

Experience report

Development of a smartphone holder for a hospital crib*

Desenvolvimento de suporte de celular para berço hospitalar

Desarrollo de un soporte para teléfono móvil para cunas de hospital

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Abstract

Objective: to describe the development of a prototype smartphone holder for a hospital crib.

Method: technological development study conducted in a pediatric unit of a university hospital in southern Brazil, between May and July 2024, following the four stages of the Double Diamond method. In the “discover” phase, the authors’ experience in clinical practice was used to confirm the need for the product. In “define,” requirements and attributes were established. In “develop,” the solution was conceived and the sketch was produced. In “deliver,” the prototype was 3D printed. **Results:** adaptations for handling screens by companions and hospitalized children were observed. The structural analysis of the cribs and the synchronic analysis of holders available on the market made it possible to define the product and create a version viable for production by 3D printing. **Conclusion:** the smartphone holder for a hospital crib shows potential to meet a practical demand of the pediatric unit.

Descriptors: Nursing; User-Centered Design; Pediatrics; Humanization of Assistance; Child, Hospitalized

Resumo

Objetivo: descrever o desenvolvimento de um protótipo de suporte para celular para berço hospitalar. **Método:** estudo de desenvolvimento tecnológico, realizado em uma unidade pediátrica de um Hospital Universitário do sul do Brasil, entre maio e julho de 2024, seguindo as quatro etapas do método Double Diamond. Na fase “descobrir”, utilizou-se a experiência dos autores na prática assistencial para confirmar a necessidade do produto. Em “definir”, estabeleceram-se requisitos e atributos. Em “desenvolver”, idealizou-se a solução e elaborou-se o esboço. Em “entregar”, o protótipo foi impresso em 3D. **Resultados:** foram observadas adaptações para o manejo de telas por acompanhantes e crianças internadas. A análise estrutural dos berços e a análise sincrônica de suportes disponíveis no mercado permitiram definir o produto e criar uma versão viável para produção por impressão 3D. **Conclusão:** o

suporte para celular para berço hospitalar demonstra potencial para atender a uma demanda prática da unidade pediátrica.

Descritores: Enfermagem; *Design* Centrado no Usuário; Pediatria; Humanização da Assistência; Criança hospitalizada

Resumen

Objetivo: describir el desarrollo de un prototipo de soporte para teléfono móvil para cuna hospitalaria. **Método:** estudio de desarrollo tecnológico, realizado en una unidad pediátrica de un Hospital Universitario del sur de Brasil, entre mayo y julio de 2024, siguiendo las cuatro etapas del método Double Diamond. En la fase “descubrir”, se utilizó la experiencia de los autores en la práctica asistencial para confirmar la necesidad del producto. En “definir”, se establecieron requisitos y atributos. En “desarrollar”, se ideó la solución y se elaboró el boceto. En “entregar”, el prototipo se imprimió en 3D. **Resultados:** se observaron adaptaciones para el manejo de pantallas por parte de acompañantes y niños hospitalizados. El análisis estructural de las cunas y el análisis sincrónico de soportes disponibles en el mercado permitieron definir el producto y crear una versión viable para su producción mediante impresión 3D. **Conclusión:** el soporte para teléfono móvil para cuna hospitalaria demuestra potencial para atender una demanda práctica de la unidad pediátrica.

Descriptor: Enfermería; Diseño Centrado en el Usuario; Pediatría; Humanización de la Atención; Niño Hospitalizado

Introduction

Children’s understanding of the changes brought about by illness and hospitalization is often limited. Being removed from the home environment, changes in daily activities, and the procedures performed generate fear, anxiety, and distrust in the pediatric patient. In this context, the responsible family member experiences anguish, anxiety, and physical and mental exhaustion. These conditions hinder treatment for the patient, the family, and the nursing team.¹⁻²

Given this, the adoption of humanized care must be understood by the care team as an essential strategy to minimize the suffering of the child and the family, as well as to enhance the recovery process. Initiatives have been undertaken to make the hospital setting more welcoming and humanized and have shown beneficial effects with regard to comfort and the perception of care for the child and the family, justifying the effort to implement these measures.^{1,2}

A recent analysis of a pediatric hospital environment revealed that some aspects need to be reassessed, such as privacy, thermal comfort, entertainment, and greater stimulation for children. The authors emphasize that the presence of elements composing an atmosphere that conveys pleasant sensations, such as

comfort and tranquility, while at the same time stimulating the senses, is extremely important for the recovery of hospitalized young children. In addition, the use of personal objects to personalize the bed has the potential to increase the sense of safety and belonging.^{1,3}

In practice, it is common to observe limitations of the child in the crib during hospitalization, such as the implementation of isolation due to the diagnosis and the need for oxygen support, among other examples. This condition impairs their participation in recreational activities, often making it essential to improvise or offer smartphones with games or animated videos to distract the child during certain periods.

Thus, the use of screens in the hospital environment has been increasing as a strategy to entertain children and to minimize the effects of hospitalization. However, it is often observed in practice that, in pediatric units, beds and cribs are not prepared to attach devices such as smartphones or tablets.

In this scenario, technological development plays a significant role with regard to care, since it contributes to the quality of care.⁴ A study conducted with children undergoing blood collection showed that the use of a digital game during the procedure was able to minimize the effects of painful processes, helping pediatric patients cope with the event and reducing their perception of pain.⁵

Nursing care frequently requires the use of creativity to develop alternative products that do not exist in the work environment or that are not suited to the urgent nature of their activities. Being in daily contact with health care needs, nursing professionals bring with them the potential to develop new technologies together with design professionals.⁴

The design process aims to solve problems through the analysis of context, always considering the user as the central component in the development of the solution. To this end, Design Thinking (DT) comprises a human-centered scientific approach that is based on real needs and grounded in empathy among the participants of the process to find innovative solutions.⁶ Structured within the DT approach, the Double Diamond (DD) diagram was developed by the British Design Council as a visual representation of the design innovation process. Composed of

four phases—discover, define, develop, and deliver—the method maps the divergent and convergent stages in a technical and creative development process with the purpose of finding a solution to a problem or idea.⁷

In addition, it is worth noting that design methodologies involve exploratory processes, of an interactive and nonlinear nature, carried out with the purpose of transforming a need into a finished product or a strategic solution.

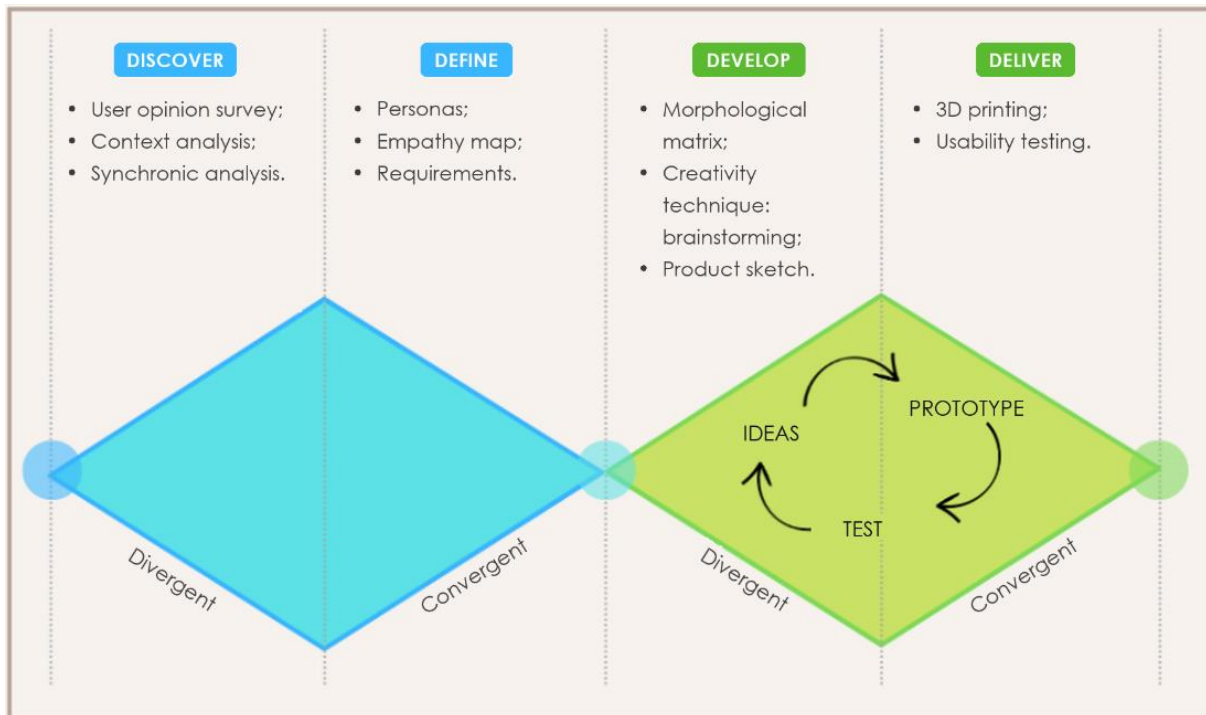
Based on these concepts and drawing on the identification of a problem in clinical practice, it was found that, in a pediatric inpatient unit, in the attempt to entertain their children during hospitalization with the use of videos on smartphones, mothers make adaptations to hold the device on the cribs where the children remain.

The objective of this study is to describe the development of a prototype smartphone holder for a hospital crib.

Method

This is a report of a technological development study of a product, based on the authors' experience in pediatric clinical practice, conducted in the pediatric inpatient unit (PIU) of a university hospital located in the state of Santa Catarina, Brazil. The work was developed between May and July 2024, within the context of the Programa de Pós-Graduação Gestão do Cuidado em Enfermagem, professional modality, of the Universidade Federal de Santa Catarina (UFSC).

For the development of this study, the DD process was used. This methodology aims to describe divergent stages (exploration of possibilities, creation and expansion of ideas) and convergent stages (analysis of information and data, direction of ideas) within a design process, seeking to identify a real and effective solution to a problem.⁷ To this end, the steps described in Figure 1 were followed.

Figure 1 – Double Diamond

In the first divergent moment of the DD (the “discover” stage), in order to understand the context of the problem, an observation of the pediatric unit environment was carried out to validate the need and understand the meaning of the product’s development.

After this initial moment, the analysis of the context was carried out through the structural assessment of the cribs and the synchronic analysis of smartphone holders available on the market. The synchronic analysis process provides an understanding of the universe of the product of interest and allows, through comparisons, the identification of opportunities and improvements, avoiding reinventions.⁸ To this end, a search was conducted on the Google Images search engine using the words: “smartphone holder,” “electronics holder for bed,” and “crib holder.” The results obtained were analyzed and arranged on a panel so that the options with similarity to the study proposal could be visualized—a holder capable of supporting a smartphone for viewing videos or games by pediatric patients while they are in hospital beds.

For the second moment of the DD, which begins the first convergence stage of the project (the “define” stage), the information obtained in the previous step was analyzed and, based on this, the personas related to the problem were identified and

developed, along with their respective empathy maps, and the requirements and attributes essential to solving the problem were defined.

Personas are fictional characters resulting from the synthesis of the findings of an exploratory study of a target audience and exemplify characteristics and attributes representative of this group.⁹⁻¹⁰ In this study, the personas created were the hospitalized child and her mother, based on the observations and experiences of the authors in pediatric clinical practice. Defining the personas contributes to the selection of the requirements of a product, since, through the identified characteristics, it is possible to raise the main points that must be addressed in the project in order to meet the demand of the user in question. In addition, the empathy map also guides the analysis of the user's needs and allows a better understanding of the user, serving as a guide for building the product.⁹

The list of requirements guides the design process with respect to the goals to be achieved.⁸ Thus, based on the requirements established by the authors, the option was defined to develop a version viable for production by 3D printing technique, as this is a strategy that allows objects to be produced quickly and versatily, making it possible to generate a first-version prototype in a short time. Prototypes are fundamental for product analysis, as they allow testing and making important structural modifications that make the results better and more efficient.²

The institution where the product was developed has prototyping laboratories with 3D printers, which led the group to understand that opting for a simpler and faster 3D version would be the best choice for obtaining the first version of the smartphone holder conceived.

For the third moment of the DD (the "develop" stage), in order to begin the second divergent stage of the design process for generating ideas or solutions, a table with the options found for each item of the holder (attachment, support, joint, material, and size) was developed based on the results obtained in the define stage. Based on this table and on the attributes listed, the authors applied the technique known as brainstorming in order to conceive concept options and select a combination among them that would best compose the first version of the holder. Subsequently, a freehand sketch was produced to guide the next step of the work.

To carry out the last stage of the DD (the “deliver” stage), contacts were made with 3D printing laboratories at the institution. After some discussions, the coordination of the Pronto 3D Florianópolis laboratory—a teaching, research, and extension space dedicated to the materialization of forms through automated techniques—agreed to carry out the 3D printing of the prototype in question. Its modeling was developed by an undergraduate student of the laboratory, and its printing was subsequently performed on a Fused Deposition Modeling (FDM) printer, which uses polymers to produce models in an additive manner. After the materialization of the first prototype of the holder, it was possible to advance to the next phase.

The device delivery and usability evaluation phases with end users constitute the scope of future investigations. This report is limited to the preliminary technical validation of the attachment of the holder to the cribs and beds of the sector, carried out directly by the researchers.

Results

In the experience presented here, the aim was to demonstrate, through the DD, the production of a smartphone holder that meets the demands of the pediatric service of a university hospital, given that, during professional practice, several adaptations for handling screens by the companions of hospitalized children and/or by the children themselves were observed.

The synchronic analysis of smartphone holders available on the market was also carried out, and although there was a large number of product options, it was found that none was ideal for adapting to the crib of the unit in question.

Based on the analysis of these data, a panel was developed (Figure 2) so that the options with similarity to the study proposal could be visualized—a holder capable of supporting a smartphone for viewing videos or games by pediatric patients while they remain in hospital beds.

Figure 2 – Synchronic analysis panel

ATTACHMENT						
SUPPORT						
ARTICULATION						
SIZE	 Compatible With 3.5"-10.4" Phone / Tablet					
MATERIAL	Plastic 	Metal 	Aluminum 			

In the next step, the personas related to the problem were identified and developed, along with their respective empathy maps, and the requirements and attributes necessary to solve it were defined.

Considering that the smartphone holder aims to contribute to the entertainment of children in a pediatric hospital unit, the following requirements were selected: cleanable and resistant material; secure and stable attachment; low cost; the possibility of adjusting the position (joint); the feasibility of accommodating different device sizes; and the ability to be materialized via a 3D printer.

Finally, in the design process for generating ideas or solutions, the options chosen by the team for each item of the holder (attachment, support, joint, material, and size) were selected (Figure 3) on the synchronic analysis panel.

Figure 3 – Selected solutions

ATTACHMENT						
SUPPORT						
ARTICULATION						
SIZE						
MATERIAL						

Thus, following the DT approach to problem solving through user-centered context analysis and guided by the DD method, it was possible to arrive at the first version (Figures 4, 5, and 6) of the smartphone holder for use in a hospital crib, conceived through 3D printing, which was taken to be tested in practice by the development team.

Figure 4 – Front view of the holder

Figure 5 – Rear view of the holder



Figure 6 – Side view of the holder



When performing the first on-site test of the prototype, it was identified that, during modeling, an adjustment not conceived in the initial sketch had been added to it and, consequently, no measurement in centimeters had been made for production. This adjustment was supposed to be positioned between the bars of the crib, and for this reason the test was not completed, since it was not possible to fit the product onto the crib.

After measuring the distance between the bars of the crib to adjust the prototype (Figures 7, 8, and 9), the team returned to the laboratory for feedback, and a manual reduction was made to the piece. In order to speed up the tests, it was decided not to carry out, at that moment, a new printing of the product, nor any further finishing at the location where the cut was made.

Figure 7 – Part to be adjusted



Figure 8 – Rear view of the prototype after adjustment



Figure 9 – Side view of the prototype after adjustment



After the adjustment, it was possible to attach the prototype properly to the crib, replacing the bag and the blanket that had previously served as the improvised smartphone holder (Figure 10).

Figure 10 – Improvised holder vs. developed prototype



Fitting the smartphone into the holder revealed another need for adaptation: the product's fixing screws were in a position that pressed the phone's command buttons (the volume and power buttons). This change was left to be carried out at another time.

In an initial experience, the product showed potential to meet the demand of mothers who, in order to entertain their children during hospitalization and minimize the suffering caused by the hospital environment as well as by invasive and painful procedures, resort to the use of electronic devices.

Discussion

Humanized care encompasses the welcoming of the child-family dyad and aims to convey safety and empathy to the patient, thereby ensuring that the hospital experience is not traumatic and that it has a favorable outcome.¹ With regard to the humanization of health care facilities, it is known that the architecture of the spaces is a contributing part of this process. In this sense, the presence of

elements composing an atmosphere that conveys pleasant sensations, such as comfort and tranquility, while at the same time stimulating the senses, is extremely important, especially when it comes to hospitalized children.

Inpatient units usually have televisions for the entertainment of patients, and in some pediatric wards recreational spaces are provided for play and reading. An exploratory study with children hospitalized for chemotherapy treatment identified the use of video games and computers as one of the preferred coping strategies.¹¹

In an effort to humanize care practices in health services, professionals have sought to introduce various support technologies for procedures with the aim of easing the stay and improving the experience of patients. Direct patient care enables the nurse to identify various care needs that would benefit from the development of technological innovations that contribute to improving the quality and safety of care. In this logic, the prototype developed here is a strategy undertaken by nurses who identified a problem in their professional practice—the attachment of electronic devices to hospital beds—to minimize the suffering of hospitalization by promoting entertainment for children.

Technological research is still growing in nursing and requires the professional development of practitioners in approaches that can support the development of new ideas in health. In this way, the application of the DT method can contribute to better performance in research involving technological innovations in nursing care.^{4,6}

In this work, the innovation strategies through the DD approach were essential to identify the needs of those involved in the practical experience of hospitalization in a pediatric inpatient unit. Furthermore, the application of the DT tools allowed the conception of new ideas and stimulated the creative process in the development of solutions to the practice problem.

It is also worth mentioning that the authors' knowledge and experience in the pediatric unit were key elements for the development of the prototype, since the experience of professionals constitutes important technical elements in the development of new technologies for the improvement of clinical practice.¹²

The production/adaptation of a technology in pediatrics requires several interfaces, among them meeting the demand of the pediatric public, since children are not always able to express their real priorities, thus requiring information to be sought from those responsible for them. By incorporating playful pediatric strategies adapted to their ages, the hospital environment becomes more collaborative for the illness and hospitalization process, contributing to a rapid improvement of their clinical condition.

It is worth emphasizing the current need to seek knowledge in other areas such as information technology, engineering, and design, as well as the establishment of interdisciplinary partnerships so that the realization of new solutions conceived by nursing and health professionals is possible.⁹

The coordination between the authors and the University's prototyping laboratory was essential for the materialization of the innovation developed. 3D printing is an additive manufacturing technique for building an object and is widely used for the development of prototypes.² Despite the time limitation for making new structural modifications to the model of the holder developed, the authors maintain the partnership with the laboratory in order to discuss possible changes and to materialize a new specimen.

Thus, despite the need for improvements, the first version of the smartphone holder developed by the present study showed potential to meet a gap observed in the pediatric unit of a university hospital.

As a limitation of this study, usability tests with users are imperative to ensure that the product is a viable solution to the problem presented, based on the perception and needs of the mothers of hospitalized children.

As for contributions to nursing, product development emerges as the possibility of creating solutions to problems identified in daily practice in order to provide appropriate care and contribute to meeting the demands of users. In addition, there is a growing trend toward the implementation of technologies in all areas, and health is no exception; therefore, expanding methodological knowledge in this regard helps nursing professionals break down barriers and pave the way for innovations in the sector.

Conclusion

The results of this study made it possible to create a product intended to bring improvements to pediatric practice with the following specifications: cleanable and resistant material; secure and stable attachment; low cost; position adjustable by the joint; accommodation of different device sizes; and the ability to be materialized via a 3D printer. It is expected that this suggested and presented product can be introduced to the market and be useful in pediatric inpatient units.

The importance of the design methodology as a creative way to create products usable in professional practice is highlighted. The application of the DT method made it possible to identify how much the convergence of clinical practice with a rigorous methodological process contributes to problem resolution, such as the one presented here.

The challenges that permeate the production of technologies in the health field continue. Nevertheless, usability tests with users are still needed, as well as the establishment of partnerships with companies for large-scale product development so that it can be made available on the market for commercialization. Thus, there will be an effective improvement in child care.

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