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Functionality of self-care for pregnancy mobile applications: A review study

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Abstract:

Self-care may help prevent pregnancy complications and mortality by informing parents. Mobile health applications (apps) can help individuals to improve the quality of self-care. Although it has been claimed that mobile apps have various benefits, their functionalities in pregnancy self-care are still unclear. A clear understanding of current apps can help researchers, practitioners, and app developers to identify appropriate functionalities for new development and future refinement of current apps. This review endeavored to identify appropriate functions for pregnancy self-care mobile apps and user interface (UI) features. The scope of this review integrates self-care for pregnancy apps published in Google Play and Cafe Bazaar (an Iranian Android marketplace), popular Android app stores, from July to October 2019 by using the systematic search technique. All 4196 downloaded apps were installed, and it was found that 76 of them met the inclusion criteria. This way, their features were extracted and categorized by the conventional content analysis. Three main themes and 69 subthemes in terms of apps functionalities and their UI features were extracted as follows: 1) Training materials (maternal and paternal) with 27 subthemes; 2) self-care functionalities (consultations, fetus tracking, clinical examination, supportive assistance, and reminders) with 26 subthemes; and UI features with 16 subtheme. The findings underlined the mHealth solutions for pregnancy self-care and the need for development of the apps regarding the extracted functionalities and UI features; however, controlled trials are needed. It is recommended that transparent reporting of mHealth interventions needs to be prioritized to enable effective interpretation of the extracted data.

Keywords:

Mobile applications, pregnancy, self-care, telemedicine

Introduction

According to World Health Organization, approximately 830 women die from preventable grounds during pregnancy and delivery every day.^[1] More than 60 million women who survive death suffer from pregnancy and delivery complications.^[2] Pregnancy care seems to be a useful strategy toward reducing pregnancy risks, elevating maternal healthy lifestyle, and promoting readiness for delivery.^[3] It seems that a great majority of pregnant women do not know the dose and don'ts of pregnancy.^[4]

Benefits of maternal care for developing countries vary between different social

classes. Some factors such as place of residence, socioeconomic status, ethnicity, education, religion, culture, need for clinical care, and decision-making ability may lead to inequalities in maternal care coverage. The costs and quality of maternal care services vary as well.^[5] The cost-effective way to reduce maternal mortality and complications before/after delivery seems to break through all of the prenatal care barriers.^[6] Accordingly, improving maternal health and empowering them to take care of themselves and their fetus is the prerequisite for community development.^[7]

Constant self-care for pregnancy can enhance maternal health.^[8] "Self-care" apps can help parents self-manage to improve

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their health through awareness.^[9] They have the potential for promoting the potential of self-care for pregnancy.^[10] Today, telemedicine, including mobile health (mHealth), supports health services and information. It has expanded as ubiquitous health care to increase universal health coverage and has led to easy access to health care, improved decision making, long-term situation management, and providing appropriate health care in emergencies.^[11]

The rapid growth of mHealth apps can play an important role in the prevention and treatment of the diseases. Today, most communication and activities are done through smartphones, and in the same vein, up to 96% of physicians provide their services and track them via smartphones.^[12] Such growth has also increased the use of mobile health services.^[12] Across low- and middle-income countries, 83% of women own a mobile phone and 58% use mobile internet.^[13] Therefore, the healthcare industry should also make efforts to employ mobile technology in this area;^[14] thus, it is now increasing access to health services via mobile health apps.

Regarding pregnancy care importance and mHealth apps efficiency in lifestyle modification and health services quality improvement, it seems that the employing self-care apps during pregnancy can help improve maternal and child health. On the contrary, women's widespread access to smartphones and their desire for using mHealth apps raise the issue of how much self-care mobile apps for pregnancy have paid attention to their needs.

Objective

This study was conducted to review the current pregnancy self-care mobile apps and provided recommendations for future apps development and current apps refinement.

Materials and Methods

In this review, functionalities of pregnancy self-care mobile apps was extracted through the conventional content analysis of the apps.^[15] Google Play and Cafe Bazaar, popular Android app stores, were the starting point for the search from July to October 2019 with the keywords "Prenatal", "Gestation", "Anticipant", "Expectant", "Maternity", "Pregnancy", "Obstetrics", and "Gravidity", in English and their equivalent Persian words. Seeing as app marketers do not follow the rules of search strategy, general terms in a non-hybrid way was employed for getting a comprehensive result. Limitation on the publication date was excluded from the search criteria.

Inclusion criteria

Smartphones running the Android operating system

hold an 86.2% share of the global market in 2022;^[16] Thus, we focused on pregnancy self-care-related apps on Android. Besides, the markets were monitored to download updates of the under-review apps, during the three months of content analysis, and three updated apps were replaced. The inclusion criteria were apps in English and Persian that were published for public access without release-time limitation to support self-care for pregnant women to avoid unnecessary obstetrical complications.

The English keywords "Prenatal", "Gestation", "Anticipant", "Expectant", "Maternity", "Pregnancy", "Obstetrics" and "Gravidity" and their Persian equivalent keywords were searched.

Exclusion criteria

Because the purpose of this study was to review pregnancy self-care applications, non-self-care applications were excluded. In addition, non-English and non-Persian apps were excluded. Furthermore, 25 apps got out of reach during the review, and textual training and single-task apps were excluded.

The criteria are shown in Figure 1.

Apps screening

During the search, 2000 and 2196 apps were found in Google Play and Cafe Bazaar, respectively, and the inclusion and exclusion criteria of the apps were reviewed according to steps shown in Figure 1. This way, the included 76 apps were divided into 66 English and 10 Persian apps [Table 1].

Data extraction and classification

Each app description was reviewed to be installed and examined to extract its functionalities and features through a conventional content analysis approach. Initially, extracted functionalities were extracted and a decision was made regarding their titles. In the second step, the functionalities and features were categorized and decided on the titles of each group. In the third step, titles, categorizations, and their relations were refined, verified, and updated. We tried to resolve any disagreement of researchers by discussing, reviewing, and reconciling the data; this way, an agreement was reached.

Ethical code and ethical considerations

Ethical issues (plagiarism, misconduct, data fabrication and falsification, double publication and submission, redundancy, etc.) have been completely observed. Moreover, this study received the required ethics approval from Isfahan University of Medical Sciences Research Ethics Committee, Isfahan, Iran with ethical code number: IR.MUI.RESEARCH.REC.1398.681.

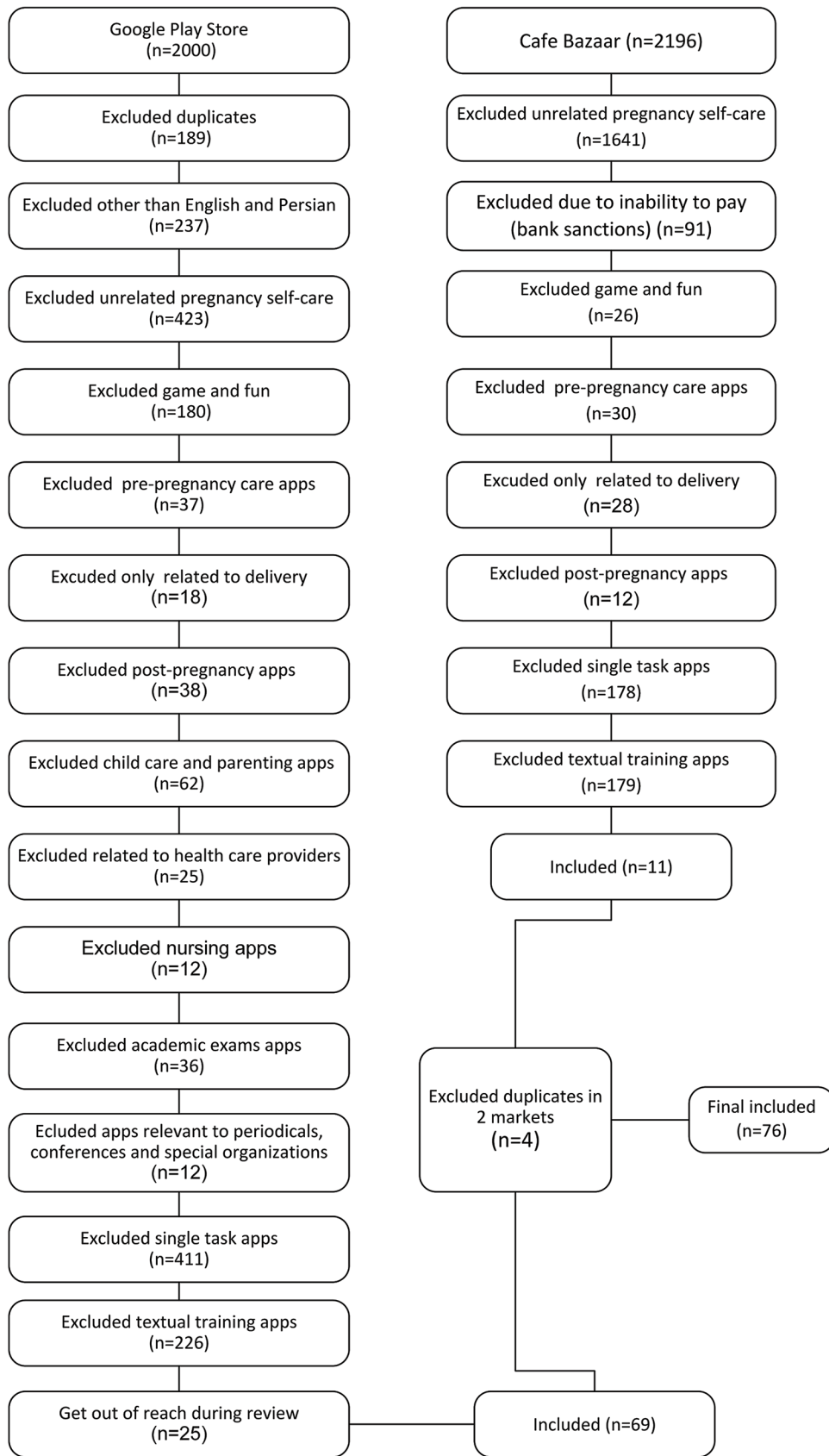


Figure 1: The trial profile for inclusion and exclusion of apps

Table 1: Reviewed apps related to pregnancy self-care

Row	App name	Row	App name
1	Healthy Living lifestyle a Pregnancy Care	39	Pregnancy Tracker Week By Week
2	Pregnancy Due Date Calculator and Calendar	40	Pregnancy Calculators Pro
3	Pregnancy Week By Week	41	Best Pregnancy Videos App
4	Your Pregnancy Companion	42	Pregnancy app: what to expect week by week
5	BabyNet Pregnancy Tracker & Chat App	43	Pregnancy calculator, symptoms, signs, calendar
6	Pregnancy Calculator	44	Expecting: positive pregnancy with affirmations
7	Pregnancy Calculator	45	Pregnancy Week By Week
8	Monogram Maternity	46	Preggo - Antenatal, Pregnancy, Specialist Consult
9	Pregnancy Tracker + Countdown to Baby Due Date	47	Pregnancy Calculator
10	Pregnancy Parenting Tips: BabyCare, Moms Community	48	Mediclinic Baby - Baby
11	Pregnancy Mentor	49	My Pregnancy
12	Pregnancy Assistant	50	Pregnancy Tracker: Baby Due Date Calculator
13	NSH Baby Bump	51	Pregnancy Assistant. Pregnancy Calendar.
14	SMART PREGNANCY PLANNING GUIDES	52	Pregnancy Care
15	Pregnancy Garbhasanskar	53	Pregnancy Friend App
16	Pregnancy Tracker	54	Indian Pregnancy, Baby Care Tips & Conception App
17	American Pregnancy	55	Motherhood, Parenting & Baby Guide
18	Pregnancy Tracker.	56	Best of the Bump Personalized Pregnancy Tracker
19	Indian Women, Pregnancy & Childcare Community	57	Ovia Pregnancy Tracker: Baby Due Date Countdown
20	HMom Pregnancy App & Due Date Calculator	58	Pregnancy Advice, Parenting Tips & Baby Care App
21	Pregnancy Week By Week Guide	59	Expecting
22	Hello Belly: Pregnancy Tracker and Baby Tips	60	Pregnancy Calendar and Tracker
23	Pregnancy Week by week	61	Pregnancy due date tracker with contraction timer
24	Pregnancy Tracker	62	Pregnancy and Babies
25	Pregnant2Parenting	63	pregnancy calendar
26	Woman Log Pregnancy Calendar	64	Pregnancy Tracker
27	Mother care - Pregnancy Week by Week	65	Pregnancy Tracker (Free)
28	Pregnancy Tracker week by week-due date calculator	66	Garbh Sanskar Guru - Best companion 4 pregnancy
29	Lincus Maternity	67	Preg/Bardari/Mamaye-Hamrahe-Shoma ^a
30	UNC REX Pregnancy & Baby	68	Niniban
31	Healthy pregnancy	69	Nini plus
32	Infano: Period, Fertility, Ovulation & Pregnancy App	70	Nini center
33	Week by Week Pregnancy App. Contraction timer	71	Bardari (Nahal)
34	Pocket Gynecologist	72	Madar sho
35	Pregnancy Week By Week pics with guide	73	Farzande Nikoo
36	Woman's Pregnancy	74	Mamana plus
37	Pregnancy tracker and chat support for new moms	75	Man, nini va bardari
38	Pregnancy Tracker	76	Noko

^aApps in rows 67-76 are in Persian

Results

Mobile apps for pregnancy care have been developed according to the needs of three categories of users: (a) medical, nursing, and midwifery students; (b) pregnant women; and (c) pregnancy care providers. In terms of content, they are divided into five categories: (a) pre-pregnancy issues, (b) pregnancy care, (c) maternity, (d) postpartum care, and (e) parenting. Their training content may also be developed taking into account two approaches: non-interactive or interactive.

As tabulated in Tables 2-4, three themes and 69 subthemes were identified from existing apps.

Discussion

The study endeavored to explore the proper functionalities and features of mobile apps for pregnancy self-care. In effect, self-care for pregnancy requires women's active participation in identifying and managing their conditions. Although many studied apps play an important role in pregnancy self-care, they cannot fully meet women's needs in a comprehensive way. According to Daly *et al.*,^[17] women are looking for apps to access information and monitor maternal and fetal health; 75% of them have downloaded at least a pregnancy app and most of them utilize at least one app every week.

Table 2: The extracted training functionalities of pregnancy self-care mobile apps

Training Function	Function Description
Maternal	
Health care	Such as complete vaccination, dental and gum hygiene, skin and hair care, bathing, proper maternity clothes, and use of cosmetics
Physical activity	Travel: Tips for travel and entertainment during pregnancy Working conditions: Tips for adapting to the work environment during pregnancy Sleep: Including changes in sleep patterns in pregnancy Exercise in pregnancy: Suggestions about the type of exercise, its duration, and intensity (in photos or videos format) during pregnancy
Nutrition	Weight tracking: Tips for gaining weight during pregnancy, and investigating the relationship between overall weight gain and gestational age Proper and varied nutrition: Proper and varied nutrition Cooking recipe: Cooking the right foods for pregnant women Medications and supplements: Introducing how to take medications and supplements such as iron, folic acid, and the like
Common complications	Changes in the mother's body: Hormonal changes during pregnancy and following that, common changes in blood oxygen level, temperature, skin, hair and nails, heart rate, breasts, cervix, and lumbar spine curvature
High-risk complications	Pregnancy risk factors: Including visual disorders, dyspnea, vaginal bleeding, fever, edema, preterm delivery, gestational diabetes, thyroid disorders, urinary tract infection, and strangury as well as tips on significant problems in pregnancy, including back pain, abdominal pain, and leg pain Other dangerous signs: Including BMI<18.5 or>35, cancer, epilepsy, age >35 or <17, twin or multiple pregnancies, history of more than 3 abortions, personal or family history of birth with congenital anomalies, history of preterm labor, infectious diseases such as HIV or hepatitis C, and itching all over the body
Common diseases of pregnant women	Hypertension: Tips on gestational hypertension and chronic pre-pregnancy hypertension and its timely control Pregnancy loss: Abortion, molar pregnancy, fetal death, and re-attempt to conceive Diabetes screening: Tips for gestational diabetes screening Other diseases: Including relatively common pregnancy-related diseases such as heart and liver disease, varicose veins, and hemorrhoids
Screening and tests	Including a description of blood and urine tests, genetic screening and anomalies, and deadline of each test
Preventive care	Fetal growth: Descriptions of fetal growth, development, and changes Complications and their solutions: Introducing pregnancy complications and ways to reduce them Lifestyle: Materials such as intercourse, sleeping positions, keeping pets, and other tips of coexistence in the family during pregnancy Vaccination: Time and method of vaccination
Mental Health	Feelings and emotions changes: Including changes in thoughts, feelings, and psyche during pregnancy Religious advice: Consists of religious memoirs, surahs, and prayers for pregnancy and the time of reciting them Music: Listening to quiet and simple music to stimulate fetal heart rate and to increase endorphin
Paternal	
Fathers training	Tips on accompanying the spouse to receive pregnancy care, participating in home affairs, providing health advice to pregnant women, empowering her to promote reproductive-sexual health to reduce mortality, improving her health, and reducing inequalities

Iyawa *et al.* conducted a systematic review to provide a narrative synthesis of the literature on the evaluation of mobile apps for self-management during pregnancy by using four databases (PubMed, CINAHL, Scopus, and EMBASE) and concluded that mobile apps for self-management have been developed with different functionalities addressing various areas of complications during pregnancy, including gestational diabetes, preeclampsia, and high blood pressure.^[3]

This review has some implications and outcomes that can greatly contribute to pregnancy care providers in developing new apps or updating the current apps to achieve their real benefits. Some highlighted findings are discussed as follows:

Pregnancy care includes an integrated approach to medical and psychosocial care; therefore, these apps should also cover their comprehensive self-care needs in aspects of pregnancy such as family, social, psychological, religious, and conventional medicine. Most apps teach day-to-day care, while the psychological and emotional dimensions such as parental and emotional support are deficient.

User training is one of the pregnancy self-care apps functionalities in maternal, fetal, and child health care; postpartum care; and paternal training. According to Leiferman *et al.*,^[18] online training can facilitate prenatal depression management through patient-provider dialogue improvement. Moreover, according to Alio *et al.*,^[19] paternal engagement may affect infant mortality

Table 3: The extracted Self-care functionalities of pregnancy self-care mobile apps

Self-care Function	Function Description
Constant consultations	Breath exercises: Doing the right breathing exercises Mental health: Asking questions about the mother's mood and sending the right motivational message to her Signs and symptoms: Entering daily signs and symptoms and managing common or high-risk pregnancy conditions Daily care: Includes evaluation of high-risk behaviors, common complaints and danger signs, trauma, general maternal condition, physical examination, and personal hygiene Blood sugar & gestational diabetes: Pregnancy blood sugar checking Sleep hours: Tracking mother's daily sleep hours Weight and diet: Tracking mother's weight based on calories consumed on a daily basis Physical activity: Tracking amount of pregnancy exercise, yoga, or walking on a daily basis Medications: Mothers' medications and supplements data entry to consult Abdomen size: Recording abdominal circumference and fetal growth rate according to gestational age Temperament: Basal body temperature increasing Heart rate: Checking the mother's daily heart rate Blood pressure: Blood pressure screening for hypertensive care
Track the fetus's condition	Blood group prediction: Fetus blood group prediction based on the parents' blood group Kicks counting and checking fetal movement: Monitoring fetus health by paying attention to its movements, continuous recording of fetal movements attributes such as its duration and intervals Illustrating fetal size with various objects: Showing fetal size based on its resemblance to fruits, vegetables, or objects tangible to parents for easier understanding Calculating fetal age and its weekly growth: Calculating gestational age, fetal size, and weight, in weeks, millimeters, and grams, respectively, based on the date of the last menstrual period. Uterine contraction timer: Controlling uterine contractions and alert delivery date
Reminders	Appointment: Doctors and midwives visit reminding Medications administration: Medications reminding Tests: Clinical tests reminding Note writing: Daily notes writing and documenting previous and current pregnancies records Sonography: Sonography reminding
Clinical examination	Examining mother's medical conditions
Supportive assistance	Helping to choose a proper clinician Emergency call

Table 4: The extracted UI features of pregnancy self-care mobile apps

UI Feature	Feature Description
Input Controls	Feedback: Sending feedback on all sections of the app to the developer
Navigational Components	Search: Searching all content for easier access to the intended one
Informational Components	About: Consist of the purpose of the app, its developers, and user contact with them Notifications: Send training or motivational announcements Messaging: Ability to send content related to each week for pregnant women Birthday widget: Counting of days left to birth and providing information about fetal imaging Q&A capability: forum with specialists and mothers
Setting	Units setting: Such as selecting weight and height units Appearance setting: Such as font, color, and others Input setting: Such as language and keyboard Account setting: Assigning a user account and setting up a personal profile Offline running: Running the app continuously without an internet connection Setting personal archives: Ability to create personal archives of mothers favorite content
Support	Backup: Data backup Update: App update and upgrade
Share	Sharing data with specialists and caregivers

through the mother's access to resources, support, and her well-being.

Maternal perception of fetal growth and bonding with it, is another functionality of self-care apps. In the words of Warrander *et al.*,^[20] it may help decrease the risk of stillbirth and fetal growth restriction.

Daily care consultation is one of the pregnancy apps functionalities. Alam *et al's*^[21] findings reveal that mobile consultation provides pregnant women with valued medical advice and support.

Medication and medical non-adherence are one of the major concerns of pregnant women that can

disproportionately undermine their status quo.^[22,23] Pregnancy self-care apps can provide reminders about medical appointments, medication administration, tests, and note writing.

Wulff *et al.*^[24] believe that stress and impaired mother-fetus bonding can lead to maternal and fetal adverse effects. Music in prenatal term can facilitate maternal mood and health and support maternal-fetal bonding. Self-care apps for pregnancy can work to stimulate the fetal heart rate as well as mother endorphin secretion by playing music during pregnancy.

According to Dawod *et al.*,^[25] maternal care history documentation can decrease some risk factors and increase parental bonding. Therefore, it seems to be an important functionality of self-care apps for pregnancy.

Like any other user-friendly self-care app for pregnancy, there are UI features in pregnancy self-care apps. Zargarzadeh's findings revealed that some UI features are important, such as setting, feedback, rating, data sharing and backup, running without Internet connection, updating, sending daily and weekly emails, and a search option.^[10]

Conclusion

In conclusion, three main themes and 69 subthemes were presented for pregnancy self-care-related app functionality and their UI features, with huge heterogeneity of functions in different apps. This can be due to the various development approaches. mHealth solutions can improve pregnancy self-care services, but due to the weak current literature, RCTs with economic, clinical, and long-term patient-centered outcomes are suggested. Moreover, it seems that if transparent reporting of mHealth pregnancy self-care interventions is a priority, effective interpretation of the extracted data Moreover to be provided. With the growing penetration of smartphones, new generations of mobile apps are emerging that require user-friendly and evidence-based methods to build their safety, performance, and social impact.

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Conflicts of interest

There are no conflicts of interest.

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