RLAE
Revista Latino-Americana de Enfermagem

Original Article

Baby Date: a mobile application for teaching nursing care to newborns in primary care*

Beatriz Molina Carvalho[1,2]
   https://orcid.org/0000-0001-6042-3679

Maria Cândida de Carvalho Furtado[1]
   https://orcid.org/0000-0001-7942-4110

Gustavo Travaini Chinalia[2,3]
   https://orcid.org/0000-0001-9809-8744

Edilson Carlos Caritá[3]
   https://orcid.org/0000-0002-9767-4751

Gabriel Zanin Sanguino[1]
   https://orcid.org/0000-0002-3273-5496

Highlights: (1) The mobile application provides content for newborn care in primary care. **(2)** The mobile application directs the nurse's consultation through evidence of care. **(3)** The mobile application can be used offline, offering knowledge at any time and place. **(4)** Navigation does not require a specific order, which gives the user freedom. **(5)** The mobile application promotes quality care in the first consultation with the newborn in primary care.

Objective: to develop and validate a mobile application for teaching undergraduates about the first nursing visit to a newborn in primary care. **Method:** methodological study with an Instructional Design framework; content drawn up from scientific documents on caring for newborns and their families, supported by the results of an integrative review on the subject. The Integrated Development Environment Android Studio 4.0.1 tool and the IntelliJ IDEA platform were used to build the digital technology. Experts validated content and students evaluated navigability. **Results:** the final version of the mobile application contains 67 screens grouped into 12 sections with random access. The device is presented on the introductory screen; this is followed by content on the physical examination, neonatal screening, nutrition, oral health, the vaccination calendar, growth, development, danger signs, and accident prevention; at the end, there is a fact sheet and references. Audiovisual resources (texts, images, and videos) complement the application; experts presented a Content Validity Index (CVI) = 1.00; for nursing students all the items had a CVI = 1.00; only the item "layout and presentation" had a CVI = 0.95. **Conclusion:** the digital technology received a satisfactory evaluation from experts and students. It is innovative in child health care, with the potential to be used in the teaching-learning process of nursing students.

Descriptors: Pediatric Nursing; Primary Health Care; Mobile Applications; Educational Technology; Education, Nursing; Students, Nursing.

Introduction

Developments and changes in higher education have been supported by the use of information and communication technologies (ICT). ICT provides the democratization of study[1], since students have the possibility of consulting materials beyond the classroom, and digital media are used to support the achievement of cognitive skills, as well as being allies for the development of procedural and attitudinal competencies[2-4].

In nursing education, the introduction of ICT has contributed to changes that rethink student participation and the roles of teachers; these changes seek to provide methodological diversification and flexibility in the construction of knowledge[5-7].

Mobile applications (APPs) stand out and are increasingly present in health teaching scenarios, with an emphasis on nursing, with productions on various topics, in which mobile technologies promote positive differences in the fields of health care, education, and management[8], with examples such as the early detection of pediatric cancer[9], the prevention of skin lesions in newborns (NB)[10], and support for nurses in dealing with domestic violence against children[11].

The growing supply of devices for use in the health area responds to the demand for mHealth, which is characterized by the use of mobile devices and digital technologies for health[12] and promotes access to care in an expanded way, making it possible to access the data contained in this tool in different places and at different times. This strategy aims to reduce existing costs in care, and improve the service provided and its management[13].

APPs, components of mHealth, enable the dissemination of education and health promotion through the manipulation of mobile devices, and are allies in the dissemination of reliable content to the population[14]. Easy access to these devices contributes to the creation of APPs that meet users' needs, making up one of the subsets considered most integral to the mobile health universe and most present in all locations; in addition, they can also be used without the presence of a mobile network[13,15].

As digital and mobile technologies are integrated into the educational environment, their inclusion motivates the improvement of efficiency in this universe. The particularities of these technologies are that they are personalized, interactive, portable, and contextualized, based on needs. Personalization, interactivity, portability, and contextualization allow mobile technologies to support teaching-learning processes, whether formal or informal; thus, they become fundamental to enhancing the educational process[15].

In terms of training nurses to provide primary health care, monitoring children and their families is an important activity. The nurse's role in this scenario includes childcare consultations, assisting children and their families through clinical assessment, and creating and strengthening bonds. This professional plays an important role, as they follow up from prenatal to postnatal care, as well as provide targeted care[16].

The topic proposed in this study focuses on content covered in undergraduate nursing courses; therefore, it is essential to qualify professionals to care for children. However, teaching children's health nursing care still presents challenges, given the still present traditional model[17].

Considering the presence, at university, of young adults who have access to electronic devices and prefer to be informed digitally[3], coupled with the need to train qualified nurses to promote child health care based on scientific evidence, according to the consensus on the competencies of pediatric and neonatal nurses[18], and to reinforce the use of ICT in higher education, this research aimed to develop and validate a mobile application for teaching undergraduates about the first nursing consultation with newborns in primary care.

Method

Study type

A methodological study that developed a mobile application for nursing students to learn cognitive and attitudinal skills[19] when caring for NBs in primary care, based on the methodological framework of Instructional Design (ID)[20].

The five phases of the ADDIE approach – Analysis, Design, Development, Implementation, and Evaluation[20-22] – were used to enable the construction of material aimed at teaching and learning. This study presents the phases of analysis, design, development, and evaluation of the mobile application, with validation by experts and evaluation by undergraduate nursing students. The implementation and handling phase of the device created is part of another ongoing study. Evaluation, the final phase of the ADDIE approach, cuts across the entire process. It is carried out after the material has been used by the target audience, to observe the experience, and reflect on ways to improve the material[20-22].

The analysis stage[20-22] revealed educational aspects of the first nursing consultation with newborns in primary health care. It was assumed that the development of an app to help nursing students

Carvalho BM, Furtado MCC, Chinalia GT, Caritá EC, Sanguino GZ.

3

work with newborns has the potential to facilitate the construction and signification of knowledge, in addition to impacting changes in the attitudinal skills of this population and influencing the quality of care provided. The childcare visit is an appropriate time to offer unique care to the individual; by assessing the child, health needs, and possible problems that can be identified at an early stage, interventions can be proposed and implemented to promote, protect, and rehabilitate the child's health[23].

The content was prepared based on a literature review[24] and also supported by materials published in journals and textbooks, as well as official documents from the Brazilian Ministry of Health, Regional Councils, the Brazilian Society of Pediatrics, and Municipal Health Departments, all focused on the care of NBs and their families.

Once the survey and organization of the items that would make up the APP had been completed, the design stage[20-22] was carried out. Here, the theoretical aspects to be included in the APP were organized, and the layout was developed, with figures and colors defined, as well as the functionality and fluidity of the resources[20-22].

At this point, the mobile APP was named Baby Date. The choice was based on the understanding that the NB's appointment with their mother is an encounter with the health professional, which enables care actions, information exchange, and health education. We also tried to make sure that the name of the APP was not listed in the main APP stores.

Period

The Baby Date mobile APP was developed[20-22], validated, and evaluated from September 2020 to March 2022.

Participants

In order to validate the APP's content, navigability, and interface, experts in the fields of nursing and technology were contacted. The APP was evaluated with the participation of nursing students (target audience) from a public higher education institution (HEI).

Instruments used for data collection

The nursing and IT experts answered an adapted electronic form (Google Forms)[25-26], and the nursing students evaluated the APP using an electronic form (Google Forms) with items of the Suitability Assessment of Materials (SAM)[27-28] adapted for evaluation[20-22] of the APP. Adaptations were made to the wording of each original SAM topic to indicate the product to be evaluated (example: Item Appearance - Is the "mobile app" attractive?).

Data collection

To validate the content of the APP, 15 nurse experts were identified as potential contributors based on a search of the Lattes Curriculum platform, considering graduation (nurse) and experience in research and/or the practice of NB primary care. They were contacted by e-mail between March and June 2021. They all agreed to contribute to the study and come from different regions of the country, such as Santa Catarina, Paraná, São Paulo, and Minas Gerais.

The experts received instructions on the validation and had access to the informed consent form (ICF), and the link to the electronic form (Google Forms) with questions to be answered on a Likert scale (Strongly Agree, Agree, Neither Agree nor Disagree, Strongly Disagree, Disagree). The questions showed the content of the screens, and for each screen, they were asked to answer questions about comprehension, language, ease of reading, ease of learning, and references used. The participants were given 20 days to answer the form and all of them met the deadline.

At this point in development, the APP contained 59 screens and, in order to optimize the validation process, it was decided to randomly divide the experts into three groups, as well as the screens to be evaluated. The division by group of judges (G1, G2, G3) considered an equal distribution of the number of screens for each evaluator (an average of 25 screens) and allowed for a more attentive validation by targeting specific screens for each of the three groups. G1 validated the Physical Examination Menu (15 Submenus). G2 validated the Neonatal Screening Menu (5 Submenus); Feeding Menu (2 Submenus); Oral Health Menu (1 Submenu); Vaccination Calendar Menu (2 Submenus); Growth Menu (2 Submenus). And G3 validated the Development Menu (item without Submenu); Danger Signs Menu (1 Submenu) and Accident Prevention Menu (3 Submenus). It should be noted that although the number of screens was divided up, all 15 experts had access to the complete file with all the screens, in Portable Document Format (PDF). In addition, all the experts received electronic forms with the initial ("Main Menu" and "Menu Items") and final screens ("About Baby Date Menu" and "References

Menu"), as well as a space for general validation of the tool.

After being validated by the experts, the content of the APP underwent a revision of the Portuguese language by a trained professional in August 2021.

The APP was produced in partnership with information technology professionals. To this end, the Integrated Development Environment Android Studio 4.0.1 tool and the IntelliJ IDEA platform were used. The programming language used to implement the interfaces and functionalities was Java, and coding followed the development standards of OOP (Object-Oriented Programming).

All the components used (or applied) to build the interface were based on Material Design, Google's official design system, created to help produce a high-quality digital user experience. To navigate between the main categories, the Navigation Drawer tool was chosen, as it offers quick navigation between unrelated destinations, is easily identified by the user, organized in an orderly fashion, and accommodates different layout models[29-30].

Standards were also adopted for the naming of layout, image, and style files, to facilitate understanding and possible maintenance of the code.

The APP can be installed on any Android smartphone or tablet, using API 16: Android 4.1 (Jelly Bean), and is compatible with 99.8% of existing Android devices. It was decided, at this initial stage, to develop an APP for the Android operating system because it is widespread on a vast network of people's cell phones, as well as being inexpensive to create and more affordable to publish. We also considered how easy it would be for the developer to use the programming tools, since devices of the same type and operationalization are not essential in the programming process, as is the case with the iOS system, for instance.

Some of the figures are authored and were created free of charge by a designer who is a member of the team, whereas other images contained in the APP were taken from textbooks and materials, all of which are duly referenced throughout the APP. The content has been organized into a main screen containing 12 sections, subdivided into icons, to facilitate navigation and the search for specific information.

This stage took place between August and September 2021 and, in order to validate the interface and navigability, five experts were identified through access to the Lattes Curriculum platform, working in the areas of child health nursing and information technology. They are from the states of São Paulo and Paraná and individual contact was made to them by e-mail. They were also given 20 days to respond to the form, and all the experts complied.

Each participant received instructions on the validation, the ICF, and a link to access an electronic form (Google Forms), with questions to be answered on a Likert Scale, using the same answer options as the content validation, and a link/QR code to install the Baby Date APP, in APK format, on their smartphones.

From December 2021 to March 2022, the APP was evaluated by the target audience, that is, nursing students. Just like the experts, the participants in this stage were contacted individually by e-mail, and instructions were sent, as well as the ICF and a link to access an electronic form (Google Forms), with questions to be answered on a Likert-type scale (with identical answer options to the previous ones) and a link/QR code to install the Baby Date APP on smartphones, in APK format. Thirteen nursing students from a public HEI in the state of São Paulo took part in this stage.

Data analysis

For the content, navigability, and interface validation phases, the content validity index (CVI)[31] was calculated and a minimum agreement of 0.80 was expected. For the target audience evaluation phase, an agreement of at least 0.70 was expected[27].

Ethical aspects

The research was approved by the undergraduate committee of the HEI to which the students were linked, and by the Research Ethics Committee, under opinion no. 4.307.807, CAAE: 34509620.0.0000.5393. All the participants (experts and nursing students) received the ICF (individualized for each participant) signed by the researchers via e-mail and as a PDF file.

Results

The development of the Baby Date APP stemmed from the need to support the teaching-learning process in the field of pediatric nursing, and the first version of the APP was delivered by the developer in September 2020. Meetings between the research team and the developer made it possible to discuss the format of the APP created, the continuity of its development, and its improvement, with the final version being delivered in October 2021, containing 67 screens (Figure 1).

Figure 1 - Screenshots of the Baby Date mobile APP

The content about the NB's first appointment in primary care was designed to be descriptive, but the APP also provided audiovisual content such as texts, images (Figure 2), and videos (Figure 3). This made it possible to complement the subject of the section being accessed or to help the user study the subject in greater depth.

The use of copyright figures is a differentiator in the construction of a technological resource. This format provides the target audience with original material that is geared towards the proposal, in this case, the care of the newborn.

The final APP contains 12 sections (shown in Figure 1), subdivided into 10 icons which include the content to be covered and evaluated by the nurse during the NB's first consultation in primary care. It also includes 2 icons with information about the APP and references. Access to these sections is not limited to a specific order. Thus, users are free to navigate the APP and open the section they want to access.

The sections are as follows: Home (introductory screen); Physical Examination; Newborn Screening; Feeding; Oral Health; Vaccination Calendar; Growth; Development; Danger Signs; Accident Prevention; About Baby Date; References.

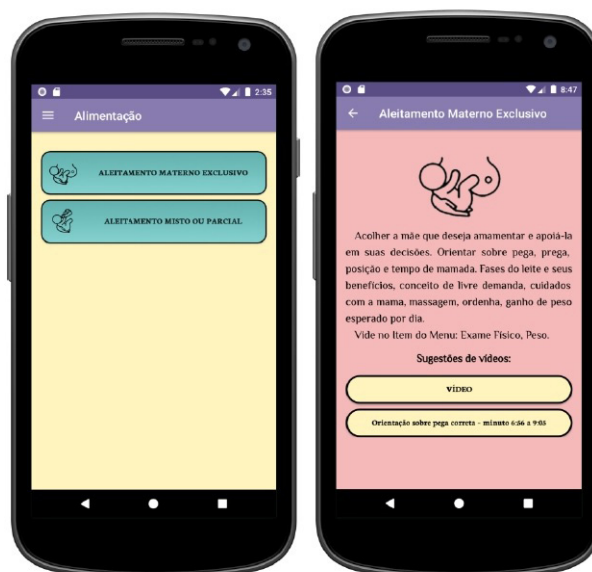Figure 2 – Screenshots of the Baby Date mobile APP

Figure 3 - Screenshots of the Baby Date mobile APP

Validation of APP content

In the content validation, as indicated above, the 15 experts were divided into three groups (G1, G2, G3), with five participants each. In G1, all the participants were female and their ages ranged from 30 to 53; in G2, three were female and two male, aged between 30 and 46; in G3, four participants were female and one male, aged between 29 and 58.

The experts work in the academic field or primary care. The selection for the research invitation was based on research and curriculum analysis on the Lattes platform of the National Council for Scientific and Technological Development (CNPq), as stated by the authors[32-36].

During the content validation process, some experts suggested adding information or modifying certain terms, which were accepted or rejected according to the researchers' analysis. Once the suggestion was accepted, the modification underwent a second round of validation. The results presented regarding the agreement and CVI were identified after both rounds had been completed; after the second round, the APP was considered validated.

The CVI[31] was calculated, with G1 having a CVI of 0.99 and G2 and G3 having a CVI of 1.00. Concerning the initial and final screens, validated by all the experts, there was unanimous agreement, with a CVI of 1.00.

Validation of the APP's navigability and interface

The navigability and interface were validated by professionals, three nurses, and two technology professionals, of whom two were female and three male. Of the nurses, one is a graduate student in child health and educational technologies and two are professors at a higher education institution, aged between 31 and 52, all working in universities, with between four and 32 years of experience in child health and between one and three years of experience in developing APPs or technologies. Among the technology professionals, one is an audiovisual technician and one is a professor at a higher education institution, aged 41 and 44, also working in universities, with 10 and 15 years of experience in developing APPs or technologies.

The criteria proposed by Fehring[32] were also used in this validation phase.

All the experts installed the APP without reporting any difficulties, and after handling the tool, they filled in the survey form. In the first round of validation, 100% agreement was reached. The suggestion proposed by one expert was accepted; however, it did not change the format, colors, or fonts. There was therefore no need for a second round to consider the navigability and interface validated.

APP evaluation by the target audience

The target audience included 13 students, of whom 12 were female and one male, aged between 21 and 41. They all came from the same public higher education institution, with 11 students from the Bachelor's and Licentiate Degree in Nursing (10 semesters) studying between the 7th and 10th semester at the time of data collection, and two from the Bachelor's Degree in Nursing (8 semesters), both in the 8th semester.

During this period of the nursing course at the HEI, the students had completed a subject on child primary care. They therefore had the necessary theory to evaluate the APP. After being invited to participate in the research, the students downloaded the resource onto their smartphones and used it, which made it possible to evaluate the APP.

In order to consider the tool evaluated, agreement of at least 0.70[30], was sought, based on the calculation of the CVI[31]. The nursing students evaluated the APP by completing the adapted SAM instrument[27-28], which considered organization, appearance, content, layout and presentation, stimulation/motivation, and cultural appropriateness. For all the items evaluated, 100% agreement was reached, except for two components of the "layout and presentation" item on the characteristics of the APP layout and whether it is attractive, with 92.3% agreement.

All items had a CVI of 1.00, except for the "layout and presentation" item, which had a CVI of 0.95.

The nursing students also made comments about the APP; however, they were not accepted, as they concerned changes that did not fit in with the tool's proposal, such as placing all the content of the support links in the APP, alternating the arrangement of texts and images, and changing the font size.

This close look at the APP's end user is pertinent and interesting. However, it should be noted that such additions would not make the APP a tool for quick access to the information needed for nursing consultations with newborns. In addition, the proposed modification, with the inclusion of texts, images, and fonts, would jeopardize the initial intention, which is to direct and highlight specific content at the time of the nursing consultation and health education with the parents and guardians of NBs.

Baby Date APP final settings

The APP offers a configuration from the introductory screen that introduces the device and indicates the main information that will support the nurse's consultation. Accessing the "Physical Examination" section shows normal values for the neonate's vital signs and the frequency of the child's visits. This section also contains icons on weight, length, head circumference, skin, skull, face and neck, chest, abdomen, genitalia, anus, rectum, osteoarticular system, spine, and neurological assessment. It indicates what to evaluate, shows images, and provides links to materials in PDF format and videos with free access on a video-sharing platform.

Moving on to "Neonatal Screening", the user identifies five tests carried out at this stage of the child's life, with information such as "why to do it", "who does it" and "when to do it". Under "Feeding", two icons lead the user to Exclusive Breastfeeding or Mixed or Partial Breastfeeding, with a link to a video or reading material in a PDF file.

The "Oral Health" section provides information on how to care for newborns, and highlights the importance of checking specific health service protocols. The "Vaccination Calendar" section required special attention for one of the icons, since there is the possibility of changes in availability or the inclusion of new immunobiological agents.

In "Growth", there is an emphasis on recording anthropometric measurements (weight, height, cephalic perimeter) in the Child's Handbook, as well as in the NB's medical records. "Development" indicates aspects that should be observed and properly evaluated during the consultation and refers to the information contained in the "Physical Examination" section, in the icon on Neurological Evaluation.

The "Danger Signs" include 14 situations that should be observed during the consultation, or questioned if they have occurred at home, to the person accompanying the child to the consultation. "Accident Prevention" is the last item in the specific sections related to the consultation. It includes sudden death syndrome, the Heimlich maneuver, bathing guidelines, all the links to access the reading material, as well as five topics that warn of situations that could lead to accidents at this stage of the child's life.

The section on Baby Date contains the APP's technical data sheet and lists those responsible for designing and developing the material, along with acknowledgments and contact details (e-mail address). Finally, the "References" section lists scientific articles, manuals, guides, protocols, documents, and textbooks that can be consulted.

Discussion

The APP contains materials that facilitate and guide nursing students when studying the topic of child health, focused on the care of babies in primary care. All the content has been prepared in order to facilitate the signification of knowledge, as it includes tables, charts, figures, and hyperlinked materials, all based on scientific evidence.

In a study to evaluate the effectiveness of health APPs for pediatric patients with chronic diseases, all the resources investigated presented data to health professionals and were focused on children and adolescents with chronic pathologies, with the design based on target users[37]. As in another study, in which the authors[38] indicated the choice of user-based design when designing an APP, since they were able to reformulate parts of the tool from the participants' contributions to present a quality and efficient final work.

Regarding the methodological path followed by researchers in the development of APPs, an integrative review[39] pointed to four types of methods frequently chosen: Systematic Instructional Design; Contextualized Instructional Design; User-Centered Design; and Systems Development Life Cycle. The authors point out that each method has stages to be completed, with similarities between them. However, the key factor when designing a digital technology is to organize the phases to be completed in order to present a complete and useful tool to its intended target audience[39], which was done for Baby Date.

The APP has content, navigability, and an interface that is appropriate for its purpose, as well as studies that point to its importance in linking theoretical and practical knowledge[3,9,40].

While considering the development of Baby Date, ID was chosen because it met the project and the APP's objective; however, the evaluation by the target audience, in this case nursing students, is seen as essential in this process. Thus, this stage of the process was carried out as a way of understanding how well students would accept the APP, based on its organization, appearance, content, layout, motivation, and cultural appropriateness.

One study[41] found that the evaluation phase with end users of an APP developed for the oncology field allowed users to handle the tool and give their opinions on the technology. The target audience said that the APP provides different useful guidelines for administering oral chemotherapy safely at home. It was also understood that the content presented had been assimilated, concluding that there was a link between scientific evidence and the population needs[41].

Carvalho BM, Furtado MCC, Chinalia GT, Caritá EC, Sanguino GZ.

9

These data corroborate the findings of this study, since the student evaluators were satisfied with the items observed in Baby Date and, in the spaces for observations and suggestions, they left favorable and timely comments about the ease that this technology will bring to the continuity of care for NBs and their families when used in clinical practice.

Other authors[37] studied APPs, components of mHealth, and identified that they benefited the monitoring and treatment of conditions such as asthma, obesity, diabetes mellitus, congenital heart disease, and attention deficit hyperactivity disorder. The tools whose usability was evaluated by nurse experts were more beneficial to children. One aspect of the limitations pointed out in the research analyzed concerned the ethical aspects, monitoring of the tool's programming, and safety[37].

Having tools that collaborate with health care and assistance is becoming increasingly useful in services. Likewise, conducting a movement based on good programming practices, in order to corroborate future updates, and following documents based on scientific evidence, make the final material more authentic and reliable.

As shown in Baby Date, figures are essential for clarification, directing the content and deepening the study. When describing the APP for congenital anomalies possibly found at the birth of babies, researchers[42], indicated the addition of photos and diagrams to elucidate the topic, taking care to extract them from reliable and scientific sources, as in this study. In addition, in order to broaden understanding of the subject proposed by the APP, the authors said they included videos and links to other resources. Every ethical precaution was taken in this process, since the images were referenced[42], as was the case with Baby Date.

In this case, the application has been prepared for use on Android and iOS devices. And, as a way of reaching the largest number of users, it can be used without access to the mobile internet network, and is responsive as it adapts to the screens of mobile devices and tablets[42].

In line with the aforementioned aspects, Baby Date was also developed with the aim of being suitable for use on smartphones and tablets. However, for the time being, it is only applicable to Android devices, which is an improvement for the APP in question.

The technology developed and commented on by authors[42] was designed to meet the demands of users in places with a shortage of specialized professionals and few available resources. When thinking about the digital technology presented in this study, the aim is to encourage primary care nurses to take a closer look at the possible conditions that NBs and their caregivers may show during childcare consultations. In this way, Baby Date provides access to up-to-date content and encourages the application of good practices[43] beyond nursing students, with use also possible by nurses who work in primary care, and supports the advancement of scientific knowledge in pediatric nursing.

A limitation of this study is that the Baby Date mobile APP has not been developed for other extensions and browsers, and is currently restricted to Android devices. Another limitation was the approach of experts from a few Brazilian locations, not covering other regions of the country, which could broaden the view of the use of this APP in different realities.

Conclusion

The Baby Date APP was developed and based on a methodological framework that favors material that is consistent with scientific evidence. It is argued that it is a differential to corroborate the teaching-learning process of nursing students in the field of child health.

Furthermore, this APP has been validated in terms of its content, navigability, and interface, and evaluated by the target audience, namely nursing students. Thus, its creation is intended to contribute to the meaning and apprehension of the contents worked on in the undergraduate course, and thus, the expectation of providing quality care to children in the early stages of their lives, with care provided in a way that promotes health and minimizes risks.

The advances for the category are relevant, not only for training future nurses, but also for their work in primary care, with regard to newborn care. They are indispensable and have been considered in the presentation of this study and the use of this APP.

As a contribution, it should be noted that the partnership between professionals in the field of technology and nursing was essential to the development of the APP and should be reinforced and valued by future developers of this type of technology. The possibility of having a professional designer think along with the team about the figures present in the material influenced the construction of a unique resource aimed at what was proposed.

Developing a mobile tool for the health area is a necessary move to support the advancement of professional training and make the integration of the health service and the assistance offered to users concrete, as a way of meeting existing needs.

We hope that this study will encourage researchers to constantly strive to idealize and develop technological resources that support and strengthen nursing, both in

teaching and in conducting professional practice in caring for individuals.

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Authors' contribution

Study concept and design: Beatriz Molina Carvalho, Maria Cândida de Carvalho Furtado, Gustavo Travaini Chinalia, Edilson Carlos Caritá, Gabriel Zanin Sanguino. **Obtaining data:** Beatriz Molina Carvalho, Gustavo Travaini Chinalia, Gabriel Zanin Sanguino. **Data analysis and interpretation:** Beatriz Molina Carvalho, Maria Cândida de Carvalho Furtado, Gustavo

Travaini Chinalia, Edilson Carlos Caritá. **Drafting the manuscript:** Beatriz Molina Carvalho, Maria Cândida de Carvalho Furtado, Gustavo Travaini Chinalia, Edilson Carlos Caritá, Gabriel Zanin Sanguino. **Critical review of the manuscript as to its relevant intellectual content:** Beatriz Molina Carvalho, Maria Cândida de Carvalho Furtado, Gustavo Travaini Chinalia, Edilson Carlos Caritá, Gabriel Zanin Sanguino.

All authors approved the final version of the text.

Conflict of interest: the authors have declared that there is no conflict of interest

Corresponding author:
Beatriz Molina Carvalho
E-mail: beatriz.molina.carvalho@usp.br
https://orcid.org/0000-0001-6042-3679