

Mobile Application for Healthy Maternal Behavior to Reduce Fetal Mortality

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Abstract

Timely health care delivery is often based on solutions that provide informational assistance and support. The scope of mobile application in medicine is quite wide and relevant, which allows you to comply with the indicated principles and provisions in the field of health care for the preservation of health. Various factors and IT solutions were identified in order to provide various methods of informational support during pregnancy to a woman. One of the reasons for the study is the early prediction of risks based on attention deficit and the probabilistic manifestation of an event of a worsening of a positive state. The results of the analysis of modern mobile applications and systems made it possible to determine the priorities of functionality for the majority of users. In accordance with the requirements and rules defined for the medical organizations of the Republic of Kazakhstan, a mobile application was developed in order to reduce the risk during pregnancy and maintain a positive emotional state. The use of methods of closed analysis, risk assessment methods, methods for determining the emotional state, as well as methods for determining the relationship when monitoring the pregnancy process opens up wide opportunities for developing a model and structure of an application with improved functionality and characteristics.

Keywords

expert system, mobile application, mortality prediction, national health system, pregnancy risk, pregnant women

1. Introduction

Information technologies are being actively implemented in various spheres of life, including healthcare, which leads to a radical change in the quality of life of people. The relevance of mobile applications in the field of medicine is confirmed and in this regard, it was decided to develop an application to support the pregnancy process. Now in our time we are witnessing that the growth of mobile applications, as well as their popularity has increased. But pregnancy is a process that needs precision, data quality, collaboration with healthcare professionals, etc. If the information is not verified, it can lead to danger [1].

The infant mortality rate in 2019 increased by 5.9 per cent and amounted to 8.4 cases (per 1000 births). The reasons are:

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- diseases of the perinatal period (hypoxia, asphyxia, birth trauma, intrauterine infection);
- congenital malformations;
- respiratory diseases;
- infectious diseases.

Various kinds of problems can arise with women during pregnancy. Another problem is ectopic pregnancy. This problem also requires the development of a support system for women using effective algorithms that provide high accuracy, so that gynecologists have the opportunity for early detection, initial treatment and avoidance of complications in the future [2].

And now there is the problem of the competence of medical staff in the field of e-health. To improve their competent work, motivation from colleagues, social support, monitoring of emotions, encouragement, empathy is needed, which will make changes in their work and improve their competence [3], [4].

A study on the long-term use of mobile applications in healthcare was examined, and the results showed that the most important factors for continued user use are usefulness of information, trust, quality of doctor's services and information, reputation of the application, and privacy enhances the influence of perception and trust in this application. Indeed, in our time, more and more mobile applications are being created in the field of healthcare, which indicates the technological development of the market, as well as the need for their introduction into the system. Use of the applications by healthcare professionals, when they were surveyed, showed positive interactions, and is considered timely and achievable [5], [6], [7], [8].

Also there is a study conducted among women in Iran, who use mobile application as an educational platform, it turned out that it improves the knowledge of pregnant women, which helps early detection of various kinds of disease and its treatment or reduction of adverse consequences [9], [10].

The work on the creation of methods for the rules of logical elements LERM (Logical Elements Rule Method) was studied, a technique for assessing and formalizing medical regulations for choice support, that is, in order to select the most suitable recommendations, it will be possible to use this method, it is useful for systems developers like us when making decisions based on clinical rules, which describes 7 steps, it is convenient and reliable in use: 1. formulate the rule in advance, 2. reformulate the rule in a logical way, 3. evaluate the conflict between them, 4. identify unnecessary points, 5. classify unnecessary elements into clear and fuzzy and exclude fuzzy ones, 6. define the general rules that are associated in sharing, 7. determine the availability of data in local systems [11].

Such consequences prompted us to develop a mobile application for women in Kazakhstan in order to prevent infant mortality in the country.

The project's main objective is to provide a single countrywide platform for pregnancy counseling and advice. The following are the main components of the pregnancy support system: 1. Public support: health experts, dieticians, and pregnancy guidelines 2. Health-care systems at the regional and state levels are interested in supporting socially disadvantaged people.

In addition objective of the study is to develop a comprehensive universal model of the system. We've identified the essential components, application and system functions, as well as the advantages of creating a new system model and then a mobile application.

What real-world problems does the app solve? It aids in quick communication and quality engagement with health-care providers, as well as saving time through thorough videos. It offers the public with accurate medical information while adhering to all standards and regulations.

2. Related Work

In the process of analyzing and collecting data, 4 mobile applications often used by pregnant women were identified:

1. Pregnancy + is one of the popular apps. It has control over changes in weight, contractions, provides basic information during pregnancy, namely educational posts, a to-do list, a shopping list and a calendar [12].
2. Pregnancy Tracker + Countdown to Baby Due Date - also has basic medical information, a calendar of other women, you can share your data, advice, information [13].
3. What to Expect Pregnancy Tracker is also an informative application where users can read publications of medical specialists and only in English, namely recommendations and advice for expectant mothers and fathers [14].
4. Contraction counter - an application that tracks contractions. There you can record the number of contractions and its time, frequency, and intensity. Helps during preparation for childbirth [15].

Obstetric telemonitoring is an urgent area today, as it helps to improve gestational outcome, to identify various complications earlier, prevent additional interventions, and provide local intervention before hospitalization. That is, collect complete obstetric parameters that will be integrated with information in the prenatal and postnatal periods [16].

This project also has similarities with another project that was developed and experimented by medical staff in Saudi Arabia, where an experiment was carried out first to identify the scope of work of medical staff, after which all competent medical staff had to classify them according to their importance. This method allows you to determine the necessary obligations for doctors in order to save their time, as well as to simplify and quickly accompany the patient without any paperwork. And as the analysis showed, it was found that paper recommendations are less perceived by patients than verbal recommendations from the doctors, which shows the importance of connection, namely, a live connection between doctors and patients [17], [18], [19].

And also for the recommendation of tablets, medicines regarding the condition of each pregnant woman requires a lot of attention. After all, it is important to control drug interactions if there is a risk when taking the drug [20]. Between January 2014 and June 2018, searches in the Pubmed / Medline database yielded 235 results, while searches in the Google Scholar database yielded 7,840 articles and 422 applications. After a preliminary review of the annotations of articles and / or product descriptions, 8,483 data sources were removed, leaving 14 requests for further study. Five were excluded because they did not meet the admission criteria [21]. In consideration of providing the public with reliable and quality information on these topics should be a priority for national health authorities, these results suggest that national health authorities should take action to try to better position their content [22].

The rules for clinical prediction were considered, which showed on the basis of interviews and surveys, 3 high-level topics were identified - usefulness, reliability and usability. That is, the connection between developers and medical staff is important here, in order to add the necessary or exclude useless data and functionality. It is also important to conduct testing among the patients themselves, so that they can identify the convenience and inconvenience of using this application, and hear their opinions too [23], [24], [25], [26].

3. Proposed Structure

Tasks were set for the main elements of the system, such as:

1. Encouragement of medical workers and health care workers for the allotted time and consultation, contributing to the preservation of the life and emotional state of pregnant women.
2. The use of modern IT-tools for the development of a consulting and reference system available to everyone online.
3. The use of IT tools for the implementation of global tasks in the field of healthcare, including indicators of social motivation.
4. Notification and proper consultation of pregnant women, as well as psychological support and monitoring of their condition.
5. Training of new specialists on the basis of practice thanks to this system, which makes it possible to analyze the history during pregnancy.

The structure of the system looks like in Fig 1. The application is created in two formats: a web version for doctors and a mobile version for patients. Both versions send a request to the Database Management System and receive the required response. The web version is responsive. The mobile version will be developed on the Android operating system, and in the future it is planned to repeat it on the iOS operating system.

The application simplifies communication with the doctor, makes it possible to maintain proper and healthy nutrition for both the mother and the baby, to maintain physical activity and the emotional state of the mother. Women will receive reliable recommendations, which have been confirmed by the Ministry of Health of the Republic of Kazakhstan. And also have the main following functionality:

- Chat with a doctor + speech recognition is a function that performs the work of a messenger, namely, the connection between a patient and a doctor. A woman can ask any questions about pregnancy that interest her in russian or kazakh.
- Geolocation - Tracking the patient's geolocation data to save time in an emergency.
- An emergency call is a direct call to a doctor, which also includes an emergency notification of a pregnant woman's family and friends.
- Medical record - a questionnaire and a patient's medical record, which stores the patient's personal data (name, surname, patronymic, IIN, telephone number, residence address, contact details of relatives, 3x4 photo, information about the patient's condition - information from the medical card from the clinic).

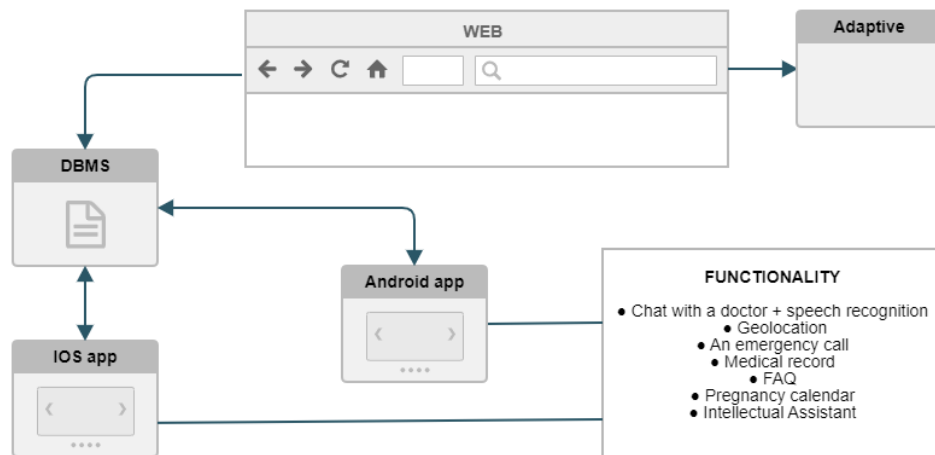


Figure 1: Structure of mobile application

- FAQ - frequently asked questions and answers to them.
- Pregnancy calendar - detailed information about the development of the baby for each period of pregnancy [27].
- Intellectual Assistant - for voice search of an answer.

4. Discussion

Everyone knows that during the pandemic, little attention was paid to pregnant women, therefore, maternal and infant mortality in Kazakhstan has become more frequent. And according to literary reviews made over the past 10 years, there has been little research in this direction. For example, the infant mortality rate in Kazakhstan in 2020 is 7.79 cases (per 1000 births) [28]. Because of this, it can be considered that maintaining the pregnancy process is a very important and relevant topic today.

The novelty of this application lies in the addition and implementation of new functionalities that were not available in the analysis of other applications, such as: chat with a doctor + speech recognition, geolocation, an emergency call, intellectual assistant. This is the advantage and new capabilities of this mobile application, because a pregnant woman can ask a question directly to the doctor both in writing and by voice via speech recognition in Kazakh and Russian, share geolocation or use an emergency call to get emergency help. And also perform a voice search for frequently asked questions.

5. Results

A literature review of similar articles was conducted, and useful points and steps were taken in creating an application.

Name of mobile application	pregnancy calendar	forum of pregnant women	useful information	list in the hospital	reminder	woman weight	gestational age	media files	schedule of visits to the doctor
Sprout Pregnancy	+	-	-	+	+	+	-	-	+
Full Term – Contraction Time	-	-	+	-	-	-	-	-	-
Ovia	+	+	+	-	-	+	+	-	+
Baby2Body	-	+	+	-	-	-	-	-	-
Glow Nurture	+	+	+	-	+	+	-	+	+
Hello Belly	-	-	+	+	-	-	-	-	-
Pregnancy Tracker: Baby Bun	+	-	+	+	-	-	+	+	-
Stork	+	-	+	+	-	-	+	+	-
Pregnancy+	+	-	+	+	-	+	+	-	-
АММА. Моя беременность	+	-	+	-	-	+	+	-	+
Mom Life Pregnancy Tracker	+	+	+	-	-	+	+	-	-
BabyChakra	+	+	+	+	-	-	-	-	-
Pregnancy Due Date Tracker	+	-	+	+	+	-	+	-	+
Беременность, роды, раз	+	-	+	+	-	+	+	-	+
Календарь беременности	+	-	+	-	-	+	+	-	-
Glow Baby	+	+	+	-	+	-	+	+	-
Baby Connect	-	-	+	-	-	-	+	+	+
Я беременна Lite	+	+	+	-	+	-	+	-	-
Беременность Зачатие и	+	-	+	+	-	-	-	-	-
Бэби +	+	-	+	-	+	+	+	+	+
Беременность и роды.	+	-	+	+	-	-	-	+	-
Мамлайф	+	+	+	+	+	+	+	+	+
Sound Sleeper: Белый Шум	-	-	+	-	-	-	-	+	-
Грудное вскармливание	-	-	+	-	+	-	+	+	-
Клуб для беременных и к	-	+	-	-	-	-	-	+	-
КАЛЕНДАРЬ БЕРЕМЕНН	+	-	+	-	-	+	+	+	-
Овуляция и беременность	+	+	+	-	-	+	+	+	+
SuperMom	+	-	+	-	+	+	+	+	+
Беременность	+	-	+	+	-	+	+	-	+

Figure 2: Classification of mobile applications. Part1

An analysis of mobile applications and systems for supporting the pregnancy process was carried out, namely, their functionality, relevant modules and their classification.

The result of the literature review is that this is the scientific base for the last 10 years. An analysis of the functionality, applications and systems has been identified and made, which will be the basis for the development or design of similar systems.

The results of the analysis of the functionality of applications and systems of more than 30 existing today since 2011. The main functionality has been identified, that is, classified into 18 categories (pregnancy calendar, forum of pregnant women, useful information, list in the hospital, reminder, woman weight, gestational age, media files, schedule of visits to the doctor, illustrations, baby name, share info in social network, to-do-list, impact counter, fight timer, video recommendations, chat with a doctor, reviews about other hospitals and doctors) for which applications and systems have been developed (Fig. 2). The result is 10 applications out of 30 have 50 percent of all categories of functionality. This means that only 33 percent of

Name of mobile application	pregnancy calendar	forum of pregnant women	useful information	list in the hospital	reminder	woman weight	gestational age	media files	schedule of visits to the doctor
Sprout Pregnancy	+	-	-	+	+	+	-	-	+
Full Term – Contraction Time	-	-	+	-	-	-	-	-	-
Ovia	+	+	+	-	-	+	+	-	+
Baby2Body	-	+	+	-	-	-	-	-	-
Glow Nurture	+	+	+	-	+	+	-	+	+
Hello Belly	-	-	+	+	-	-	-	-	-
Pregnancy Tracker: Baby Bun	+	-	+	+	-	-	+	+	-
Stork	+	-	+	+	-	-	+	+	-
Pregnancy+	+	-	+	+	-	+	+	-	-
АММА. Моя беременность	+	-	+	-	-	+	+	-	+
Mom Life Pregnancy Tracker	+	+	+	-	-	+	+	-	-
BabyChakra	+	+	+	+	-	-	-	-	-
Pregnancy Due Date Tracker	+	-	+	+	+	-	+	-	+
Беременность, роды, раз	+	-	+	+	-	+	+	-	+
Календарь беременности	+	-	+	-	-	+	+	-	-
Glow Baby	+	+	+	-	+	-	+	+	-
Baby Connect	-	-	+	-	-	-	+	+	+
Я беременна Lite	+	+	+	-	+	-	+	-	-
Беременность Зачатие и	+	-	+	+	-	-	-	-	-
Бэби +	+	-	+	-	+	+	+	+	+
Беременность и роды.	+	-	+	+	-	-	-	+	-
Мамлайф	+	+	+	+	+	+	+	+	+
Sound Sleeper: Белый Шум	-	-	+	-	-	-	-	+	-
Грудное вскармливание	-	-	+	-	+	-	+	+	-
Клуб для беременных и к	-	+	-	-	-	-	-	+	-
КАЛЕНДАРЬ БЕРЕМЕНН	+	-	+	-	-	+	+	+	-
Овуляция и беременность	+	+	+	-	-	+	+	+	+
SuperMom	+	-	+	-	+	+	+	+	+
Беременность	+	-	+	+	-	+	+	-	+

Figure 3: Classification of mobile applications. Part2

applications have the maximum amount of functionality. In the result of this research there were taken a copyright certificate for general software, and for extended software functionality from the National Institute of Intellectual Property, Kazakhstan, May 17, 2021, No.17582.

6. Conclusion

In fact, it is very important to move to digital health, as it provides analytical information data in different areas of health, using data standards, as well as simplifying all the operations and actions performed [29], [30].

To date, research is being carried out to build a full-fledged universal model of the system. We define the main parameters, advantages for creating a new system model and then the implementation of a mobile application. This study has not yet been completed and is at the stage of completing the milestones. In the future, to monetize this project, it will be possible to

implement boxes where there will be 32 products that doctors recommend to every woman, this will simplify their care and is beneficial for both the patient and doctors, that is, they can be purchased immediately from medical centers. This will make this application active, since the activity is the problem of modern mobile applications in Kazakhstan.

The analysis of software applications, systems and algorithms provides a good opportunity for developers, researchers and analysts to conduct deeper and more detailed research on this topic and present new opportunities, solutions, methods for qualitative analysis and application of promising technologies in the development of applications and systems.

We see that due to the development of infocomm technologies, mobile applications and systems in the field of advice and accompanied by complex technological life processes, social networks are now frequently used, software applications and systems with the results of preliminary analysis and forecasting for improving the well-being of society, citizens, organization of work, events and leisure work. Today mobile applications have a positive impact and help users. Therefore, the research work is relevant and have a great importance in Kazakhstan.

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