Original Research Article

Puerperium Software for Adolescent Care

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Abstract

This study describes the creation and development of the PUERPERIUM software, which utilizes the General Comfort Questionnaire translated into Brazilian Portuguese and adapted for postpartum adolescents. The software development process followed five steps: (1) requirements elicitation, involving the extraction of functionalities and identification of quality attributes such as usability, reliability, security, and availability; (2) definition of the software project and architecture, including the selection of technologies such as programming languages and services; (3) software implementation; (4) validation, verification, and testing; and (5) deployment. The software development began with identifying the necessary requirements, followed by designing the architecture consisting of the server layer and visualization layer. During implementation, the integration of the General Comfort Questionnaire and the selected technology was achieved. Key features such as authentication screens, a patient grid, instrument completion forms, and reporting tools were developed. The software's logo and overall layout were also designed. Subsequent phases involved validating the software's appearance, usability, and functionality. The complete implementation will include making server layer elements available online and providing a beta version of the visualization layer on a public platform. The software aids nurses in efficiently and systematically assessing the comfort levels of postpartum adolescents, thereby facilitating care aimed at promoting comfort.

Keywords: Technological Development, and Innovation Projects, Nursing Informatics, Postpartum Period, Adolescent Health, Patient comfort.

1 INTRODUCTION

Adolescent mothers are more likely to experience greater stress, difficulties in providing adequate environments and care for newborns, greater effort to adapt to the new role, less cognition to care for the newborn, and high levels of anxiety and depression compared to adult mothers (Kingston *et al.*, 2012, Nunes, 2013, Riva Crugnola *et al.*, 2014, Dinwiddie *et al.*, 2017). Pregnant adolescents aged 10 to 19 face higher risks of eclampsia, puerperal endometritis, and systemic infections than women over 20 years of age (Xie *et al.*, 2019). Among girls/women aged 15 to 19, complications arising from pregnancy and delivery are the leading causes of mortality worldwide.

Health professionals must consider the specificities of pregnancy, delivery, and postpartum in adolescents, as these can impact education, work, and health during a critical life stage (Kingston *et al.*, 2012, Montgomery, 2003). Therefore, nursing care provided to adolescents during the postpartum period is crucial in addressing the adversities associated with adolescent motherhood, thereby fostering a positive experience for both mothers and babies (Fatori *et al.*, 2021, Talungchit *et al.*, 2021).

Technological innovation can enhance working conditions and propagate best practices in the care provided to individuals, families, and communities. In this context, theoretical foundations are essential for nursing as both a discipline and a profession. Nursing theories can be applied to identify problems and devise solutions to meet patient needs (Leandro *et al.*, 2020).

Among nursing theorists, Katharine Kolcaba proposed the Comfort Theory, which posits that comfort is a holistic experience and defines it as the state wherein human needs for relief, tranquility, and transcendence are met in the physical, sociocultural, psychospiritual, and environmental contexts (Kolcaba, 2003). Kolcaba developed a comfort measurement instrument, the General Comfort Questionnaire (GCQ), to guide research and nursing care. The GCQ consists of 48 items that evaluate overall well-being, with response options ranging from 1 (totally disagree) to 4 (totally agree). The scores support clinical reasoning by summing the positive items and reverse coding the negative items. Higher scores indicate greater comfort, while lower scores suggest a need for interventions to enhance comfort (Kolcaba, 2003).

In women's health, particularly regarding the postpartum period of adolescents, the Comfort Theory and the computerized GCQ promote good care practices by leveraging technology. Producing technology requires scientific foundations and aims to solve practical problems with tangible technological solutions (Cupani, 2016). The development of technology involves testing and validating its use, functionalities, design, and adaptations.

This article aims to describe the creation, planning, and development of the PUERPERIUM software, which utilizes the GCQ translated into Brazilian Portuguese and adapted to promote comfort among postpartum adolescents.

2 METHOD

This descriptive study focuses on the creation, planning, and development of software aimed at enabling the use of Kolcaba's General Comfort Questionnaire (GCQ) – Brazilian Portuguese version – to promote the comfort of postpartum adolescent women.

The process of creating, planning, and developing the PUERPERIUM software followed five steps: (1) requirements elicitation; (2) architecture and design; (3) implementation; (4) validation, verification, and testing; (5) deployment.

The first step, requirements elicitation, involved extracting functionalities and identifying the software's quality attributes, such as usability, reliability, security, and availability. Requirements elicitation is the process of discovering, collecting, and documenting system requirements, an essential activity to understand what the system should do and how it should behave (Wiegers, 2013). Within this step, the software requirements were

categorized into two groups: functional and non-functional. Functional requirements describe the services the software provides to the user, while non-functional requirements include performance restrictions and system qualities. These non-functional requirements are further divided into product requirements, organizational requirements, and external requirements (Sommerville, 2011). During this phase, the actors and system requirements were outlined through a use case diagram and illustrative tables.

In the second step, the software project and architecture were defined, including the selection of technologies to be used. This step involved determining which programming languages and services would be utilized. Based on the functional and non-functional requirements, guidelines for accessing the application were established, and the solution architecture diagram was produced.

The first two steps were completed in full. The third step, software implementation, involved selecting and coding some functional and non-functional requirements using the Dart programming language through the Flutter platform. At this stage, the software was prepared for testing.

Steps four and five—validation, verification, and testing, along with deployment—complete the development cycle. Evaluating aspects such as appearance validity, usability, and functionality is crucial to examine the inherent attributes of the digital material produced. Face validity pertains to the aesthetics of the material, including shapes, colors, and images, which must align with the content as they may impact understanding. Usability assesses how easy it is for users to interact with and understand the software (Lima *et al.*, 2019). The tested features evaluate system functions, prioritizing navigation and interactions. Therefore, understanding the user and identifying their needs is essential [21]. In the software implementation phase, the technologies will be made available for download and installation, facilitating their use.

To ensure copyright protection, the software was registered with the National Institute of Industrial Property (INPI) and cataloged under number BR512023003227-1.

3 RESULTS

Firstly, six functional requirements and five non-functional requirements were identified and documented as the main products and artifacts resulting from the elicitation process (Tables 1 and 2).

Table 1: Software functional requirements

Initials	Functional requirement	Description
RF01	Authenticate	The system provides authentication for your access.
RF02	Recover password	The system allows the user to recover his/her password.
RF03	*CRUD nurses	The system allows you to register, visualize, update and delete nurses.

Initials	Functional requirement	Description
RF04	CRUD patients	The system supports registration, visualization, updating and deletion of patients.
RF05	CRUD GCQ	The system allows nurses to register, visualize, update and delete the instrument General Comfort Questionnaire (GCQ) per patient.
RF06	GCQ report per patient	The system issues a report with GCQ data per patient.

*CRUD is an acronym in English for Create, Read, Update and Delete.

The software offers access to its functionalities for two types of actors: (i) software administrators and (ii) nurses registered in the system.

The software architecture comprises two components. The first, called the server layer, has the primary functions of storing data with patients' GCQ responses, registering users (nurses and patients), and generating reports on GCQ. The second component, called the visualization layer, presents the user (nurse) with screens to fill out the GCQ.

The two-tier architecture was defined mainly due to mobility and performance. Mobility refers to making data collection accessible to the system's main actor, the nurse. Regarding performance, the objective was to keep it lightweight, with all processing occurring in the server layer.

Table 2: Software non-functional requirements

Initials	Non-functional requirement	Description
RNF01	Usability	Nurses are able to use all the software features.
RFN02	Reliability	The software is available for use at all times of the day.
RFN03	Efficiency	The software has a response time to interaction with its functionalities of no more than 6 (six) seconds.
RFN04	Privacy	The software takes into account privacy issues, as set out in the General Personal Data Protection Law (LGPD) (Brasil, 2019).
RFN05	Security	The software can be accessed by registering with a password.

The choice of technologies aims to increase mobility and facilitate the use of GCQ by nurses, considering its robustness, security, and widespread use by the software development community. At the server layer three technologies were used: MySQL database, PHP programming language (version 8), and Apache server. In the visualization layer the main technology used was the Android platform, applied through Flutter technology.

After defining the requirements and architecture, the implementation phase commenced. This phase involved coding using the selected technologies, prioritizing some functional and non-functional requirements for initial implementation. The integration between GCQ and the chosen technology was prioritized, outlining the scope of this step. Accordingly, based on the previous steps, three requirements were implemented: RN01, RF05, and RF06.

The logo and overall layout of the PUERPERIUM software were created and developed with the assistance of a graphic designer. The system includes various screens: (1) Authentication Screen, designed to restrict access to registered users; (2) Patient Grid Screen, displaying a grid of patients with codes, offering two main actions: completing the General Comfort Questionnaire (GCQ) and viewing charts showing the patient's scores; (3) GCQ Navigation Screens, allowing users to navigate and complete the GCQ items; (4) Report Screen, containing scores and two charts derived from GCQ responses, representing comfort levels across different contexts and states, aiding in nurses' clinical reasoning; and (5) Explanation Screen, providing an overview of the PUERPERIUM software and its functions.

It is worth mentioning that on all screens where data from system actors (nurses and patients) will be collected, a consent form is introduced, highlighting which data will be processed, in accordance with the General Personal Data Protection Law (LGPD), nº 13.853, dated July 8, 2019.

Validation of appearance, usability, and functionality was tested. Nonetheless, a pre-test with nurses who are experts in women's health and provide care for postpartum women is necessary. For this purpose, the items to be evaluated were organized in an online questionnaire.

When implementing the software, the elements of the server layer will be made available on an internet server, linked to a domain, to be accessed by any device with internet access. For the visualization layer, a beta version of the software will be made available on a public platform.

4. DISCUSSION

The planning and development of software for using the General Comfort Questionnaire (GCQ) in the context of postpartum adolescents represent an innovation for the clinical practice of nursing care in

primary care and other assistance settings. This software aids nurses in verifying comfort levels in a practical, agile, and organized manner, thus understanding the situations experienced by postpartum adolescents and offering care directed toward promoting comfort.

The creation and development of software to use GCQ, Kolcaba's instrument, constitute an innovation in health care due to its accessibility, practicality, portability, and functionality. This aligns with the importance of e-health and m-health in all areas and categories of health care. M-health is promising as it demonstrates relevant attributes to users (Early *et al.*, 2019). Health professionals can benefit from its use because technology contributes to better professional performance (Ljubicic *et al.*, 2020).

Throughout the software planning and development process, integrating different areas of knowledge, such as health, informatics, and design, was fundamental. It is also worth underlining that this technological innovation was associated with Comfort Theory and digital artifacts, demonstrating that technology developed for the health sector must be produced with health professionals, as they are the holders of the clinical practice of health promotion and recovery.

The creation of software by nurses and its development in alliance with other professionals is fundamental because it demonstrates that nurses and other health professionals are responsible for innovation in health services and contribute to adapting to an increasingly digitalized work environment. Furthermore, it promotes more efficient management of patient data in real time, providing support for the tasks carried out by nurses and, consequently, increasing the quality of care provided (Bygholm, 2018, Kaihlanen *et al..*, 2023).

Software typified by mobile applications have proven to be well-adhered strategies, as they create opportunities to improve health care without time and location restrictions. Regarding obstetric nursing care, the benefits of using technology have been documented in several studies ((AWHONN, 2018, Heuvel *et al.*, 2018, Ivory, 2017, Watterson, 2015).

The creation of mobile technologies is relevant to prevent avoidable complications related to pregnancy, delivery, and puerperium. It has also been demonstrated as an innovation in low- and middle-income countries and can even serve as a model for seeking appropriate solutions to improve maternal care in the United States (Kasthurirathne *et al.*, 2017).

Postpartum is a unique phase that involves issues like motherhood, sexuality, self-esteem, and restructuring of family and personal life, which can negatively impact health and well-being. In this phase, the care provided by the nurse can prevent complications and promote a positive experience for the postpartum woman and her family, primarily in the context of primary health care. Accordingly, the relevance of technology for the care provided to postpartum women by nurses should be endorsed as a strategic possibility.

Regarding the topic of comfort, Kolcaba's theoretical framework can be applied to different populations and contexts to acquire comfort and promote health. It should also be emphasized that adopting this theory ensures that comfort needs are correctly identified by nurses when caring for postpartum women. The use of theory in nurses' clinical practice provides care that alleviates discomfort, making the applicability of GCQ essential (Lin *et al.*, 2023).

Accordingly, the software developed with support from Kolcaba's Theory demonstrates that innovation and technology are required to promote health, leading to good practices in the care provided by nurses.

5. CONCLUSION

The software created and developed using Kolcaba's instrument (GCQ) to assist nurses in caring for girls/women represents an innovation in nurses' clinical practice. This software is a valuable contribution to clinical practice, particularly in assisting adolescent postpartum women, as it constitutes a technology for decision-making by nurses to define a care plan during the postpartum period.

Based on Kolcaba's Theory, the software is an innovation because it enables nurses to have an agile and organized clinical practice, assess the comfort levels of postpartum adolescents, and develop a care plan aimed at promoting comfort throughout the postpartum period.

The production of the software, involving the collaboration of nurses, computer scientists, and design professionals, contributes to the quality of production and development of health technologies.

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