

Evaluation of Gynecology Patient-Oriented Free Mobile Android Medical Apps

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Abstract

Introduction: Women's lives have always been marked by numerous questions and anxieties related to their reproductive system. Smartphones have contributed significantly to the development of and progress in modern medicine. At this moment, mobile medical applications in the field of gynecology offer quick and easy access to information about women's reproductive health, starting with puberty and ending with late menopause. *Aim:* The purpose of this study was to identify mobile applications in the field of gynecology that provide correct, easy to understand and evidence-based medical information. *Materials and methods:* The study took place between July 1-20, 2021. A search was carried out on the "Google Play" webpage using the keywords: pregnancy, fertility, ovulation, and menstrual cycle. Only applications in English were considered eligible. Each application was evaluated according to its general characteristics (country of origin/ranking/download count). We also evaluated six specific criteria for each individual application: interactivity, functionality, aesthetics, contents, benefits, and evidence-based aspects. *Results:* Eighty-five applications available on "Google Play" were selected and described. The extracted applications could be easily used by both patients and gynecologists. All analyzed applications were evaluated with almost the maximum score for interactivity, functionality, aesthetics, content, and benefits. None of the applications offered sufficient details to prove that the information provided was based on evidence. *Conclusions:* All the applications included in the study had an extremely attractive interface and were built to be easy to use. Unfortunately, none of the applications met the necessary criteria to be classified as evidence-based mobile medical applications.

Keywords: App; Menstrual cycle; Ovulation; Fertility; Pregnancy

Introduction

A mobile application is a self-contained software designed for a mobile device that performs specific tasks for mobile users [1]. The term "app" is the abbreviation for "software application". Mobile applications were originally intended for office functions such as e-mail, calendar, and contact lists. Public demand for such apps led to their rapid expansion to areas including mobile gaming, GPS (Global Positioning System), and other services based on location, order tracking, and the ticket purchase. Apps are usually downloaded from the store of the operating system as App Store for iPhone or Google Play for Android. Some apps are free and some are available for a fee [1].

According to the AppBrain website, in September 2022, there were 2.667.238 mobile apps available in Google Play, of which 40.906 were medical apps. Of all mobile medical apps, 6% (n=2.440) were pay-only apps, with an average price of \$11.49, and 29% of the available medical apps (n=12.011) were classified as poor quality [2].

Software used in healthcare may qualify as a medical device, although where software is used for general purposes even in healthcare, or where it is intended for lifestyle and well-being purposes it will not be considered a medical device. To legally qualify whether it is or not a medical device, it is necessary to define the software's features and intended use. Mobile applications are to be considered medical devices when the intended use is to use patient data as input to produce an output, that represents a medical information. Furthermore, this output would be used for the purpose of monitoring a patient, providing a preliminary diagnosis or suggesting a course of treatment. Mobile applications are not to be classified as medical devices if the purpose of the software is not related to the patient's care.

Patients who turn to the specialist in obstetrics-gynecology have many anxieties and questions throughout their reproductive life. The workload in gynecology is very high and the average time allocated to a patient per consultation is 15-20 minutes. Mobile medical applications can support women of all ages because they provide quick and helpful information about all signs and symptoms that may or may not be gynecological or obstetric emergencies. Both patients and doctors can use these applications for all medical problems that occur during a woman's life, starting with puberty and ending with the late menopause period.

DeNicola reported in 2020 the most common applications in obstetrics-gynecology, as related to: Menstrual Tracking, Contraception, Fertility, Pregnancy, Monitoring, Clinical decision-making, Remodeling care, Postpartum, General Gynecology (Sexually transmitted infections, Diet and wellness), Gynecologic Surgery/Inpatient, Menopause, Urology-Gynecology, and Gynecology-Oncology [3].

The global women's health app market was valued at more than two billion dollars in 2020. The segment of menstrual health apps dominates the field contributing to 40% of the revenue share, and is estimated to have a strong, growing presence from 2021 to 2028 [4,5].

The question is, what is the quality of these apps in terms of information and algorithms as supported by scientific proof? Is the information provided supported by medical references? Is the recommendation grade mentioned? Does app provide the level of evidence for the information provided?

As in other areas of the digital world, there is a minimal quality control at the apps' stores level to assure that the medical apps have passed the MDR (for European Union) or FDA (for US) medical software compliance regulations so to be able to provide the consumer safe, evidence-based, or effective health apps. Peer recommendations largely guide the use of clinical apps and not by rigorous evaluation of the included information and algorithms [6].

Low-risk interventions such as mobile health apps do not require such a rigorous evidence base to be considered appropriate in-patient discussions. No guidelines currently recommend the use of mobile apps, although there is growing evidence examining the effectiveness of these interventions [7]. Theoretically, a mobile medical application can offer the latest changes in medical guidelines and specialized literature respectively, with minimal energy consumption on the part of users.

Mobile apps have a great potential to enable the medical practice, providing more efficient means for the caregiver to communicate with the patient, but also to serve as a reference guide at hand at the point of care [8].

The aim of this research was to assess the gynecology patient-oriented medical applications that are available free on android mobile device.

Material and Method

Data Sources and Criteria of Inclusion

In July of 2021, we have downloaded and evaluated mobile medical applications regarding women's health available on the Google Play platform within the Android operating system for mobile phones. The search was carried out using the following keywords: "app"; "menstrual cycle"; "ovulation"; "fertility"; "pregnancy". The keywords were first introduced in the "Google play web" for better efficacy.

Mobile medical applications were included in the analysis if they could be used for free and if they were, available only in English language. The study was conducted during 1-20 July 2021.

Data Collection

The mobile medical apps were downloaded, installed, and tested on a Smartphone which runs on the Android system. We evaluated the general (e.g., country of origin, ranking, and number of downloads) and specific (e.g., interactivity, functionality, aesthetics, content, benefits, evidence-based medicine [9-12]) characteristics (Table 1). Three elements were required to identify evidence-based applications: the presence of references, the presence of grades of recommendation, and the presence of levels of evidence. Each criteria presented in Table 1 received a score from 0 to 5. Since each criterion evaluated several issues (5 issues), if all issues were present for a criterion, then the score was equal to 5 [12].

Table 1. Criteria of evaluation of the medical apps (adapted from [9-12])

No.	Criteria	Item
1	Features	¹ Message sending? ² Notifications sending? ³ Alerts sending? ⁴ Feedback provided? ⁵ Is content sharing allowed?
2	Functionality	¹ Do automatic suggestions appear during search? ² Are results for keywords in the same semantics provided? ³ The number of steps for the user in order to receive the results are less than or equal to 5? ⁴ Is a tutorial available when first running the app the app? ⁵ Is help menu is available in any page?
3	User interface	¹ Are the standards imposed by the operating system (menus, buttons, and their location) followed? ² Are the icons used suggestive? ³ Are the illustrations, and images suggestive? ⁴ Are there available different interfaces variations, images, layouts and forms for the user to see which option works best? ⁵ Are there available different fonts and messages sizes for the user to prioritize messages?
4	Content	¹ Is the content in accordance with the title? ² Does the app have specific objectives? ³ Does the app have achievable goals? ⁴ Is the content complete (Is the minimum information needed to provide the desired response available?) ⁵ Is the content concise? (Short and targeted to the answer)
5	Benefits	¹ Does the app have the potential to reduce the cost of care? ² Does the app provide patients faster access to medical personnel and care? ³ Does the app facilitate remote patient monitoring? ⁴ Does the app improve patient – caregiver communication? ⁵ Does the app increase patient independence?
6	Evidence Based Medicine	¹ The application provides informative articles? ² Are there references to sustain the provided information? ³ Is the grade of the recommendation specified? ⁴ Is the level of evidence mentioned? ⁵ Is the source (location) of the articles mentioned?

Data Analysis

The summary statistics were made with Microsoft Excel. The summary of the qualitative variables was done by reporting the absolute and relative frequency, accompanied by the associated confidence

intervals calculated using an exact method similar with the one reported by Jäntschi and Bolboacă [13,14]. Graphical representations were done with Microsoft Excel.

Results

Eighty-five mobile medical applications related to women’s health were downloaded from the Google Play Store by using the search strategy. Applications that presented download errors were excluded from the beginning.

General Characteristics of Android Medical Women’s Health Apps

Out of the total of 85 mobile medical applications in the field of gynecology, 12.49% (95%CI [7.07 to 22.33], n=11) were built in the US, but 48.23% (95%CI [37.66 to 58.81], n=41) the country of origin was not mentioned.

Regarding the evaluation of the mobile apps by the users, 75.29% (95%CI [64.72 to 83.51], n=64) were evaluated with scores greater than or equal to 4. The highest score was obtained by the following three applications: “Pregnancy Week By Week”, “SmileReader – Ovulation tracker”, “Fertility monitor, Ovulation & Period Tracker: Fertility Calendar”, these getting a score of 4.9 (out of 5) from users. For 48.23% (95%CI [37.66 to 58.81], n=41) of the mobile medical application regarding the women’s health the country of origin was not mentioned.

One third (36.46%, 95%CI [25.89 to 47.04], n=31) of the applications had more than 1.000.000+ downloads (Table 2). Considering the total number of evaluated applications, only 8.23% (95%CI [3.54 to 16.45], n=7) of these apps had around 1000+ downloads.

Table 2. Top 10 mobile women’s health medical apps by downloads

No.	Name of the application	Number of downloads
1	Women’s Calendar: Menstrual Cycle Period Tracker	20.000.000+
2	Baby & Mom – Pregnancy Idle 3D Simulator	10.000.000+
3	Clue Period Tracker, Cycle & Ovulation Calendar	10.000.000+
4	Period Tracker	10.000.000+
5	Period Tracker: Ovulation Calendar & Fertile Days	10.000.000+
6	Pregnancy Tracker + Countdown to Baby Due Date	10.000.000+
7	Woman Log Period Tracker & Calendar	10.000.000+
8	Maya – Period, Fertility, Ovulation & Pregnancy	5.000.000+
9	Pregnancy Tracker & Baby App	5.000.000+
10	Pregnancy Week By Week	5.000.000+

Evaluation of Medical Women’s Health Apps According to their Specific Characteristics

1. Features

A percentage of 21.25% (95%CI [20.01 to 39.98], n=25) of the evaluated applications allowed all forms of interactivity (Table 3) and 17.85% (95%CI [16.48 to 35.28], n=21) obtained a score 4 out of 5 for this specification (Figure 1). Only three applications were rated with 0 at this criterion.

2. Functionality

The evaluated applications show a high level of functionality. Similar to interactivity, the same apps with the highest interactivity received the maximum score for all 5 sub-criteria from the functionality chapter (Figure 2).

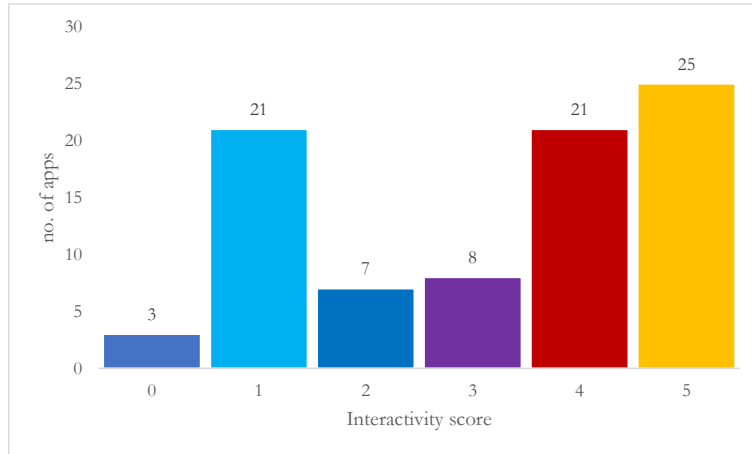


Figure 1. Distribution of scores for interactivity (0 = no interactivity, 5 = highest interactivity)

Table 3. Applications that allow the highest form of interactivity defined as applications that enable sharing information, sending messages, notifications, alarms, and receiving feedback

No downloads	Name of the app	Apps with high interactivity no./n
20.000.000+	1. Women’s Calendar: Menstrual Cycle Period Tracker	1/25
10.000.000+	1. Pregnancy Tracker + Countdown to Baby Due Date 2. WomanLog Period Tracker & Calendar	2/25
5.000.000+	1. Maya - Period, Fertility, Ovulation & Pregnancy 2. Pregnancy Tracker & Baby App	2/25
1.000.000+	1. GLOW. Pregnancy & Baby Tracker + Baby Registry App 2. I'm Pregnant - Pregnancy Week by Week 3. Ovia Pregnancy Tracker: Baby Due Date Countdown 4. Pregnancy & Baby Tracker Free: Preglife 5. Premom Ovulation Tracker. My Cycle & Fertility app 6. 9 months pregnant mother care 7. Femometer - Fertility Tracker 8. GLOW. Ovulation & Period Tracker 9. My Period Tracker / Calendar 10. Ovia Fertility: Ovulation & Cycle Tracker	10/25
500.000+	1. Lunar - Period Tracker & Ovulation Calendar 2. Menstrual & Ovulation Calendar 3. Pregnancy Tracker, Week by Week, Day by Day	3/25
100.000+	1. Ovulation Calculator Fertility 2. Teen Period Tracker	2/25
50.000+	1. Pregnancy Companion - Week by Week Tracking	1/25
5.000+	1. Conceive Fast -Yoga to Boost Fertility & Ovulation 2. Fertility, Ovulation, and Period Tracker	2/25
1.000+	1. Pregnancy Photo Stickers 2. Menstrual Period Fast Pain Relief Yoga - No Cramps	2/25

3. User Interface

In terms of aesthetics, more than half of the applications (51.76%, n=44) received scores between 4 and 5 (see the sub-criteria of the aesthetic criterion in Table 1). However, 24.7% (95%CI [16.48 to 35.28], n=21) received only a grade for aesthetics. One application was marked with 1 for the aesthetics part, this being “Fit Pregnancy”. Moreover, “Fit Pregnancy” application has only 1000 downloads and a ranking of 0 from users.

4. Content

The evaluations from the Interactivity, Functionality, Aesthetics chapter largely overlap with the evaluation of the Content section. The mobile medical applications that received the maximum score of 5 for their content can be found in Table 4. Considering that we evaluated the content of some mobile applications intended for an informative medical purpose, it is good to emphasize that 17.25% (95%CI [16.48-35.28], n=21) fulfilled only one sub-criterion out of 5 (Table 4).

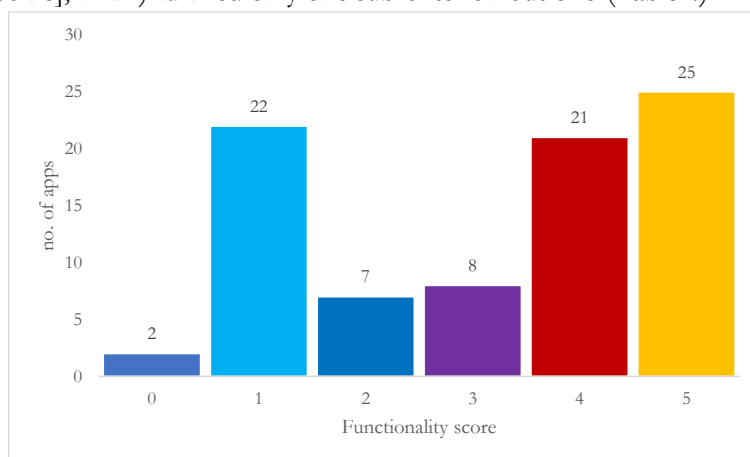


Figure 2. Functionality of apps by scores (0 = no functionality, 5 = 12 criteria of functionality accomplished)

Table 4. Women’s health mobile applications that offer the lowest content

Number of downloads	Name of the app	Apps with high interactivity no./n
1.000.000+	1. Music for Pregnancy Relaxation	1/21
500.000+	1. CycleBeads Period & Ovulation 2. Mommy and Baby Twins Pregnancy Daycare Game 3. Ovulation, Fertility & Pregnancy Tracker Calendar 4. Pregnancy Food	4/21
100.000+	1. Exercise During Pregnancy 2. My Calendar 3. MY OVULATION CALCULATOR 4. Pregnancy & Baby Tracker Free App 5. Pregnant Mommy - Newborn Baby Care 6. Pregnant Mother Simulator - Virtual Pregnancy Game 7. Pregnant Run	7/21
10.000+	1. Menstrual Calendar - Fertile Days 2. Ovulation & Period Calendar 3. Ovulation & Period Tracker: Fertility Calendar 4. Period Tracker - Ovulation Tracker & Pregnancy 5. Pregnancy tracker week by week, countdown	5/21
5.000+	1. Irregular Period - Menstrual cycle app 2. Ovulation Calendar Calculator	2/21
1.000+	1. Period Calendar: Period and Ovulation Tracker 2. Period Tracker - Ovulation Tracker & Health Tips	2/21

5. Benefits

Tables 3 and 4 lists the mobile medical applications that received the maximum (Table 3) and

minimum (Table 4) scores for the benefits section.

6. Evidence-Based Medicine

None of the mobile medical apps that were analyzed meets all the criteria to be considered evidence-based. None of the medical app provide informative articles. There is no medical app out of the ones analyzed that has the references to sustain the provided information mentioned in the app. Hence, we were unable to measure the criteria item related to the source (location) of the articles mentioned in the app. Furthermore, the grade of the recommendation and the level of evidence were not mentioned also in the medical apps analyzed.

Discussions

General Characteristic

In obstetrics and gynecology, we have an unlimited number of mobile medical applications that both patients and doctors can use. It is very difficult to have evidence of the number of mobile medical applications intended for women's health because new ones appear, or others disappear every day. Today a woman who has a smartphone can monitor her fertile period. Thanks to menstrual calculators, the calculation discs for the probable date of birth have been replaced by both doctors and patients with intelligent applications that accurately calculate the age of pregnancy according to the date of the last menstruation. Applications that offer the "alarms" function are very useful. These applications provide reminders about the maximum fertility period or if the next menstrual bleeding is approaching. Moreover, there are applications that allow functions of supervising blood pressure and blood sugar levels during pregnancy. Some applications allow the monitoring of menopause symptoms or provide signs and symptoms for identifying sexually transmitted diseases.

Mobile apps in healthcare have gone through the roof over the past 5 years. According to Liquid-State, in 2018, more than 318,000 mobile healthcare apps were available for patients, and around 200 new healthcare apps were being built daily. This number is stunning, and we can assume that it has increased substantially since the Covid-19 pandemic [15].

The number of patients who use mobile medical apps in the field of gynecology is impressively high. Throughout this research, it was highlighted that 36% of the evaluated applications had around 1,000,000 downloads.

However, the UpBrain site reports that only 2% of all applications available in the Google Play store have over 50.000 downloads. In September 2022, the most downloaded mobile medical application (50.000.000+) was "PeduliLindungi". This is a medical application developed in Indonesia that provides information about the spread of the disease COVID-19 [2].

Looking at the total number of applications analyzed, 75.29% (n=64) were evaluated with a score greater than or equal to 4. The same website UpBrain reports in real time that only 16.3% of the mobile applications (both medical and non-medical) have evaluations from users. The average number of stars is usually 4 [2]. There is probably a habit or inertia when users are evaluating applications. The grade must be high but not the maximum.

Almost half (48.23% (n=41)) of the gynecology apps included in the study do not mention the country of origin in their descriptions, and 12.49% (n=11) were built in the USA. In 2016, Capras et al. pointed out that almost a quarter of the medical applications included in their analysis were developed in the US, while the medical applications developed in India represented only one tenth. They noted that a significant percentage of apps (43%) did not offer developer data, raising questions about the quality of the information provided [12].

The degree of expertise of the authors of the content of the app is a sign of quality. A medical application can be developed by anyone, and it is essential to assess whether the team creating the app has sufficient qualifications to create the medical content. For this purpose, it is important to determine whether an application's content experts are listed in the domain in which they developed the application [16]. The question remains how healthcare workers should navigate these mobile medical applications to safely recommend and even prescribe these apps to patients.

Criteria of Evaluation for Mobile Medical Applications

Features, functionality, user interface, content, benefits, and evidence-based medicine were evaluated on the mobile apps available for women's health on Android operating system included in the study.

A percentage of 21.25% (n=25/85) of the evaluated applications allowed all forms of interactivity and 17.85% (n=21/85) of them obtained an average of 4 out of 5 for this specification. This means that approximately half of the evaluated gynecology applications offer a high form of interactivity. A number of 46 applications meet 4 or 5 interactivity criteria, characterized by the possibility to share information, send messages, send notifications, send alarms and receive feedback. These results are in opposition to those reported in 2016 by Capras et al., when most of the evaluated apps (77 apps) did not allow any interactivity and obtained a score of 0 points on this criterion [12].

In addition to the possibility of setting alarms and sharing information with other people, the field of mobile applications has developed a very interesting tool called "push notification". "Push notifications" can find utility in managing health resources and medical information. Push notifications can do much more than just monitoring patients when communicating with patients. The push notification feature can be used to send reminders about upcoming appointments or changes on them. In addition, they can be used to send interesting and relevant content, such as instructions on how to care for a wound in the postoperative period. For example, period tracker applications send every time "push notifications" about women mental and physical state depending on the hormonal variations that occur every day of the menstrual cycle. Thus, the patient is informed at every moment of the changes that occur in his body, regardless of whether it is a chronic disease or a physiological condition [17].

As in the case of interactivity, 21.25% (n=25) of the mobile women health applications succeeded to obtain the maximum score for all 5 sub-criteria from the functionality chapter. The majority of them provided automatic suggestions during search; provided results for keywords in the same semantics; the number of steps for the user in order to receive the results were less than or equal to 5; provided a tutorial when the user first run the app; provided a menu help in any application page.

An application may contain relevant clinical information or measure a patient's vital parameters with high accuracy; however, if that app does not install, launch, and run consistently, its overall usefulness will suffer. Thus, examining the functionality and operability of an application is an important part of the evaluation process [17]. For example, the functionality of an app that provides dysmenorrhea treatment algorithms may simply mean that it downloads materials properly, does not crash/freeze, and has few technical errors. App market user reviews are often a good source of information regarding app functionality and overall performance [17].

In terms of aesthetics, more than half of the applications (51.76%, n=44) received scores between 4 and 5 (see the sub-criteria of the aesthetic criterion in Table 1). There is one application which was marked with 1 for the aesthetics part, this being "Fit Pregnancy". Moreover, "Fit Pregnancy" application has only 1000 downloads and a ranking of 0 from users.

Mobile medical applications have potential for disseminating state-of-the-art and evidence-based medical information, but data about the user-friendly interface design is scarce [18,19]. An attractive user interface is essential [18,20] as it influences the users' initial evaluation. The user's evaluation happens in the split second of utilization and serves as a baseline for the subsequent adoption of the respective application [18,21-23].

Communication of evidence-based science to health consumers and the effectiveness of mobile health apps can be undermined if application design is ignored. Apps' design and features can influence users' experience and willingness to endorse apps. Everyone uses their own set of cues to match their expectations, or mental models, when evaluating information [18,24,25]. These expectations may or may not be met by the prototype level or the similarity of an application to its comparative group [18,25,26].

Based on the design cues included as interactive features, applications can look like others and exceeds end user expectations or can be different from others and not meet user's expectations [18, 27]. Users adhere faster to apps with a touch and feel that aligns with one's mental model on how that app should operate [18,27,28,29]. Users guide themselves by these expected features when

exploring novel apps and platforms [18,29]. Hence, having the expected features in place increases the familiarity and the chances adoption of the app [18,27-29].

In 2021, Lazard and collaborators proved that applications that are carefully designed to fit the expectations of potential users, with increased prototypes, have a much higher chance of being downloaded and used in everyday life. Prototypicality is positively related to favorable reception and expectations for the future use of health apps. Apparently, people prefer applications with a standard interface, adapted to the operating systems they are used to [18].

Despite a large number of downloads, 21 out of 85 of the evaluated medical applications failed to meet all five sub-criteria for the "Content" chapter. Women are increasingly using mobile medical applications to improve menstrual cycle tracking in addition to using traditional methods such as a paper calendar or written symptom monitoring [3,30]. A recent survey found that across all age groups (<18 years to >40 years), 47% of women use a mobile medical app to track their menstrual cycle [3,30,31].

Considering the clinical importance of accurate menstrual tracking, the question is whether mobile medical applications for women's health provide correct information and whether they bring improvements or risks to the current standard of care [3]. A study that evaluated a sample of over 100 menstrual cycle tracking apps pointed out that only 20% were considered clinically accurate, and there were few citations from the medical literature or involvement of health professionals. In addition, 19% of these applications contained erroneous medical information [32].

Mobile medical applications have many benefits, and they were all designed to increase the patient's quality of life. Unlike traditional and inefficient phone calls for doctors, mobile medical applications allow patients to send secure messages and schedule appointments with their doctor quickly. In fact, telemedicine is one of the fastest-growing ways patients use mHealth apps on their mobile devices. These applications offer them the convenience of visiting the doctor from their phone or tablet, so patients do not have to travel to the doctor's office or take time off from work [33].

In 2018, Michael Ross MD published a classification of the best mobile medical applications for monitoring medication adherence: "Medisafe", "Mango Health", "Round Health", "WellthApp", "Dosecast", "MyMeds", "Meds 360°". In a study published by Ahmed and collaborators 420 free apps were further analyzed to identify strategies used to improve medication adherence. They identified three broad categories of adherence strategies, reminder, behavioral, and educational [34,35].

Some mobile medical apps could track a patient's condition between visits and notify a clinician when a patient's biodata puts the patient at risk. Without mobile devices and mobile health technology - and especially wearable devices, continuous tracking and monitoring of patients would be inconvenient or impossible [34].

None of the analyzed mobile medical apps met all the criteria to be considered evidence based. None of the medical apps provide details about the scientific articles that support the information, hence there are no references (with the respective source / location of the articles) to sustain the content of the app. Furthermore, there is no grading of the recommendation and no level of evidence, or the mentioned in the app.

In 2016, Capras et al. [12] identified 21 evidence-based medical applications after searching with the keywords "evidence-based medicine". Most apps scored from 0 to 2 (maximum possible being 5). The EBM element met by all applications was represented by the availability of references that support the information presented. Two medical applications, Medscape and Dynamed responded positively to all criteria which have been established for evidence-based medical application. Both apps provide medical information and are used for diagnosis, treatment and prognosis and have been designed exclusively for doctors [12].

Pregnancy is the clinical moment when digital health technology can have the greatest impact. Women have become more involved in information regarding their pregnancies, by becoming increasingly interested in medical information providers [3,36]. There is a high demand for easily accessible pregnancy information, especially in the early part of pregnancy [3,37,38]. Unfortunately, only 4% of obstetrics-gynecology Web sites were created or sponsored by a physician or midwife

[3,39]. The remaining available information is largely inaccurate or unapproved 24. The challenge is to fill this gap with evidence-based information.

The "Text4baby" program attempted to do this by developing a large library of evidence-based pregnancy and postpartum text messages [3,40]. Messages include information on quitting alcohol and tobacco, taking prenatal vitamins, and seeking prenatal care. Over 700,000 women participated in the program [3,41].

Conclusion

All the applications included in the study had an extremely attractive interface and were built to be easy to use. Unfortunately, none of the applications met the necessary criteria to be classified as evidence-based mobile medical applications. None of the evaluated applications offered references, level of evidence and grades of recommendation to support the information provided to patients or doctors.

Conflict of Interest

The authors declare that they have no conflict of interest.

Appendix

280days: Pregnancy Diary:

<https://play.google.com/store/apps/details?id=com.amanefactory.totsukitoka>

9 months pregnant mother care:

<https://play.google.com/store/apps/details?id=pregnant.mother.care.pregnancy>

Baby & Mom - Pregnancy Idle 3D Simulator:

<https://play.google.com/store/apps/details?id=com.AlexGame.PregnancyIdle>

Baby2Body: Pregnancy Wellness (access anticipated):

<https://play.google.com/store/apps/details?id=com.baby2bodylimited.android>

Clue Period Tracker, Cycle & Ovulation Calendar:

<https://play.google.com/store/apps/details?id=com.clue.android>

Conceive Fast -Yoga to Boost Fertility & Ovulation:

<https://play.google.com/store/apps/details?id=drzio.yoga.boost.fertility.ovulation.conceiving>

CycleBeads Period & Ovulation:

<https://play.google.com/store/apps/details?id=com.cyclebeads>

Easy Period Calendar – ovulation:

<https://play.google.com/store/apps/details?id=pl.mobiem.android.kalendarzyk>

Exercise During Pregnancy:

<https://play.google.com/store/apps/details?id=com.stefanroobol.pregnancyworkouts>

FEMM Health Period and Ovulation Tracker:

<https://play.google.com/store/apps/details?id=org.femmhealth.femm>

Femometer - Fertility Tracker:

<https://play.google.com/store/apps/details?id=com.bm.android.thermometer>

Fertility Test Analyzer App: Ovulation & Pregnancy:

<https://play.google.com/store/apps/details?id=com.colnix.fta>

Fertility, Ovulation, and Period Tracker:

<https://play.google.com/store/apps/details?id=com.pregnancytrackerfree.periodovulation>

Fit Pregnancy:

<https://play.google.com/store/apps/details?id=com.fit.pregnancy.fitpregnancy>

GLOW. Ovulation & Period Tracker:

<https://play.google.com/store/apps/details?id=com.glow.android>

GLOW. Pregnancy & Baby Tracker + Baby Registry App:

<https://play.google.com/store/apps/details?id=com.glow.android.nurture>

HiMommy - Pregnancy Tracker App:

<https://play.google.com/store/apps/details?id=androidgecko.com.himommy>

I'm Pregnant - Pregnancy Week By Week:

<https://play.google.com/store/apps/details?id=com.kolesnik.pregnancy>

Irregular Period - Menstrual cycle app:

<https://play.google.com/store/apps/details?id=com.women.irregularperiods>

Jurnal Menstrual – Calendar:

<https://play.google.com/store/apps/details?id=com.brc.PeriodTrackerDiary>

Lunar - Period Tracker & Ovulation Calendar:

<https://play.google.com/store/apps/details?id=com.period.calendar.ovulation.tracker.lunar>

Maya - Period, Fertility, Ovulation & Pregnancy:

<https://play.google.com/store/apps/details?id=in.plackal.lovecyclesfree>

Menstrual & Ovulation Calendar:

<https://play.google.com/store/apps/details?id=com.grupoprecedo.calendariomenstrual>

Menstrual Calendar - Fertile Days:

<https://play.google.com/store/apps/details?id=it.hopecorp.menstrualcalendar>

Menstrual Cycle - Woman Log :

<https://play.google.com/store/apps/details?id=com.fourricegroup.mc>

Menstrual Period Fast Pain Relief Yoga - No Cramps:

<https://play.google.com/store/apps/details?id=drzio.menstrual.period.painrelief.yoga.nocarms>

Mommy and Baby Twins Pregnancy Daycare Game:

<https://play.google.com/store/apps/details?id=com.lzg.mommy.and.baby.twins.pregnancy.daycare.game>

Music for Pregnancy Relaxation:

<https://play.google.com/store/apps/details?id=com.ultimategamestudio.musicforpregnancy>

My Calendar:

<https://play.google.com/store/apps/details?id=com.veevapps.periodcalendar>

My Days X - Ovulation Calendar & Period Tracking:

<https://play.google.com/store/apps/details?id=com.chris.android.mydaysfree>

MY OVULATION CALCULATOR:

<https://play.google.com/store/apps/details?id=com.ecare.ovulationcalculator>

My Period: Period Tracker, Ovulation & Fertility:

<https://play.google.com/store/apps/details?id=com.mobileappsteam.periodtracker>

My Period Tracker / Calendar:

<https://play.google.com/store/apps/details?id=com.linchpin.myperiodtracker>

My Saheli - Period Tracker, Health & Utility App:

<https://play.google.com/store/apps/details?id=fitnesshealth.fertilityandperiodtracker.femtech>

MyPeriod : Period Tracker & Ovulation Calendar:

<https://play.google.com/store/apps/details?id=com.riseapps.myperiod.tracker>

Ovia Fertility: Ovulation & Cycle Tracker:

<https://play.google.com/store/apps/details?id=com.ovuline.fertility>

Ovia Pregnancy Tracker: Baby Due Date Countdown:

<https://play.google.com/store/apps/details?id=com.ovuline.pregnancy>

OvTracker - Ovulației Tracker:

<https://play.google.com/store/apps/details?id=com.inidamleader.ovtracker>

Ovulation & Period Calendar:

<https://play.google.com/store/apps/details?id=com.ashencode.easytwoperiod>

Ovulation & Period Tracker: Fertility Calendar:

<https://play.google.com/store/apps/details?id=com.imedicalapps.ovulationtracker>

Ovulation Calculator Fertility:

<https://play.google.com/store/apps/details?id=ovulationcalculator.com.ovulationcalculator>

Ovulation Calendar Calculator:

<https://play.google.com/store/apps/details?id=com.andromo.dev488478.app994887>

Ovulation, Fertility & Pregnancy Tracker Calendar:

<https://play.google.com/store/apps/details?id=com.ela.android>

Pepapp Period Tracker & Menstrual Cycle Calendar:

<https://play.google.com/store/apps/details?id=com.pepapp>

Period Calendar: Period and Ovulation Tracker:

<https://play.google.com/store/apps/details?id=pregnancy.periods.tracker.ovulation>

Period Tracker:

<https://play.google.com/store/apps/details?id=com.period.tracker.lite>

Period Tracker - Fertility & Ovulation Calendar:

<https://play.google.com/store/apps/details?id=apps.healthcare.periodtracker>

Period Tracker - Ovulation Tracker & Health Tips:

https://play.google.com/store/apps/details?id=com.period_tracker

Period Tracker - Ovulation Tracker & Pregnancy:

<https://play.google.com/store/apps/details?id=com.oshihar.periodtracker.ovulationtracker.period>

Period Tracker - Period Calendar:

<https://play.google.com/store/apps/details?id=com.creativecode.periodtracker>

Period Tracker & Fertile days:

<https://play.google.com/store/apps/details?id=com.netincome.periodtracker>

Period Tracker & Ovulation Calendar:

<https://play.google.com/store/apps/details?id=com.heafit.periodtracker.ovulationtracker>

Period Tracker : Ovulation & Fertility:

<https://play.google.com/store/apps/details?id=com.appbasic.periodtracker>

Period Tracker Bloom, Menstrual Cycle Tracker

<https://play.google.com/store/apps/details?id=com.smsrobot.periodlite>

Period Tracker, Ovulation and Pregnancy Calendar:

<https://play.google.com/store/apps/details?id=com.fitnessworkout.studio.periodtracker.calendar>

Period Tracker: Ovulation Calendar & Fertile Days:

<https://play.google.com/store/apps/details?id=com.technoapps.period.calendar>

Pregnancy - Get Baby Pregnancy Stages:

<https://play.google.com/store/apps/details?id=com.pregnancy.tracker.due.date.countdown.pregnancycalculator.ovulation.calculator>

Pregnancy & Baby Tracker Free App:

<https://play.google.com/store/apps/details?id=com.zoobagames.android.hamilelik>

Pregnancy & Baby Tracker Free: Preglife:

<https://play.google.com/store/apps/details?id=com.gravid.gravid>

Pregnancy Baby & Baby Kick:

<https://play.google.com/store/apps/details?id=com.pregnancy.android>

Pregnancy Companion - Week by Week Tracking:

<https://play.google.com/store/apps/details?id=apps.healthcare.pregnancycompanion>

Pregnancy Due Date Calculator, Calendar & Tracker:

<https://play.google.com/store/apps/details?id=com.amikulich.pregnancycalculator>

Pregnancy Exercise and workout at home:

<https://play.google.com/store/apps/details?id=com.pregnancy.exercise.and.workout.at.home.fitness.for.pregnant>

Pregnancy Food:

<https://play.google.com/store/apps/details?id=pregnancy.food.recipes>

Pregnancy Guide App:

<https://play.google.com/store/apps/details?id=com.ellstudiosapp.ibuhamil>

Pregnancy Journey - Journey To Motherhood:

<https://play.google.com/store/apps/details?id=com.worldofmedicalsaviours.pregnancyjourney>

Pregnancy Photo Stickers:

<https://play.google.com/store/apps/details?id=com.photoeditor.and.games.baby.photo.stickers>

Pregnancy Symptoms:

<https://play.google.com/store/apps/details?id=com.andromo.dev876788.app1061450>

Pregnancy Tips Diet Nutrition:

https://play.google.com/store/apps/details?id=com.pregnancy.healthy.diet_nutrition.tips

Pregnancy Tracker & Baby App:

<https://play.google.com/store/apps/details?id=com.wte.view>

Pregnancy Tracker + Countdown to Baby Due Date:

<https://play.google.com/store/apps/details?id=com.babycenter.pregnancytracker>

Pregnancy Tracker App (Due Date Calculator):

<https://play.google.com/store/apps/details?id=com.raanapps.pregnancytracker>

Pregnancy tracker week by week, countdown:

<https://play.google.com/store/apps/details?id=pregnancy.tracker.eva>

Pregnancy Tracker, Week by Week, Day by Day:

<https://play.google.com/store/apps/details?id=com.timskiy.pregnancy>

Pregnancy Week By Week:

<https://play.google.com/store/apps/details?id=com.easymobs.pregnancy>

Pregnancy Workouts for Every Trimester:

<https://play.google.com/store/apps/details?id=eu.fitric.pregnancyworkout>

Pregnant Mommy - Newborn Baby Care:

<https://play.google.com/store/apps/details?id=com.prtgamestudio.mommypregnantbabycare>

Pregnant Mother Simulator - Virtual Pregnancy Game:

<https://play.google.com/store/apps/details?id=com.pregnant.mom.games>

Pregnant Run:

<https://play.google.com/store/apps/details?id=com.HerbariumGames.PregnantRun>

Premom Ovulation Tracker. My Cycle & Fertility app:

<https://play.google.com/store/apps/details?id=premom.eh.com.ehpremomapp>

SmileReader - Ovulation tracker, Fertility monitor:

<https://play.google.com/store/apps/details?id=com.smilelab.drugs>

Sprout Pregnancy:

<https://play.google.com/store/apps/details?id=com.mas.apps.pregnancy>

Teen Period Tracker:

<https://play.google.com/store/apps/details?id=me.magicgirl.magicgirl>

WomanLog Period Tracker & Calendar:

<https://play.google.com/store/apps/details?id=com.womanlog>

Women's Calendar: Menstrual Cycle Period Tracker

<https://play.google.com/store/apps/details?id=ru.brainstorm.android.womenscalendar>

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