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Mothers' views on mobile health in self-care for pregnancy: A step towards mobile application development

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Abstract:

BACKGROUND: Applications for pregnancy self-care (APSC) can improve post-partum by empowering pregnant women's status quo. This study endeavored to identify the operational needs of an application (app) from the perspective of Iranian pregnant women.

MATERIALS AND METHODS: In a qualitative manner, semi-structured and face-to-face interviews were conducted using an interview guide. Interviewees were pregnant women who encountered to health facilities of Isfahan University of Medical Sciences for prenatal care and were willing to be interviewed. The interviews were conducted from June 2019 to June 2021. All the recorded interviews were transcribed. The obtained data were analyzed through conventional content analysis using MAXQDA 12 (Developer: VERBI GmbH Release: 2015 Version: 12 OS: Microsoft Windows Type: Qualitative Data Analysis - Offline). Data saturation was obtained after 14 interviews. One of the researchers, as a data encoder, became acquainted with them by immersing himself in the data. After the data was first encoded and summarized, the codes were analyzed. In addition, an attempt was made to reduce the impact of researchers' experiences at different stages of the study process.

RESULTS: Based on the opinions of pregnant women, 7 main themes (nutrition, training, fatal monitoring, relaxation, health, risk factors, physical activity) and 38 sub-themes were identified for APSC development. The findings revealed that pregnant women tend to use APSC, but because they are not comprehensive, women search the Internet to answer some of their information needs.

CONCLUSIONS: The findings can be useful in developing a comprehensive pregnancy self-care mobile application that is localized based on the operational needs of pregnant women to make them capable and self-caring in controlling pre-risk situations.

Keywords:

Mobile applications, pregnancy, self-care, telemedicine

Introduction

Pregnancy care helps women by reducing risks, promoting healthy lifestyles, and increasing pregnancy readiness.[1] It can detect potential complications early and prevent their occurrence, if possible, and refer to medical centers, considering complications.[2] All women need support and access to care during pregnancy, delivery, and several weeks after delivery. However, there are barriers to receiving care during pregnancy.

Information technology offers innovative solutions to provide pregnancy care that support women at risk even in remote areas. Training based on smartphone-based software was effective in increasing knowledge and self-care. Using up-to-date and popular methods can be a way to raise awareness and improve self-care behaviors.[3]

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In the healthcare sector, self-care apps promote the self-management of individuals, which elevates their awareness and health.[4,5] Because new technologies offer the potential to monitor illness and focus on self-care, many mobile health (mHealth) apps can provide the right tools for self-monitoring and self-care and facilitate physiological data gathering and physician-patient communication. Applications for pregnancy self-care (APSC) provide maternal training, behavioral risk factors monitoring, and maternal emotional support appropriately. It also reduces the negative consequences of childbirth, which have high financial and social costs in the short and long run.[6]

Providing pregnant women access to valid information and supporting them during pregnancy with the aim of making a positive change in their behaviors is one of the challenges of maternal and child health professionals that can lead to empowering them, especially young women, to improve pregnancy outcomes and to ensure the use of supportive resources in self-care.[7]

45% of smartphone users are 18–34 years old, which overlaps with the female population in the childbearing demographic. The feeling of motherhood also motivates to use a smartphone to access pregnancy care.[8]

Effective use of APSC in lifestyle modification and care quality improvement can provide the growth of public health at a low cost. Of course, the lack of specific standards or regulations for this type of software indicates the responsibility of developers to comply their apps with evidence-based content. Furthermore, due to the greater exposure to pregnancy, there is a lack of a native APSC for Iranians that covers all aspects of pregnancy self-care.

This study aimed to explore mothers' views on mobile health in self-care for pregnancy to develop a mobile application.

Material and Methods

Study design and setting

In this qualitative study, the operational needs of APSC were determined from the pregnant women's view for the first time in Iran from June 2019 to June 2021, and recommendations were developed for the development of an APSC. The interviews were conducted in the health facilities of Isfahan University of Medical Sciences.

An interpretive, qualitative study design was used to identify the operational needs of APSC from the pregnant women perspectives in Iran and the data were collected.

Study participants and sampling

To identify the interviewees, a purposive sampling method with a maximum variation approach was used. This approach allowed us to detect important common patterns that cut heterogeneities. In addition, the snowball sampling method was used to create a related human network, reach more interviewees, and complete the list of interviewees. Eligible interviewees were pregnant women who encountered health facilities for prenatal care and were willing to be interviewed. See Table 1 for the characteristics of the interviewees.

Data collection tool and technique

Face-to-face semi-structured interviews were conducted to discover and evaluate pregnant women's perceptions, attitudes, and mental interests about the features of the application, by a member of the study team (BP) in Persian. All interviews were recorded with the permission of interviewees and then transcribed verbatim as soon as possible. Each interview lasted 10 min on average. Formal consent was given before proceeding with the interviews. First, by deep and frequent reading of the interviews with an inductive approach, operational needs were extracted and then, main themes and sub-themes were revealed by categorizing them. Data saturation was reached after 14 interviews. At saturation point, new data were no longer illuminating the themes and interview comments and patterns began to repeat and little new material was generated. At the fourteenth interview, our major analytic categories were saturated and there seems little point in continuing and so it would be appropriate to bring data collection to a halt. A conventional content analysis approach was applied to analyze the data using the MAXQDA 12. The stepwise guide put forward by Braun and Clarke was applied including familiarization with data, generating initial codes, searching, reviewing, defining and nominating themes, and producing the report.[9]

Table 1: Characteristics of the interviewees

Row	Gestational age (weeks)	Frequency of pregnancy
1	3	2
2	18	2
3	19	2
4	20	1
5	24	1
6	24	1
7	25	2
8	26	2
9	27	3
10	35	1
11	35	1
12	36	2
13	36	2
14	40	1
Mean	26.3	1.6

After several reviews, they were categorized based on the similarity and suitability of the concepts. In the next step, the main and secondary themes were compared and edited, and the reliability of the interviews was confirmed by the method of test-retesting. In this way, the interviews were randomly selected and each one was recoded twice in the interval of thirty days. The themes of "agreement" and "disagreement" were counted and calculated. The stability of themes over time was 92%.

Quality assurance

Credibility, transferability, dependability, and confirmability of the findings were confirmed. Prolonged engagement (about 12 months) and interviewee checks were adopted to enhance credibility. The purposive sampling method and detailed descriptions avoided unclear statements, which in turn increased the transferability of the data. Furthermore, the data were cross-checked and the dependability and confirmability of the results were authenticated by the external reviewers.

Ethical consideration

In addition to giving formal consent, all interviewees were informed of the study objective before the interview meetings. Participation was voluntary and all interviewees were permitted to quit or stop the interview during the interview process. Confidentiality of information was assured as well. All the interviews were conducted in a private room. Informed consent was obtained from the participants that included consent to recording their interview. The Research and Ethics Committee of the Isfahan University of Medical Sciences approved the study (Approval ID: IR.MUI.RESEARCH.REC.1398.681) (date: 2020/02/19).

Results

Table 1 shows the characteristics of the interviewees.

Based on the interviewees' ideas, seven themes were extracted [Table 2]. The themes and sub-themes are described as follows.

Nutrition

Supplements and medications administration

Introducing how to take medications and supplements such as iron, folic acid, and the like.

> *"Medications that can or can't be taken at a certain time, should be mentioned." (Interviewee 3, 5)*

Foods and calories: Tracking mother's diet based on calories consumed on a daily basis

> *"I had questions for my food. I was looking for these." (Interviewee 1)*
>
> *"Know what is good for her nutrition that affects her [fetus]'s growth." (Interviewee 13)*
>
> *"One can have a plan for her diet so that she does not gain weight by accident." (Interviewee 7)*
>
> *"[Nutrition Awareness] be careful to make sure that the food you eat has no problem. The information must be accurate; so, one does not become obsessed." (Interviewee 9)*

Weight measurement

Tips for gaining weight during pregnancy, and investigating the relationship between overall weight gain and gestational age.

> *"When I look at the weight chart, I realize how much I have gained or lost. I think this is good." (Interviewee 8)*
>
> *"If the mother herself can draw a chart of her weight, I think this is better. Once she sees that her weight is rising sharply, she can control herself. But when there is a range for pregnancy, it's important." (Interviewee 7)*

Training

Screening tests and their times

Including a description of blood and urine tests, genetic screening, and anomalies and the deadline for each test.

> *"Once a month, they do a test for sugar, fat, thyroid (hormones), so on (to see) if all of these are controlled. It is much better if the APSC is available." (Interviewee 14)*

Weekly training

Includes evaluation of high-risk behaviors, common complaints and danger signs, trauma, general maternal condition, physical examination, and personal hygiene.

> *"(On ultrasound), I was curious. Before I came to the doctor, I was searching the internet.....; what is this? For what?" (Interviewee 12)*

Accompanying fathers

Tips on accompanying the spouse to receive pregnancy care, participating in home affairs, providing health advice to pregnant woman, empowering her to promote reproductive-sexual health to reduce mortality, improving her health, and reducing inequalities.

> *"Men do not understand the condition of their (pregnant) wife. It's much better if they have information; these [fathers' training] would be better if they were provided." (Interviewee 7)*

Post-partum care

Including management of the mother, newborn, and infant during the post-partal period, when the mother's body returns to its pre-pregnancy state.

Table 2: The themes and sub-themes for APSC development

Themes	Sub-themes	Interviewee Number
Nutrition	Supplements and medications administration	1,2,3,4,5,6,8,10,11,14
	Foods and calories	1,2,3,4,5,6,8,9,10,11,12,13,14
	Weight measurement	1,2,3,4,5,6,7,8,9,14
Training	Screening tests and their times	2,13,14
	Weekly training	2,3,4,12,14
	Accompanying fathers	10
	Post-partum care	2,4,7,8,9
Fetal monitoring	Gestational age calculating	8
	Fetal growth or weight	2,3,9,10,13
	Fetal size based on themes	12
Relaxation	Music	2,3,4,5,8
	Religious	4,5,6,7,8,9,10,11,13,14
	Psychological	2,3,4,5,6,7,8,9,13
	Social	4
	Emotional	6,10
Health	Hygiene	4,7,14
	Dress	10,12
	Teeth	14
	Bath	6,7
	Sexual	7,10
	Personal	4,7,14
	Urinary tract infection	7
Risk factors	Fetal movement	2,3,4,5,6,9,10,11,13,14
	Dyspnea	11,14
	Heartburn	14
	Fever	5
	Pre-eclampsia	1
	Edema	1
	Nausea and vomiting	8,12,14
	Vital signs	7,13
	High blood sugar	4,5,9
	Pain	1,4,5,9,12
	Hypertension	2,4,5,7,9,10
	PROM1	4,5
Physical activity	Travel	4
	Sleep and rest	2,4,6,11
	Exercise	2,3,4,5,6,8,9,13,14
	Walking	1,2,5,7,10,11

[1]Premature rupture of membranes

"I think even a series of brief training on breastfeeding after birth is necessary, especially in the first pregnancy." (Interviewee 4)
"During breastfeeding, if the bilirubin level is over which number, is treatment necessary? Or other such care." (Interviewee 9)

Fetal monitoring

Gestational age calculating

Calculating gestational age, in weeks, based on the date of the last menstrual period.

"(APSC must) calculate gestational age." (Interviewee 8)

Fetal growth or weight

Calculating fetal size and weight, in weeks, millimeters, and grams, respectively, based on the date of the last menstrual period.

"It is better for the APSC to show (fetal growth) monthly in the form of animation." (Interviewee 9)

Fetal size based on themes

Showing fetal size based on its resemblance to fruits, vegetables, or objects tangible to parents for easier understanding.

"I enter my pregnancy week on the Internet, it gives the size (of the fetus)." (Interviewee 12)

Relaxation

Music

Listening to quiet and simple music to stimulate fetal heart rate and to increase endorphins.

"Sometimes a mother can relax by listening to light music." (Interviewee 3)

Religious

Consists of religious memoirs, surahs, and prayers for pregnancy, and the time of reciting them.

"It's good to have religious content in the APSC. Sometimes when I'm a little stressed, I relax by God, reading the Quran and praying. The presence of these items in the APSC prevents a pregnant woman from surfing the web." (Interviewee 14)
"I really think it relaxes me." (Interviewee 7)

Psychological

Including changes in thoughts, feelings, and psyche during pregnancy.

"Mental health is important during pregnancy. A pregnant woman does not know what to do." (Interviewee 2)
"Depression should be prevented for the mother, during and after pregnancy. The mother should know its symptoms; this way, she can control them, timely." (Interviewee 7)
"The texts in the APSC should motivate, increase life expectancy." (Interviewee 8)
"I surfed the internet that depression during pregnancy was normal." (Interviewee 9)

Social

Tips for women whose social situation may impact adversely on the outcomes of pregnancy for them and their baby.

"In Iran, unfortunately, people look at a pregnant woman as a patient which leads to limitations for her; But in some other countries, a female athlete exercises during pregnancy." (Interviewee 4)

Emotional

Including changes in thoughts, feelings, and emotions during pregnancy.

"A pregnant woman needs her husband's love and attention more than ever." (Interviewee 10)

Health

Such as complete vaccination, dental and gum hygiene, skin and hair care, bathing, proper maternity clothes, and use of cosmetics.

Hygiene

"What to do healthily during pregnancy to avoid further problems." (Interviewee 7)

Dress

"I have searched the internet a lot for what to wear." (Interviewee 12)

Teeth

"I do not know what to use in the face of toothache." (Interviewee 14)

Bath

"Tips should be taught to ensure the safety while bathing." (Interviewee 7)

Sexual

"I asked the doctor how long I could have sex with my husband. She said: up to two weeks before the delivery; but it was on the internet until four weeks before the delivery!" (Interviewee 10)

Personal

"The APSC should contain information about, for example, the use of ointments and powders." (Interviewee 14)

Urinary tract infection

"My weight was high in a month. I searched and understood that it was too high. It turned out that I had a urinary tract infection." (Interviewee 7)

Risk factors

Fetal movement

Monitoring fetal health by paying attention to its movements, and continuously recording fetal movement attributes like its duration and intervals.

"I was worried about the fetus moving, it did not move for a whole day, it was very stressful, I had to go to care center." (Interviewee 14)

Dyspnea

Monitoring breathing discomfort, which is common during pregnancy, and usually a physiologic result of pregnancy itself but can be caused by a new or underlying disease.

"If there is an APSC that is much better. In the last months (of pregnancy) walking and shortness of breath is very difficult." (Interviewee 14)

Heartburn

Tips for heartburn or acid reflux in pregnancy. It can be caused by hormonal changes and the growing baby pressing against the stomach, which can help ease indigestion and heartburn by making changes to diet and lifestyle.

"I got heartburn, they say take mint distillate; It seems necessary to integrate the notes into [the APSCs]." (Interviewee 14)

Fever

Suggestions about reducing fever in pregnancy. Defines maternal pyrexia as a temperature of 38.0°C once or 37.5°C on two occasions 2 h apart.

"My doctor said: 'Check your fever yourself. If the fever is above 38 degrees, see me." (Interviewee 5)

Pre-eclampsia and edema

Tips for diagnosing pre-eclampsia, a serious medical condition that can occur about midway through pregnancy (after 20 weeks). This condition needs to be treated by a healthcare provider.

"Last week my foot became swollen, I searched and found that it was probably Preeclampsia." (Interviewee 1)

Nausea and vomiting

Suggestions to control nausea and vomiting in pregnancy (NVP), commonly referred to as morning sickness, typically begins between the fourth and seventh week after the last menstrual period, and typically resolves in the second trimester.

"I once had a question about what to do for nausea, for example." (Interviewee 12)

Vital signs

Entering daily signs and symptoms and managing common or high-risk pregnancy conditions.

"(Blood) Pressure, (Heart) beat and others (vital signs) very important to me." (Interviewee 13)
"For example, it is good to be able to control blood pressure, etc. [via mobile]." (Interviewee 7)

High blood sugar

Tips for gestational diabetes screening

"Gestational diabetes is important because sometimes a person wants something sweet, but she doubts." (Interviewee 9)
"I ate fruit for a while, but my doctor said: its sugar should be considered; because you get gestational diabetes. I searched for fruits on the Internet. I use those that have low sugar." (Interviewee 5)

Pain

Tips on significant problems in pregnancy including back pain, abdominal pain, and leg pain.

"The pain is important to me, because I'm backache right now. I searched carefully for an APSC but found nothing. The APSC should contain content about back pain, important exercises for natural childbirth and the like." (Interviewee 5)

Hypertension

Tips on gestational hypertension and chronic pre-pregnancy hypertension and its timely control.

"For example, when you take blood pressure (you can) understand its amount, normality and range of risk." (Interviewee 10)

Premature rupture of membranes (PROM)

Tips to be aware of PROM, which is the rupture (breaking open) of the membranes (amniotic sac) before labor begins.

"Have information beforehand that things (like PROM) that happen to her do not lead to a sudden event." (Interviewee 4)

Physical activity

Tracking the amount of pregnancy physical activity daily.

"[It should be said in the APSC] what (physical activities) can you do? How much can you do?" (Interviewee 4)

Travel

Tips for travel and entertainment during pregnancy.

"It's important for me to know what I need to know if I want to travel so that there is no problem." (Interviewee 4)

Sleep and rest

Including changes in sleep patterns during pregnancy.

"How and how much activity I can do each week is important. How can I sleep? When can I sleep on back or when should I not sleep on back?" (Interviewee 4)

Exercise and walking

Suggestions about the type of exercise, its duration, and intensity (in photos or video format) during pregnancy.

"There should be an APSC that reminds me when to do each exercise and shows each exercise." (Interviewee 9)
"What exercise can be done during pregnancy?" (Interviewee 3)

Discussion

This study mainly endeavored to determine the operational needs to develop an APSC from the pregnant women's view. This section provides discussions on some highlighted results. Interviewees noted the following implemented programs that are more directly

aimed at a pregnant woman and her fetal health, namely, the amount of nutrients, weight gain, fetal movement monitoring, sedatives, and pregnancy exercises.

Weight management as one of the dimensions of pregnancy care is an important predictor of pregnancy outcomes.[10] The weight management findings are consistent with the results of Bogaerts, Oba, Tippu, Toftemo, Badon, and Zhong. Bogaerts *et al*.[11] concluded that being overweight before and during pregnancy is a threat to public health because it may lead to pregnancy-related complications. According to Oba *et al*.,[12] low gestational weight gain (GWG) leads to a higher risk of intrauterine growth retardation. On the other hand, according to Tippu, Toftemo, Badon, and Zhong, high GWG is associated with increased complications such as diabetes, pre-eclampsia, cesarean section, and macrosomia.[13-16]

Rahmawati *et al*.[17] concluded that some mothers typically receive confusing nutritional statements from people. According to Zaidi, Scholl, Zeng, and Mate, maternal nutrition, before and during pregnancy, plays a key role in reproductive health to reach optimal pregnancy outcomes and can avoid some of the health before, during pregnancy, and between consecutive pregnancies, such as the risk of fetal mortality, intrauterine growth retardation, low birth weight, preterm delivery, reduction of congenital anomalies, poor brain development, and risk of infection[18-21]; the findings of this study are consistent with the results of them.

The interviewees noted that guidance on mental healthcare, before and after delivery, is effective in identifying high-risk mothers' mental health problems. According to Kmietowicz,[22] 12% of women experience depression, and 13% experience anxiety, during and after pregnancy. These disorders affect 20% of women during a year after delivery. Self-care about tobacco, alcohol, and drug abuse during pregnancy are other dimensions of psycho-behavioral care. According to Rezzoug *et al*.,[23] smoking leads to an increased retardation risk of intrauterine growth.

The findings show that the management of maternal physical activity is important in pregnancy care. Garnweidner-Holme *et al*.[24] designed fields in his app for recording the amount of time pregnant women spent on physical activity. He provides information about physical activity tailored to mothers before pregnancy condition and images of physical activity tailored to individual preferences. This is consistent with Kiani and Pirzadeh's[25] findings who state that the use of mobile applications improves the level of physical activity of pregnant women because the use of videos, photos, gifs, and music in the applications could help facilitate learning and acquisition of physical activity skills and motivation.

The interviewees state that they had experienced changes in their sleep patterns. According to Shi *et al*.[26] and Shiga *et al*.,[27] due to changes in sleep patterns, sleep disorders are common during pregnancy. An increase in sleep duration and drowsiness has been observed during the first trimester of pregnancy, while in the third trimester and the first month after delivery, the mother experiences a decrease in sleep time and an increase in nocturnal awakenings. Therefore, care for sleep disorders during pregnancy should be considered.

Interviewees highlighted that evaluating physical activity during pregnancy is important. According to Krzepota *et al*.,[28] exercise causes positive physiological and psychological changes during pregnancy. Guidance on the type, duration, and intensity of physical activity during pregnancy is vital to maternal-fetus health. It is also beneficial for mothers to monitor health behaviors, prevent obesity, and plan and promote physical activity programs.

The interviewees state that it is necessary for providers to be able to remotely monitor and control the mother's condition and send an appropriate response to her. In her app, Jahanbakhsh *et al*.[29] developed the ability to automatically send high-risk symptoms to a doctor. The app warns the user in case of high blood pressure, overweight, and high blood sugar, and also gives alerts when needed. This app makes it possible for the user to communicate with the physician in case of high-risk signs by sending a short message to the doctor.

From the interviewees' view, enabling fetal monitoring is important. They emphasized that the messages about fetal growth and change in the mother's body were instructive and entertaining and it can facilitate the use of the self-care apps. This is consistent with Velu *et al.'s*[30] findings who state that informing the mother about fetal growth improves her perception of the effects of pregnancy on her work situation. Through fetal monitoring, women with high-risk pregnancies can receive more specific consultations. They also found it helpful to recall specific personal advice based on previous risk analysis in the app.

According to interviewees, it is important to prevent a mother's high-risk symptoms. Timely lifestyle interventions that target high-risk mothers are necessary. The findings corroborate Moholdt and Hawley[31] and Bogaerts *et al*.[11] results. Many interviewees also noted that they are unaware of their optimal blood sugar level. They were of the opinion that a self-care app can

facilitate recording and controlling their blood sugar levels which is consistent with the results reported by Jahanbakhsh *et al*.[29]

The interviewees believe that pregnancy self-care should have a couple-oriented approach and consider the participation and companionship of husbands, which is consistent with Charandabi *et al*.[1] results that state husbands should be involved in receiving maternity care, participating in household affairs, providing health advice to the wife, and empowering women to improve their reproductive health to reduce mortality, improve women's health, and reduce inequalities. According to the findings, pedagogical materials were considered important for accompanying fathers and all spouses are interested in learning more about their wife's pregnancy.

Ledford *et al*.[32] mentions that mothers used mobile apps to record more information about their pregnancies. The unique features of mobile apps allow the mother to record information during and between appointments. This creates a portable electronic health record. Women vote for mobile apps that provide regular notifications and allow the mother to track her own data. Mobile apps are used to involve women to change behavior during pregnancy.

In all countries, many pregnancy self-care applications have been created in different languages. But in the meantime, Persian language applications are lower in terms of content quality and the quantity of the features provided to pregnant women than other applications. On the other hand, pregnant mothers' interests and enthusiasm for using mobile applications were significant. In this study, the different aspects of the operational needs of a self-care mobile application are collected from the perspective of pregnant women.

Limitations and recommendation

It should be noted that interviewees were not physically fit to sit for a long time. Besides, some of them did not have enough time for interviews. This is a common problem in qualitative data gathering. In the end, the interviews were conducted regarding the willingness of the interviewees in their presence and whenever there was a break during receiving care. Due to the coronavirus disease 2019 (Covid-19) pandemic, the duration of the interviews took a long time. Analysis, coding, and classification of the features are subjective and depend on the skill, expertise, and knowledge of the analyst; accordingly, there may be differences from person to person. Of course, it has been tried to be done carefully considering various aspects of care.

Developing pregnancy self-care mobile application for Iranian women based on the presented needs findings and Developing pre-pregnancy and post-partum self-care application for Iranian women;

Also, Usability and effectiveness evaluation of the application are suggested for future research.

Conclusion

According to the finding, pregnant women tend to use apps during pregnancy but due to the lack of comprehensiveness of apps, they search the Internet in response to some of their information needs. The findings of this study can be useful for designing an APSC that is localized based on the operational needs of pregnant women to make them capable and self-caring in controlling pre-risk situations.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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