

How Design Can Impact the Performance of a Healthcare Application, Affect Users' Decisions and Contribute to Patient's Well-Being: A Scoping Review Protocol.

Jose George Dias de Souza (✉ jose.george@aluno.uepb.edu.br)

Universidade Estadual da Paraiba <https://orcid.org/0000-0002-3338-558X>

Frederico M. Bublitz

Universidade Estadual da Paraiba

Daniel Scherer

Universidade Estadual da Paraiba

Protocol

Keywords: scoping review, design, architecture, software, performance, health usability, human factor

Posted Date: November 12th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-104157/v1>

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Abstract

Background: Pregnancy is an important phase in a woman's life, the gestational period however is accompanied by fears and apprehension, especially for women who are experiencing this phase for the first time. Prenatal care is essential to prevent diseases and reduce risk for pregnant women, thus enabling healthy development for the baby. Nowadays many women find it difficult to make an adequate prenatal care, for the most varied reasons. Taking into account that the world is increasingly connected to the internet, it is important to understand, analyzing a set of health applications, which are the best decisions from the design point of view, usability to become a useful application for pregnant women, another relevant point is to understand how the architecture of these solutions were designed to be scalable. Thus, a well-defined systematic review is needed to identify the impacts of architectural, design and performance decisions on health applications, reducing risks and minimizing human errors.

Methods/Design: This study will follow a well-defined methodological structure. The methodology is separated into the following sections: Research question identification; Extraction of relevant studies; Selection criteria; Charting the data; Collating, summarizing, and reporting the results. The research question aims to analyze the approaches used to build health applications aiming at design decisions, architecture and the impacts that are generated for the end user. The researchers will use the following electronic databases for data extraction: PubMed (Medline); IEEE Xplore Digital Library; ACM Digital Library; Web of Science; and Scopus Document Search. The search for research will consist of a set of terms and keywords.

Discussion: This work has the interest of presenting a model, a standard, a guide for creating a health software interface, always aiming at the quality of the interface, the user experience and the possible gain with the performance of the application, considering that users will have more security to make decisions.

Systematic review registration: Submitted on October 11, 2020 Open Science Framework.

Background

Pregnancy is an important stage in a woman's life, the gestational period, however, is accompanied by fears and apprehension, especially for women who are experiencing this phase for the first time. During pregnancy, women face several physiological changes [1] as well as psychological changes [2].

Prenatal care is essential to prevent diseases and reduce risk for pregnant women, thus enabling healthy development for the baby. Human support is also essential to ensure better effectiveness. Some studies have already proven that partner support brings greater psychological well-being to women in high- and low-risk pregnancies [3].

Currently, many researches use technologies applied to health and patient monitoring, more specifically in the area that involves pregnancy, many researchers focus on developing mobile and web applications [4] [5] to monitor and guide pregnant women during the prenatal period.

For any software and above all critical applications such as healthcare systems, usability is essential to minimize human errors and guarantee efficiency, effectiveness and user satisfaction, as used by researchers in Thailand [6] in the construction of a service for health. Good design allows users to make important decisions with more confidence. Another important aspect is to understand the relationship between the performance of the interface, with the design and architecture. The back-end of an application needs to respond quickly to requests from the front-end, a poorly designed software architecture has negative effects for users who expect quick responses to every action made on the screen, whether in web or mobile applications.

In the literature it is possible to find several researches focused on the development of applications for pregnancy, like Jakpros, a mobile application focused on educating women, the application brings information about health during pregnancy on themes of prenatal, perinatal, postnatal and reproductive health [7]. In this sense, it is necessary to understand, analyzing a set of health applications, which are the best decisions from the design point of view, usability to be taken, another relevant point is to understand how the architecture of these solutions were designed to be scalable.

In the development of an application, whether web or mobile, it is not always easy to decide which technologies will be used. In this sense, it is necessary to make a detailed survey of the problem scenario in which that application is inserted. researchers use and for what reasons for the development of health applications.

Thus, a well-defined systematic review is needed to identify the impacts of architectural, design and performance decisions on health applications, reducing risks and minimizing human errors [12], which is a major cause of death in the USA [11]. Furthermore, it is important to rely on user experience concepts.

Methods

This work is about presenting a protocol for a systematic review and will follow a well-defined structure. The methodology of Levac et al. [10]. The research is developed in six stages: 1) identifying the research question; 2) identifying relevant studies; 3) study selection; 4) charting the data; 5) collating, summarizing, and reporting the results; and 6) consultation (optional).

Research question identification

Currently, most mobile applications for health are focused on pregnancy and women [9], so it is important to note how usability and design can generate better results for these applications. Thus, the main focus of this work is to understand the various ways in which usability and a design is directly related to the performance of a health application and how it can be useful to positively impact users' decisions, in addition the possibility of construction of a protocol containing: architectural model to be followed, heuristics and usability based on user experience to achieve good results in health applications:

- Motivation: What decisions were made to solve design problems, which decisions were effective and how this can impact performance, which architectural model (back-end) was used to meet the needs of the “client” side of the application and for what reasons.
- Stakeholders: Who is directly involved with the pregnancy process. What is the profile of users who will use the software. The design was designed focused on the user. The architecture is modern and scalable. What are the impacts and benefits of the solution.
- Benefits: Each user has a different level of knowledge about a system, so it is necessary to establish an efficient design that suits users. Therefore, it is necessary to understand how the systems deal with this issue.
- Domain: The projected design is capable of handling different domains, imagining a mobile application scenario, users can use it at any time from any location. If there are restrictions in this regard, they should be noted.
- Approach: What was the approach used to develop the application design, which programming paradigm was used, which architectural model was chosen, which usability concepts were applied and for what reasons.
- Governance: There is security for the application data. In healthcare applications, it is critical that data is safe, consistent and available.

Extraction of relevant studies

This systematic review will be guided by electronic databases. All extracted studies were taken from the following databases: PubMed (Medline); IEEE Xplore Digital Library; ACM Digital Library; Web of Science; and Scopus Document Search. The choice for these databases was due to the fact that they are bases with a large number of scientific researches related to the field of computer science and health.

The researchers involved in this systematic review have strong knowledge in computer science, mobile and web development, usability and human factors, design, software architecture and software engineering. For this review, several keywords were tested during some search rounds in different databases, in order to arrive at a search string suitable for the search. Some words were initially considered in the search, such as: “Easy-to-use” however we realized that the word although useful for the search could be exchanged for Human Factor, at the end of the tests we reached the following search string: ("Human Error*" OR "Human Factor*" OR "user error") AND ("*Health*" OR "patient well-being" or "health and wellness*") AND ((*performance*" AND "*design*") OR "*architecture*").

Selection criteria

The purpose of this systematic review is to provide a comprehensive understanding of how researchers around the world are developing applications for health in a safe, efficient and effective way. In the medical context, terms used inappropriately can generate confusion and, therefore, the importance of standardizing a design and language is necessary, care with this standardization has already been observed by other researchers [9] who proposed an application mobile for pregnant women in a linguistic

community diversified. As the concepts of usability, user experience, design, performance and architecture are important to ensure that users get a pleasant experience and make decisions safely.

Initially, as in any systematic review, it is necessary to define points of acceptance (INC) and rejection (EXC) of research. Therefore, some issues for inclusion and exclusion were raised, these points were properly discussed among the researchers and analyzed. Based on this, it was only then that they discussed which INC and EXC points would be adopted for the review. One of the most important points for the acceptance of the research is that the work is software, be it web or mobile and is directly related to the health area, good works were found that were not directly related to health and that is why we decided not to consider in this review. Below are the acceptance points:

- INC.01: The article addresses a solution, technical or methodological that relates architecture, design and usability of an application.
- INC.02: The article must be written in English.
- INC.03: The article must be from the last 5 years.
- INC.04: This is a primary or secondary study.
- INC.05: Article is available for access.
- INC.06: The study is aimed at solving a problem related to a medical product for health.

During the extraction of the articles in the chosen bases, it was verified that there was a number of works considered that involved the terms used in the search string. For the sake of viability, it was decided to limit the results, so the works published in the last five years were selected. Then the rejection terms (EXC) will be presented:

- EXC.01: Do not meet any of the acceptance criteria described above.
- EXC.02: Duplicate article.
- EXC.03: The study is not directly focused on health.
- EXC.04: Studies that do not address any specific point related to software engineering, be it elicitation, specification and/or modeling of software requirements.
- It presents some usability technique to solve a design or performance problem.

After considering all the acceptance and rejection criteria described above, the articles were then screened. At that moment, a quick reading of the summary and introduction was carried out and the classification of studies with greater affinity with the theme researched at this stage was not considered.

Charting the data

This step of the systematic review will be based on the use of several resources, a database will be used with the collection of studies extracted from the bases used: ACM, Scopus, PubMed, IEEE and Web Of Science, as well as spreadsheets and graphs will be used to better view the results. Relevant information

about each article will be filled in forms, such as: title, author (s), year of publication, country, institution of the researchers and results.

For accepted studies, more details will be raised, it will be necessary to explain the study information, objectives, methods used, results, impacts and results. For each study, the strengths, limitations and possible failures will be named.

Collating, summarizing, and reporting the results

Following the recommendations of Levac et al. [10] this stage will consist of the following phases:

- **Analysis:** For this stage, the studies will be analyzed and classified into three categories: Strongly aligned (1), aligned (2) or weak (3). Points will be raised based on the bibliography of the studies. Strongly aligned studies are those that are described with solid bases and concepts, where the authors analyzed the risks and impacts of the solutions. The aligned ones are the studies where some knowledge was used to mitigate a design and performance solution but its impacts were not listed and the studies classified as weak are the studies where the researchers did not apply concepts of usability, user experience and design to build your applications.
- **Reports:** The intention is to generate reports containing graphics, analysis with positive and negative points of each study. The results will be structured for later publication in a scientific conference.
- **Implications:** The intention is to support future research with greater technical support as a guide to good practices for building health system interfaces.

Patient and Public Involvement

Patients and or public were not involved.

Discussion

This work has the interest of presenting a model, a pattern, a guide for creating a user interface. software for health, always aiming at the quality of the interface, the user experience and the possible gain with the performance of the application, considering that users will have more security to make decisions. It is still important to note that the architectural decisions of an application will also be taken into account for the development of this guide.

Based on this information, it will be easier to identify gaps in future projects, including the correction of these gaps. This study is also expected to serve as a basis to support future government projects, taking into account that in Brazil the largest health plan is public and administered by the Ministry of Health.

Abbreviations

PRISMA-P: Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols.

PROSPERO: International Prospective Register of Systematic Reviews.

Declarations

Consent for publication

The authors declare no conflict of interest.

Funding

This research received no specific grant from any funding agency in public, commercial or not-for-profit sectors.

Ethical Approval and Consent to participate

This is a scoping review study and there is no requirement for ethical approval, as primary data will not be collected. The results from this scoping review will be published in a peer-reviewed journal and reported at scientific meetings. The aim of this study is to share the results of a systematic review to support other researchers in the development of future research in the area of health, but precisely in the field of usability and software architecture.

AUTHOR CONTRIBUTIONS

For this work, the author José George Dias de Souza elaborated the conceptualization, writing and methodology with the support of Frederico M. Bublitz and Daniel Scherer. Review and editing by Daniel Scherer.

Acknowledgements

The review team gives recognition to Dr. Daniel Scherer.

Availability of supporting data

At the time of submission, we have not yet created a web link to make the data available.

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