps in health: an integrative review of the literature. Texto Contexto Enferm. 2015;26(4):e2260017. doi:10.1590/0104-07072017002260017

7. Assis EM, Ferreira JF, Santos JG, Clemente JP, Alvim ALS. Empoderamento do paciente: construção de aplicativo de celular para prevenção de incidentes à saúde. Tecnol Soc. 2024;20(62):219-32. doi: 10.3895/rts.v20n62.16390

8. Fehring RJ. Methods to validate nursing diagnoses. Heart Lung. 1987;16(6 Pt 1):625-9. https://pubmed.ncbi.nlm.nih.gov/3679856/

9. Carvalho LR, Évora YDM, Zem-Mascarenhas SH. Assessment of the usability of a digital learning technology prototype for monitoring intracranial pressure. Rev Latino-Am. Enfermagem. 2016;24:e2777. doi: 10.1590/1518-8345.1054.2777

10. Sousa CS, Turrini RNT, Poveda VB. Tradução e adaptação do instrumento "Suitability Assessment of Materials" (SAM) para o português. Rev Enferm UFPE Online. 2015;9(5):7854–61. doi: 10.5205/reuol.6121-57155-1-ED.0905201515

AUTHORS' CONTRIBUTIONS

Évilin Martins de Assis, Julya Kelly Ferreira, João Gabriel dos Santos, Júlia Pimentel Clemente, Delma Conceição Soares da Silva, André Luiz Silva Alvim contributed to the bibliographic research, writing of the abstract, introduction, methodology, discussion, interpretation and description of the results, preparation of tables, conclusions, review, and statistics. **André Luiz Silva Alvim** contributed to the writing of the abstract, project administration, acquisition of funds, bibliographic research, review, and statistics.

All authors approved the final version to be published and are responsible for all aspects of the work, including ensuring its accuracy and integrity.

Please cite this article as: Assis EM, Ferreira JK, Santos JG, Clemente JP, Silva DCS, Alvim ALS. Empowering Patients: Development and Validation of a Mobile Application to Prevent Adverse Health Events. Rev Epidemiol Control Infect [Internet]. 2026 Jun. 14; 16. Available from: https://seer.unisc.br/index.php/epidemiologia/article/view/21095