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Web app for the monitoring of pregnant and puerperal women: technological production

Aplicativo *web* para o acompanhamento de gestantes e perpuéras: produção tecnológica

Aplicación *web* para el seguimiento de gestantes y puérperas: producción tecnológica

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ABSTRACT
Objective: To describe the production process of a web app prototype to monitor pregnant and puerperal women. **Method:** A technological production study, of the prototyping type, developed in five stages: Identification of the relevance of an app for the online monitoring of pregnant and puerperal women with the participation of two users and nine professionals; prototype modeling; prototyping validation; and design and implementation of the app in its online version. **Results:** The app has proved to be a technological tool that is easy, fast and safe to access, as well as an important ally in the virtual care of pregnant and puerperal women, minimizing exposure and waiting time in emergency services and professional offices. **Conclusion:** The web app has expanded users' adherence to the prenatal, childcare and postpartum consultations, providing a new space for the nurses' professional practice.
DESCRIPTORS: Obstetric Nursing; Nursing Care; Mobile Apps; Information Technology.

RESUMO
Objetivo: Descrever o processo de produção de um protótipo de aplicativo *web* para o acompanhamento de gestantes e puérperas. **Método:** Estudo de produção tecnológica, do tipo prototipagem, desenvolvido em cinco etapas: Identificação da relevância de um aplicativo para o acompanhamento *online* de gestantes e puérperas com a participação de duas usuárias e nove profissionais; modelagem do protótipo; validação da prototipagem; *design* e implementação do aplicativo em sua forma. **Resultados:** O aplicativo tem se mostrado uma ferramenta tecnológica de fácil, rápido e seguro acesso, além de importante aliado no atendimento virtual de gestantes e puérperas, minimizando a exposição e o tempo de espera em pronto atendimentos e consultórios profissionais. **Conclusão:** O aplicativo *web* tem ampliado a adesão de usuárias às consultas pré-natais, puericultura e puerpério, possibilitando um novo espaço de atuação profissional para o Enfermeiro.
DESCRITORES: Enfermagem Obstétrica; Cuidados de Enfermagem; Aplicativos Móveis; Tecnologia da Informação.

RESUMEN
Objetivo: Describir el proceso de producción de un prototipo de aplicación *web* para el seguimiento de gestante y puérperas. **Método:** Estudio de producción tecnológica sobre el desarrollo de un prototipo, realizado en cinco etapas: Identificación de la importancia del uso de una aplicación para el seguimiento *online* de gestante y puérperas con la participación de dos usuarias y nueve profesionales; creación del modelo del prototipo; validación del desarrollo del prototipo; diseño e implementación de la aplicación *online*. **Resultados:** La aplicación ha demostrado ser una herramienta tecnológica de acceso fácil, rápido y seguro, además de un importante aliado en la atención virtual de gestante y puérperas, minimizando la exposición y el tiempo de espera en los servicios de emergencia y consultorios profesionales. **Conclusión:** La aplicación *web* ha ampliado la adhesión de las usuarias a las consultas prenatales, puericultura y posparto y habilitó un nuevo espacio para la práctica profesional del enfermero.
DESCRIPTORES: Enfermería Obstétrica; Cuidados de Enfermería; Aplicaciones Móviles; Tecnología de la Información.

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INTRODUCTION

Digital technologies have taken on unimaginable proportions in the last decade, in the sense of responding to the demands of consumers who are increasingly looking for fast, efficient and wide-ranging tools. In this evolutionary process, computers (desktops and notebooks) gradually lost space to the mobile versions (smartphones and tablets), which offer low cost and are widely accessible to the population. As a result of their versatility, mobile devices, especially cell phones associated with Web 2.0 tools and the emergence of apps, enabled even greater functionality and reach[1-3].

As in other areas, digital technologies have also gained space in the health area, in which they optimize time and resources and ensure more agility and resoluteness[4]. Mobile applications, in particular, have been encouraged in health education, online monitoring of patients, appointment scheduling, management of medication dosages and verification of vital signs, among other functionalities[4-6].

A number of studies show that dialog between professional and user allows, through mobile apps, continuous monitoring, in addition to enabling electronic data storage, with a view to decision-making and offering dynamic and safe information[6-7]. Another study, in the area of maternal and child health, shows that mobile apps strengthen the breastfeeding social support network for puerperal women, in addition to enabling fast and safe access to the information[8].

In this same direction, a recent study shows that 93% of the young women in the United Kingdom use the Internet and social networks to clear their doubts[9]. Although not replacing face-to-face monitoring and guidelines, technological tools, in particular apps, are alternatives to support pregnant and puerperal women, as they reduce or avoid frequent commutes and, consequently, reduce demand in the health services and expand adherence to treatments[10].

Although there is a range of mobile apps related to the care of pregnant and puerperal women focused on the infant's development, breastfeeding and gestational changes, devices focused on puerperal care and/or systematic monitoring of pregnant and puerperal women are uncommon. Therefore, the study has the following research question: What is the relevance of web apps for the monitoring of pregnant and puerperal women? Thus, the objective is to describe the production process of a web app prototype to monitor pregnant and puerperal women.

METHOD

A technological production study, of the prototyping type, which aimed at producing a web app for the monitoring of pregnant and puerperal women, in order to meet a specific demand in the Brazilian South region. The study was developed between 2018 and 2019, based on five stages: Identification of the relevance of an app for the online monitoring of pregnant and puerperal women with the participation of two users and nine professionals; prototype modeling; prototyping validation; and design and implementation of the application in its online version.

Stage I - Identification of the relevance of an app for the online monitoring of pregnant and puerperal women. In this stage, data survey was carried out, based on conversation circles with nine professionals (seven nurses, a dentist and a psychologist), working in the care and monitoring of pregnant and puerperal women, and with two users who had already undergone a recent pregnancy, selected by means of simple random sampling. The conversation circles, in a total of three and held on previously scheduled dates and times, were conducted based on the following questions: Do you consider an app relevant to monitor pregnant and puerperal women? If so, how do you imagine the functionality of this app? The suggestions and agreements indicated in the conversation circles were recorded in a field diary and constituted the base material to design the mobile app.

Stage II - Called prototype modeling, it represented the elaboration of a prototype, in partnership with a technical professional from the Technology and Information course of the proposing institution.

Stage III - Prototyping validation. This process had the participation of two users and nine health professionals and was carried out based on a specific validation instrument. The evaluators validated the prototyping through the Delphi technique; they assessed each of the 18 items of the five dimensions. It is noted that, in each item, a space was provided for the evaluators to comment and/or suggest changes, if necessary, as referenced in studies[11-12].

The Delphi technique consists of an analysis among evaluators with experience in the area, carried out from rounds of questionnaires in order to establish theoretical consensus. This technique resorts to two or more rounds and will depend on the complexity of the topic and on consensus among the evaluators. Two Delphi rounds were carried out for this study[11-12].

Stage IV - Design and implementation of the app in its online version. After prototyping validation, the final app prototype design was created. For this purpose, periodic analysis and discussion meetings were held between the actors involved, having in hand the field diary records and the diverse evidence of an integrative review study previously structured for greater theoretical grounds. A partnership was also established with the Innovation Agency of the proposing institution, in order to enable hosting of the app in the institutional server's cloud, so as to allow wide remote access to the users. At the end of this stage, the app was registered at the National Institute of Industrial Property, under code BR512019002855-4.

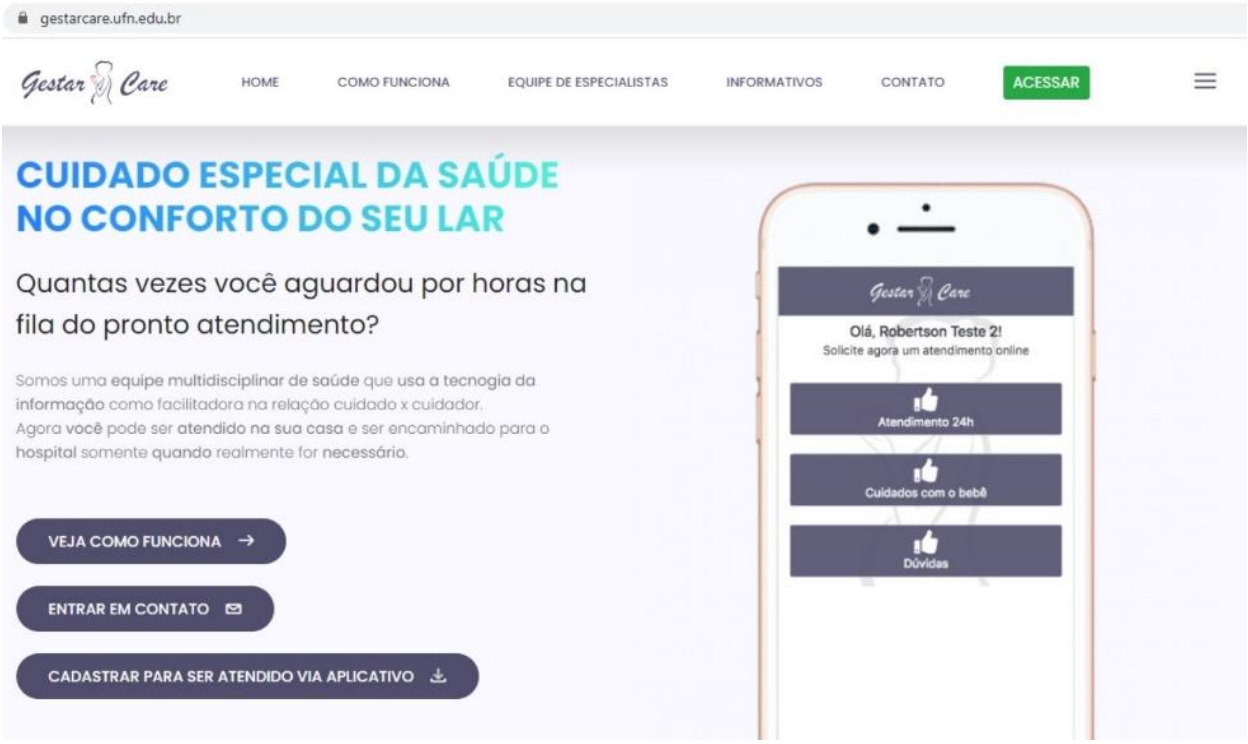
The project was submitted for approval by the Research Ethics Committee and approved under Opinion No. 2,556,661/2018, in accordance with Resolution 466/2012 of the National Health Council[15].

RESULTS

The results will be detailed based on the five methodological stages previously presented, as follows:

Stage I: From the conversation circles with two users (pregnant and puerperal women) and nine health professionals (seven nurses, a dentist and a psychologist), the relevance of web devices focused on maternal and child health was identified. The importance of remote devices for monitoring pregnant and puerperal women was perceived in the participants' statements, especially regarding clarification of recurrent doubts related to breastfeeding, surgical wound care and recurrent baby crying, among others. It was also noted that the puerperium is a period marked by fear, anxiety and insecurity, in which women want to establish a more effective bond with a health professional, even if through informal means such as WhatsApp®, among others. In summary, there was an evident need to enable a quick and easy-to-access invention, both for the professionals and for the pregnant and puerperal women. In this sense, the participants indicated the items that should primarily be part of the app.

Stage II: Based on the previous findings and analysis of the information that emerged in the conversation circles, the initial sketch of the app's prototype was defined, which was deposited in the "Easy Easy App" Platform. Prototyping presented information that was organized in cycles and with an interactive design, in the format of three areas: a) Main screen/Client site: user's access to the care, medical chart, professionals, registration, financial and health information icons; b) Administrative area: used by the nurse-managers to carry out registration and approval of the service requested by the user, as well as directing the appointment to a clinical nurse and general management of the system; c) Clinical nurse area: in this area, the nurse will receive notification of care, make a video call or answer by text or audio and record the care provided in the medical chart, as well as registration and closure of the appointment. The initial screens of the *Gestar Care*® app will be presented below (Figure 1).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Gestar Care
HOME
COMO FUNCIONA
EQUIPE DE ESPECIALISTAS
INFORMATIVOS
CONTATO
ACESSAR
CUIDADO ESPECIAL DA SAÚDE NO CONFORTO DO SEU LAR
Quantas vezes você aguardou por horas na fila do pronto atendimento?
Somos uma equipe multidisciplinar de saúde que usa a tecnogia da informação como facilitadora na relação cuidado x cuidador.
Agora você pode ser atendido na sua casa e ser encaminhado para o hospital somente quando realmente for necessário.
VEJA COMO FUNCIONA
ENTRAR EM CONTATO
CADASTRAR PARA SER ATENDIDO VIA APLICATIVO
Gestar Care
Olá, Robertson Teste 2!
Solicite agora um atendimento online
Atendimento 24h
Cuidados com o bebê
Dúvidas


Gestar Care
Olá, Anelise Dutra Godinho!
Solicite agora um atendimento online
Atendimento
Cuidados com o bebê
Pós-parto
Home
Prontuário
Profissionais
Inform.
Sair


Você solicitou atendimento online
Pré-natal
Aguarde, um de nossos profissionais irá atender o seu chamado
Ok, Eu entendi!
Home
Prontuário
Profissionais
Inform.
Sair

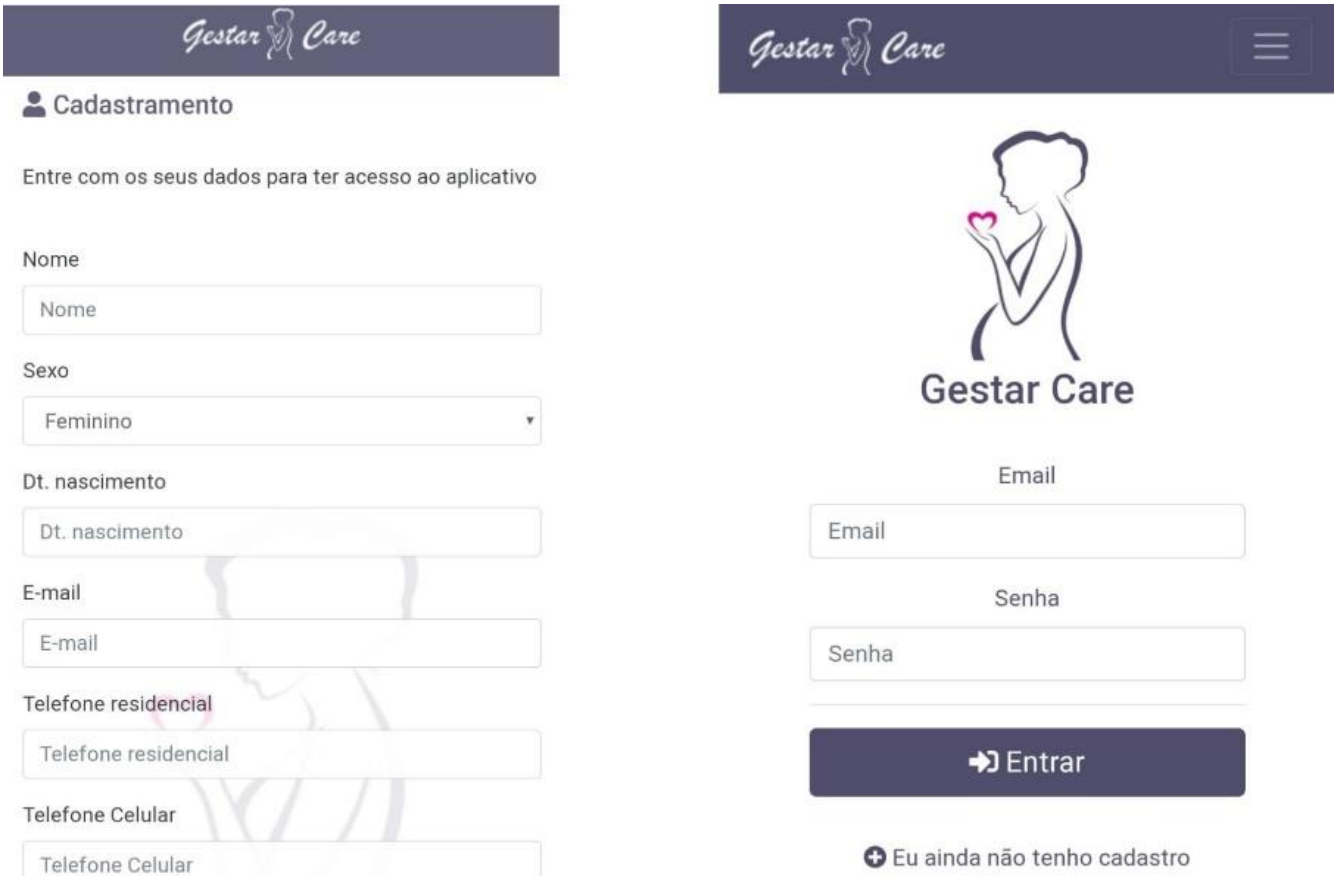


Figure 1 - Initial screens of the *Gestar Care*® app
Source: Elaborated by the authors, 2018.

Stage III: Prototyping validation was carried out using a specific instrument, with the participation of two users and nine professionals previously specified. The professionals were selected based on their previous experience in the obstetric field for more than two years. They received an invitation letter via e-mail with a detailed presentation of the technology, the product validation instrument and the reason for their choice as evaluators. After favorable decision to participate, the evaluators had access to the prototype's screens and, subsequently, they filled out the validation instrument, with their suggestions being integrated into the technology. The instrument considered criteria such as functionality, confidentiality, accessibility, usability, flexibility, feasibility, innovation and entrepreneurship.

The evaluators were given a seven-day period to return the validation instrument. Prototyping validation and the considerations made by the evaluators, as well as a score higher than four, were considered relevant for the possible implementation of the app.

Using the Delphi technique, the evaluators assessed each of the 18 items of the instrument, based on numerical values, as follows: (1) unimportant; (2) little important; (3) relatively important; (4) important; and (5) very important.

In the analysis by the evaluators, the validation instrument was returned with significant suggestions for the (re)adaptation of some items of the app prototype's dimensions. The evaluators were in agreement regarding the feasibility and confidentiality dimensions.

In the "*as formas de pagamento serão através de cartão de crédito*" ("the forms of payment will be by credit card") item, it was suggested to include "*disponibilização de outras formas de pagamento*" ("availability of other forms of payment"), as not all people have a credit card. Slips, deposits and transfers would be among the options. Two evaluators suggested that the service fees were accessible and that there was the possibility that they might also be free, eventually. It was decided to offer free availability of the services related to the information on the app's page and the fees for the consultations, according to the price table of the acting professional. For this purpose, credit card, bank slip and pix (bank transfer) can be used. It is noteworthy that the services provided up to the present day were all free and will continue in this modality until the end of 2021.

In relation to confidentiality, in the "*a tecnologia corresponde às normas ético-legais dos Conselhos profissionais*" ("the technology corresponds to the ethical-legal norms of the Professional Councils") item, the evaluators reported doubts regarding the (non)existence of a resolution that regulates the legality of using apps for teleconsultations. According to Technical Opinion No. 10/2016, for being a set of actions performed by nurses in an orderly and systematized manner, the Nursing consultation cannot be performed remotely. However, after a prior face-to-face Nursing consultation and in agreement with the user/family member/caregiver, forwarding of images, data and videos by electronic means is authorized. The complementary data ensure continuity and follow-up of the users, by diagnosing their needs and (re)scheduling the next appointment in the short-, medium- or long-term[14].

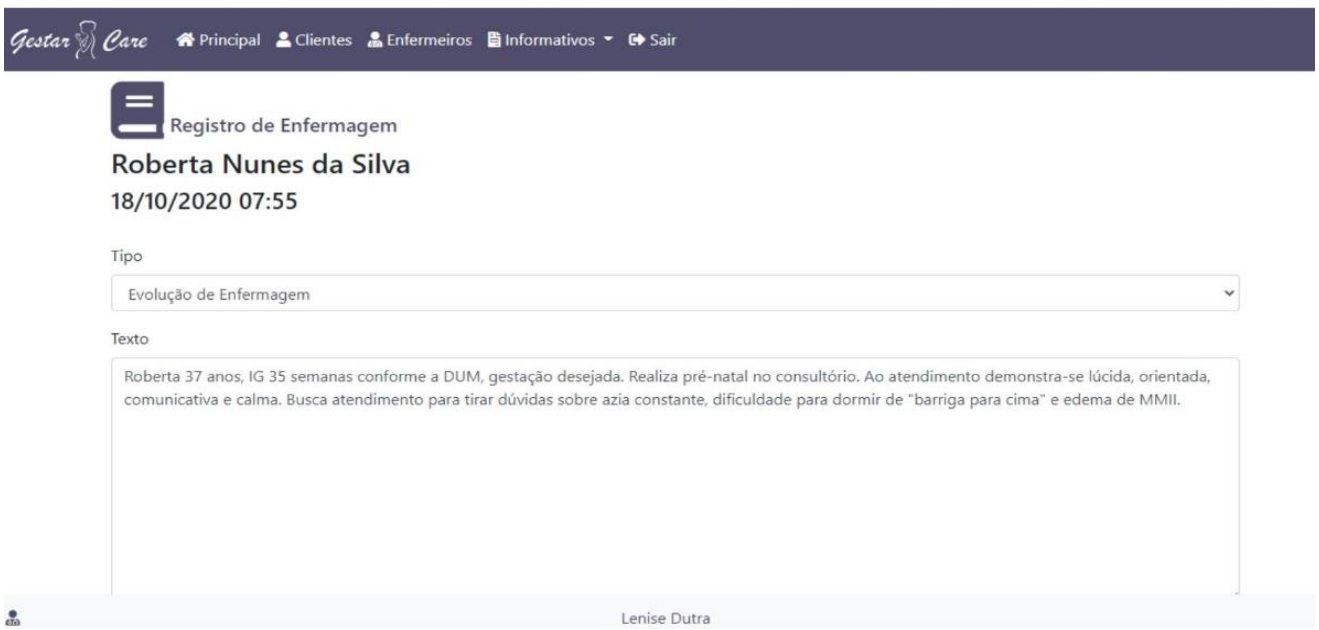
In relation to the agreement percentage among the evaluators, the following classification was obtained: in the functionality dimension, 99%; in the confidentiality and accessibility dimension, 100%; and, in the feasibility dimension, 85% and 100% agreement in the first and second Delphi rounds, respectively, considering a Likert score between 4 and 5 points. In the innovation dimension, 100% agreement was obtained in the first round. Thus, the technology could be considered functional, accessible, reliable, feasible and innovative and, thus, enable implementation of the app for the monitoring pregnant and puerperal women.

Stage IV: Development and implementation of the app in its online version. For development of the app, partnerships were established with a professional from the Information Systems area and with the technology department of the Franciscan University. Thus, during the second half of 2018, planning meetings were held between the researchers and the system programmer. The meeting dealt with the app's characteristics and the resources to be introduced, considering reliability of the information, functionality, accessibility,

feasibility, technological innovation and the benefits for the population.

It was decided to develop the multi-platform web app using free technologies compatible with computers and mobile devices (Android and iOS). The main methodologies and technologies employed to create the app were the following: SCRUM - Agile methodology for the management and planning of software projects; TRELLO - Online app to apply the SCRUM's disciplines; PYTHON - A programming language; DJANGO FRAMEWORK - A set of tools and practices that facilitate the development of web apps using the Python programming language; BOOTSTRAP - A set of visual components that provide better usability and experience to the user, in addition to allowing for the automatic adaptation of the system's screens according to the size of the access device (PC, Smartphone or Tablet); MYSQL - A database to store the records captured via the app; and LINUX SERVER - A server that hosts the app in the cloud and allows users (clients/administrators/nurses) to access it from anywhere via the Internet. The server in question is hired from a private company (Digital Ocean – Located in the USA) and was provided by the proposing institution.

The app screens were designed and developed in an original and accessible manner, as well as with pleasing and attractive visual aspects. The illustrative screens for the professionals' access are presented below, when opening and recording the service (Figure 2).



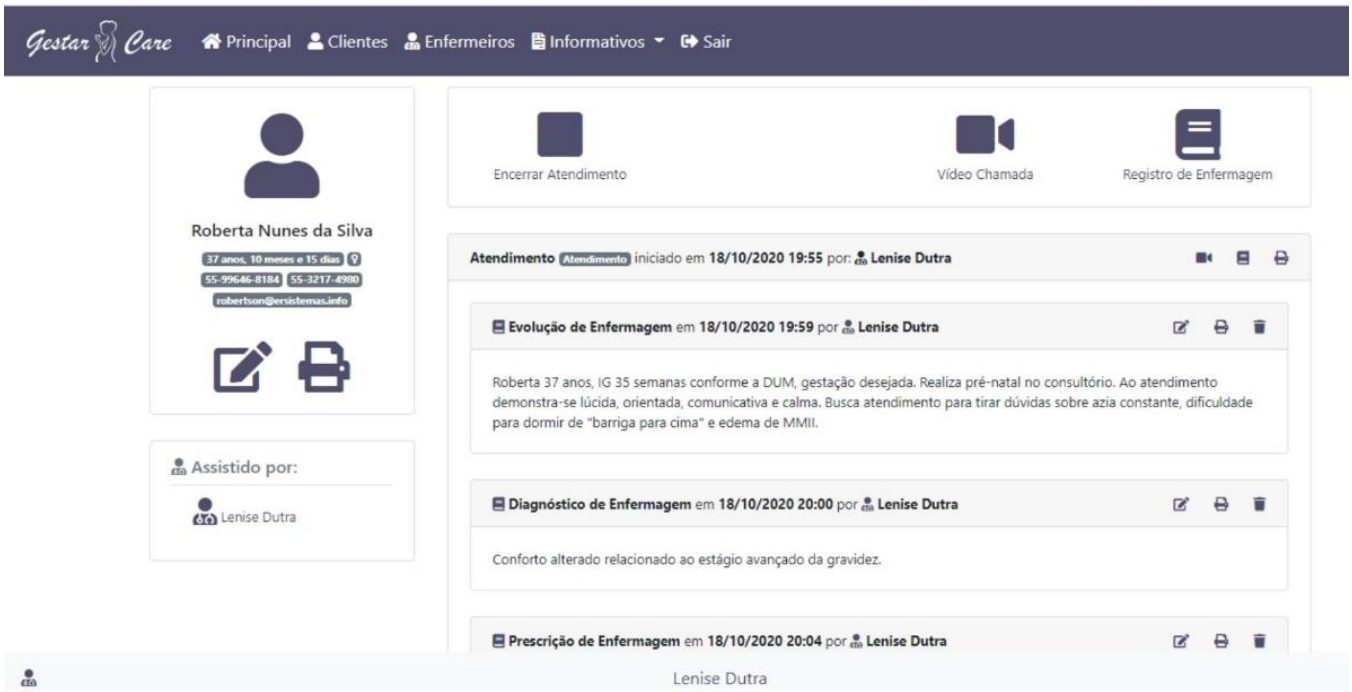


Figure 2 - Illustrative screens of the professionals when they open and record the service
Source: Elaborated by the authors, 2018.

The last stage was characterized by registration of the app at the National Institute of Industrial Property (*Instituto Nacional de Propriedade Industrial*, INPI) under Code BR512019 002855-4. The *Gestar Care*® app is still running and providing appointments free of charge, as already mentioned. To date, no evaluations have been carried out, considering the period of adjustments and adaptations recommended by the users. However, there are informal reports from users recorded on their social networks, in which they show their personal satisfaction with the service received.

DISCUSSION

The path from conception to validation and implementation of the *Gestar Care*® app evidenced that the device can be considered functional, accessible, reliable, feasible and innovative, especially in pandemic periods when social distancing is highly advisable. In addition to that, the device contributed to professionalizing the appointments and the monitoring of pregnant and puerperal women, as this process had been taking place informally.

A previous study shows that 62.5% of the health professionals used WhatsApp® as an alternative to communicate with their patients[15]. Another similar study evidenced that 87% of the professionals communicated with the users through the same method[16]. The first study denoted, although superficially, the trivialization of medical services and appointments. Under this approach, through the *Gestar Care*® app, this study aims at professionalizing the appointments through a programmable and paid operating system.

While the health professional is rewarded for the appointment provided, the user makes the payment according to the service received, through compatible and accessible prices for the consumer.

Unlike other apps, *Gestar Care*® can store the electronic medical charts, in which each service provided is recorded by such professional, in the format of evolution, diagnosis or prescription. At the end of the professional appointment and respecting the legal criteria, the medical chart will no longer be editable. In this sense, a number of studies show that one of the disadvantages and legal limitations found among the health professionals who offer online appointments is related to the impossibility of recording the care provided in medical charts[17-18].

Online service through *Gestar Care*® enables interaction between health professionals and users, through video calls and text messages, in addition to sending photographs and videos. The efficacy of these alternatives can be confirmed in another study, which evidences that 60% and 26% of the health professionals showed greater interest and interactivity with the users through video calls and telephone calls, respectively[19].

The advantages of online monitoring become even more assertive in the puerperal period, a time when most women require support in the breastfeeding process and in care with the infant, especially in situations where there is no social support network. However, a study shows the lack of technological devices that assist puerperal women in terms of emotional support and other personal needs or with the newborn[18].

A systematic review, in particular, analyzed apps focused on prenatal care and evidenced an important technological weakness in this specific area, especially with regard to a systemic and wide-ranging approach. Under this approach, the study concluded that, although they are of great relevance, the vast majority of the apps were unavailable to the general population[19].

An app developed in Italy, focused on prenatal care in underserved communities, exerted a promising impact on minimizing the medical costs, although it did not impact quality of care. The app in question allows including information about personal data, health history, screening and access to education in health information and guidelines in the delivery plan. Although the app provides information and guidelines after assistance by a reference team, it does not provide online consultations[20].

In relation to the user-professional-health system link, a study[19] shows that this is a complex process in the development and functionality of an app, due to the different cultural and care perspectives in the area of maternal and neonatal health. It also shows that these devices are tools with added social and economic value, but that they are not capable of solving real weaknesses due to discontinuity and fragmentation in the health systems.

Nevertheless, other studies show optimism regarding advancement of the apps, mainly with regard to individualized and user-centered

care, especially in more remote realities. In this same direction, special emphasis was attributed to the value and advancement of Telemedicine in the pandemic period caused by COVID-19, in which online connections, in the different areas, took shape and expanded their repercussion and impacts on people's, families' and communities' lives[18-20].

As a limitation of this study, the (inter)dependence of professionals belonging to other knowledge areas from conception to development of the app is considered, taking into account that the ideas were not always apprehended and incorporated in their original form. On the other hand, this technological study was a driver for new inter-professional partnerships and allowed for interdisciplinary action, which is so necessary for a broader understanding of the health phenomenon.

This study is expected to arouse the interest of Nursing professionals and other health professionals for the development of new digital technologies, capable of contributing to the universalization of access to health and to the improvement of quality of care, especially in the area ofmaternal and child health.

CONCLUSION

The mobile device presents itself as a technological tool with easy, fast and safe access, as well as an important ally in the virtual care to pregnant and puerperal women, minimizing exposure and waiting time in emergency services and professional offices.

The web app has also expanded the users' adherence to the prenatal, childcare and postpartum consultations and enabled a new space for the nurses' professional practice, with more autonomy, resoluteness, recognition and professional valuation.

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