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Review

Gestational Diabetes Mellitus Postpartum Follow-Up Testing: Challenges and Solutions

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Key Messages

- Rates of postpartum follow up for diabetes testing have been low in most parts of the world, and issues related to poor follow-up rates need to be addressed.
- Use of proactive reminder systems using mobile health technology is one key strategy discussed in this review.
- The Women in India with Gestational Diabetes Mellitus Strategy project, which adopted several strategies that led to a 95.8% postpartum follow up, is presented.

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ABSTRACT

One in every 4 pregnancies is affected by hyperglycemia, of which 90% is gestational diabetes mellitus (GDM). Women with GDM are at a high risk of developing both short- and long-term complications. Various studies have shown the heightened risk of type 2 diabetes among women with GDM. Despite clear evidence from published literature about the substantial risk that GDM imposes on women after delivery, rates of postpartum follow up have been low in most parts of the world. Several reasons, such as lack of awareness among health-care professionals and patient-related barriers, such as emotional stress and adjusting to motherhood, have been cited as reasons for poor follow-up rates. To address these issues and come up with solutions to improve postpartum follow-up rates, it is important to understand these barriers both from the patient and the health-care system points of view. In this review, we have summarized some of the key issues contributing to the low postpartum follow-up rates and have discussed possible strategies to tackle them. Use of proactive reminder systems, such as postal service, telephone call, short messaging service and e-mail, recall registries for GDM and utilization of mobile health technology are some of the key strategies that have been discussed in this review. A brief note on the Women in India with GDM Strategy project, which developed a model of care for GDM in resource-constrained settings and adopted several strategies that led to a 95.8% postpartum follow up, has also been presented.

Mots clés:
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RÉSUMÉ

Une femme enceinte sur 4 est atteinte d'hyperglycémie. Parmi ces femmes, 90 % sont atteintes du diabète sucré gestationnel (DSG). Les femmes atteintes du DSG sont exposées à un risque élevé de subir des complications à court et à long termes. Plusieurs études ont montré que les femmes atteintes du DSG sont exposées à un risque accru de diabète de type 2. Bien que la littérature publiée ait clairement

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montré que le DSG fait courir un risque important aux femmes après l'accouchement, les taux de suivi post-partum étaient faibles dans la plupart des régions du monde. Plusieurs raisons ont été avancées pour expliquer les faibles taux de suivi. Parmi ces raisons, notons le manque de connaissances des professionnels des soins de santé et les obstacles liés à la patiente, comme le stress émotionnel et l'adaptation à la maternité. Pour aborder ces questions et trouver des solutions pour améliorer les taux de suivi post-partum, il est important de comprendre les obstacles liés à la patiente et le point de vue du système de soins de santé. Dans la présente revue, nous avons résumé certaines de ces grandes questions qui contribuent aux faibles taux de suivi post-partum et avons discuté des stratégies possibles pour y remédier. Le recours aux systèmes proactifs de rappel, comme les services postaux, les appels téléphoniques, les messages textes et les courriels, les registres de rappels du DSG et l'utilisation des technologies mobiles en santé constituent les grandes stratégies dont nous parlons dans cette revue. Nous avons également présenté une note succincte sur le projet Women in India with GDM Strategy, qui a permis l'élaboration d'un modèle de soins aux patientes atteintes de DSG dans des contextes de ressources limitées et l'adoption de nombreuses stratégies ayant mené à un suivi post-partum de 95,8 %.

Introduction

Gestational diabetes mellitus (GDM) affects 1% to 14% of pregnant women worldwide. According to the International Diabetes Federation (IDF), 1 in every 4 pregnancies is affected by hyperglycemia, of which 90% is GDM (1). It is well recognized that women with GDM are at a higher risk of developing adverse complications, both in the short term and long term (2). Several studies have highlighted the heightened risk of development of type 2 diabetes among women with GDM (3,4). A recent meta-analysis reviewed 2,626,905 women from 30 cohort studies and showed that women with GDM had a substantially high risk (odds ratio, 17.92) for developing type 2 diabetes (5).

Despite such clear evidence from published literature and recommendations from various scientific societies on the importance of postpartum screening, rates of postpartum follow up have been abysmally low in most parts of the world (6). Lack of awareness among health-care professionals and patient-related barriers, such as emotional stress and adjusting to motherhood, have been cited as possible explanations for the poor postpartum follow-up rates (7).

In this review, we aim to summarize some of the key issues contributing to the low postpartum follow-up rates and discuss possible strategies for improving postpartum follow up in women with GDM.

What Do the Current Guidelines Say About Postpartum Testing for Diabetes in Women With GDM?

Several scientific societies have put forward guidelines for postpartum testing of diabetes in women with GDM. Most of them recommend a 2-h oral glucose tolerance test (OGTT) using diabetes criteria applicable to nonpregnant women. Table 1 summarizes some of the current guidelines. The Fifth International Workshop-Conference on Gestational Diabetes Mellitus, the Endocrine Society and the Australasian Diabetes in Pregnancy Society recommend the 2-h 75-g OGTT at 6 to 12 weeks' postpartum (8–10). The 2013 Canadian Diabetes Association (now, Diabetes Canada) clinical practice guidelines also recommends the 75-g OGTT but at a different time frame (6 weeks to 6 months), whereas the American College of Obstetricians and Gynecologists recommends either a 75-g OGTT or a fasting plasma glucose at 6 to 12 weeks' postpartum (11,12). The American Diabetes Association recommends only the OGTT but at 4 to 12 weeks' postpartum (13). The National Institute for Health and Care Excellence guidelines recommend only fasting plasma glucose at 6 to 13 weeks' postpartum (14).

Although the OGTT is considered the criterion standard and also the most sensitive tool to detect diabetes, having to undergo the test in the morning in the fasting state, especially for a new mother who has to deal with the needs of a newborn, makes it a cumbersome task. This is cited as one of the main reasons for low rates of follow up. In efforts to make the testing easier, some studies tried to investigate the utility of glycated hemoglobin (A1C) (which can be done in a nonfasting state) instead of the 2-h OGTT. However, A1C lacks the sensitivity to detect hyperglycemia and, therefore, could not obviate the need for the OGTT (15–17). Claesson et al (15) showed that the sensitivity of A1C for diagnosing diabetes in women with a previous history of GDM was 69.2% (specificity, 59.7%), based on a cutoff value of 5.2% (area under the curve [AUC], 0.708). Another study by Katreddy et al (16) showed that a cutoff of 6.5% had a sensitivity of 71.4% and specificity of 98.5%, with an AUC of 0.98. A meta-analysis that evaluated the accuracy of A1C pooled results from 6 studies and reported a sensitivity of 0.36 (95% confidence interval, 0.23 to 0.52) and specificity of 0.85 (95% confidence interval, 0.73 to 0.92), with an AUC of 0.67, indicating that A1C was not suitable for screening or diagnosing diabetes or abnormal glucose tolerance postpartum (17).

Compliance to screening

Women with a history of GDM in their previous pregnancies and women on insulin therapy during pregnancy were found to be more adherent to postpartum follow up (18). This is probably because of greater awareness of their risk of future diabetes. In a systematic review, it was reported that, apart from the use of

Table 1
Guidelines for postpartum screening for diabetes among women with gestational diabetes mellitus

Year	Organization	Postpartum time period recommended	Type of test recommended
2007	Fifth International Workshop-Conference on Gestational Diabetes Mellitus	6–12 weeks' postpartum	2-h 75-g OGTT
2013	Endocrine Society	6–12 weeks' postpartum	2-h 75-g OGTT
2013	Canadian Diabetes Association (now, Diabetes Canada)	6 weeks' to 6 months' postpartum	2-h 75-g OGTT
2013	American College of Obstetricians and Gynecologists	6–12 weeks' postpartum	2-h 75-g OGTT or FPG
2014	Australasian Diabetes in Pregnancy Society	6–12 weeks' postpartum	2-h 75-g OGTT
2015	National Institute for Health and Care Excellence	6–12 weeks' postpartum	FPG
2017	American Diabetes Association	4–12 weeks' postpartum	2-h 75-g OGTT

FPG, fasting plasma glucose; *OGTT,* oral glucose tolerance test.

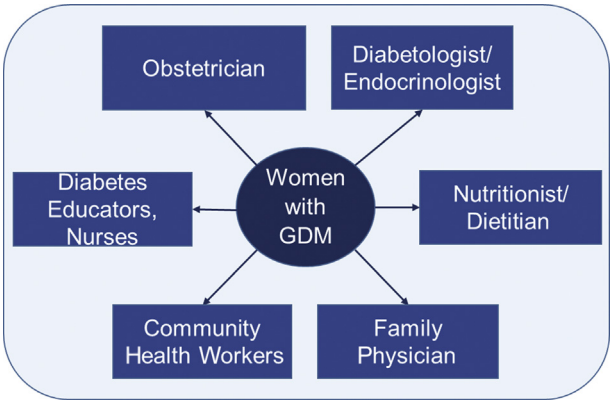

Figure 1. Key points of contact within the health-care system. *GDM,* gestational diabetes mellitus.

insulin, other factors associated with higher rates of follow up are higher maternal age, primiparity, higher income and higher education (19). A recent study showed that patients seeing a resident physician or a midwife were more likely to undergo postpartum testing (20). It is, therefore, imperative that every member of the health-care system who is in touch with women with GDM takes that extra effort to reinforce the importance of postpartum screening. Figure 1 shows some of the key health-care professionals who interact with women with GDM.

Several studies have looked at reasons for noncompliance for postpartum testing, considering it both from the patient's and health-care professional's perspective. A study from The Netherlands indicated that lack of agreed protocols, unclear communication by the physician in secondary care and insufficient attention for GDM follow up in the primary care system could be possible reasons (21). A qualitative study in Denmark tried to understand the experiences of women during pregnancy and how that experience affected or influenced their participation in the follow up (22). Their results showed that women experienced lack of continuity and improper care and coordination from the health system. Difficulties expressed by women included excessive waiting time to meet health-care providers and little communication about health risks. Moreover, they felt they were given very little or no priority by health-care professionals. These experiences expressed by the women reflected poor patient-centric care, which ultimately affected the women's decision to return to the physician or the health centre to complete their postpartum diabetes testing. Because of lack of time, physicians often tend to rush through their consultations, just conveying the information about follow-up briefly or by handing out brochures, rather than reinforcing the need for this or examining the patient's understanding of the issue (22).

From the health system point of view, the absence of standardized postpartum care for women has been identified as a barrier. Specifically, diabetes-related policies meant for doctors do not reach the primary care clinic. This gap in communication between the delivery unit where the women delivers and the primary care clinic where these women return for the postpartum check-up has led to confusion and uncertainty among the health-care provider's regarding postpartum screening for diabetes. Shah et al (23) evaluated the long-term trends in postpartum testing for diabetes and showed that despite high rates of postpartum visits to family physicians and obstetricians between 1994 and 2008, very few women with GDM actually received the testing. It is, therefore, essential to target intervention among physicians in both primary and secondary care, setting up proper communication channels between them to ensure that women with GDM receive postpartum testing and do not undergo subsequent pregnancies with undiagnosed diabetes, which would worsen their chance for a healthy pregnancy.

Table 2 highlights some of the key challenges in postpartum follow up and outlines some ways to address them.

After delivery, women continue to face several other barriers that affect postpartum follow up. Women go through emotional stress and face difficulty adjusting to motherhood. In such situations, women find it difficult to come for postpartum testing in the fasting state, especially when breastfeeding throughout the night. Because of these reasons, loss to follow up after delivery is very high. Except for a visit or 2 after delivery, women subsequently lose touch with their obstetrician. They do, however, regularly visit their family doctor. This could be one of the best opportunities to remind women to undergo postpartum testing. Family physicians should be made aware of the women's history of GDM and efforts must be taken to ensure that women undergo postpartum testing.

Do Proactive Systems Help Improve Postpartum Glucose Testing Rates?

Several studies in recent years have tried to increase postpartum follow up using strategic systems. Rate of adherence to postpartum follow up has been shown to be better when proactive systems are in place, in addition to routine care. The extra effort and time taken by the health-care provider, by sending reminders to patients to return for follow-up, through telephone, e-mail or short messaging service (SMS), increased the odds of a postpartum visit by 3 times more than when reminders were not sent (24). Figure 2 represents some of these systems that can help improve follow up.

Reminder systems

A randomized controlled trial in Canada conducted in the year 2009 evaluated the effectiveness of postal reminders and showed that the rate of follow up in a group that received reminders (both patients and physicians) was 60.5% compared with 14.3% in the group that did not receive any reminder (25). However, when this reminder system was introduced into routine care, the effectiveness was not as high as it was in the randomized controlled trial (2.8% vs 13.5%) (26). This gap in translation of research to health-care practice needs to be considered as an important issue that needs to be addressed by the health-care system and policymakers.

Lega et al (27) showed that a physician-based reminder system was effective in improving postpartum screening rates to 62% compared with the group that did not receive a reminder (36%). Hunt and Conway (28) showed that hiring case manager nurses to contact patients postpartum at least thrice, and providing an option of home blood sample collection for completing the OGTT, increased the rate of follow up from 18% to 57%. A Finnish study found that rates of follow up increased after a phone call reminder given by nurses (29). This is consistent with what was observed in other studies where a personalized approach, such as making telephone calls in lieu of e-mails or letters, improves screening rates and enhances the patient's commitment (30). Another study by Vesco et al (31) showed that by bringing in nurses who, in addition to routine duties, would coordinate the care for women with GDM by following them using an electronic system to send out reminders, markedly increased the adherence rate from 9% to 71.5%.

GDM recall register

The South Australian GDM Recall Register is an example of following up with women with a history of GDM over the long

Table 2
Challenges in postpartum follow up and suggested solutions to address them

Challenges in postpartum follow up	Solutions to address the challenges
Inconsistent guidelines	Physicians need to stay updated on the current recommendations and guidelines.
Lack of communication/collaboration among physicians in primary and secondary care	Proper communication channel to be set up between health-care providers in primary and secondary care, so physicians can be aware of the patient's history of GDM and make the test mandatory to all women who have had GDM.
Little communication given to women during pregnancy about risk of not undergoing postpartum testing, leading to • Women not considering the test necessary or declining the test • Women having wrong perception of postpartum health—feeling healthy and not in need for care or fear of receiving bad news	Women should be educated about GDM and the associated risks right from preconception stage. They should be informed about the need for postpartum testing and consequences of noncompliance to testing in their early antenatal visits and repeatedly thereafter to reinforce the message.
Adjustment to the new baby—emotional stress, feeling overwhelmed and lack of time	Support system from health-care service providers and dedicated team of certified professionals, such as diabetes educators, nurses, dietitians/nutritionists and lactation consultants, who can provide appropriate counselling to make the transition into motherhood easier for women.
Loss to follow up after delivery	Repeated reminders during the antenatal period and proper follow up and reminders in the health-care system that enable health-care providers to follow up with women after delivery.
Logistics of accessing care postpartum—difficulty to come to the hospital for testing in fasting, especially when breastfeeding throughout the night	Health-care providers can implement home care services to help women undergo blood testing at home after delivery.
Other domestic responsibilities make it difficult for women to take time out to visit the hospital for testing	
Financial constraints, especially for women belonging to low socioeconomic strata	Health-care providers and policymakers should help cover costs involved in investigations and, if possible, provide transport to women who cannot afford it.

GDM, gestational diabetes mellitus.

term. Women with GDM were invited to enrol into the register during their pregnancy. Their details were entered into the register. The recall function works through reminder letter sent out to the women. The first reminder was sent out 15 months after their delivery, with subsequent reminders sent to all women every 12 months. After the first reminder was sent out, 56% of the women reported to have completed an OGTT in the previous 12 months. In the subsequent years, the number of women who completed the testing gradually increased and, in the sixth year, after the sixth reminder letter was sent out, 66.7% of the women reported to have completed postpartum testing (32).

In Belgium, the GDM Recall Registry sent out reminders to women with GDM postpartum. After the first year, 67.4% of the women reported having completed the screening test, and after the fifth year, this increased to 71.9%. This is one of the few studies that has provided data on successful use of a recall register in the long term and has been implemented in several parts of Belgium as part of routine care (33).

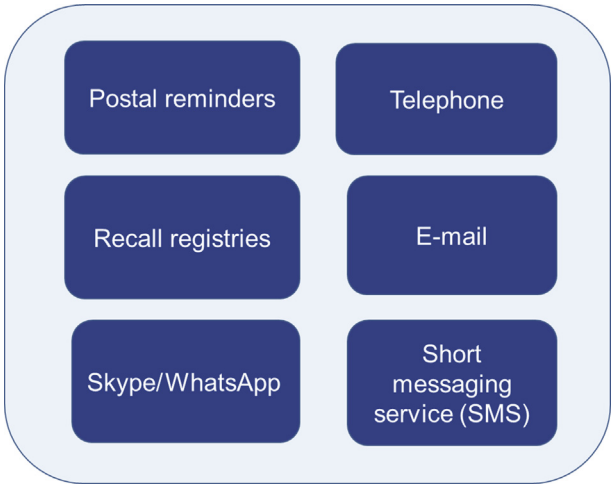

Figure 2. Proactive systems to improve postpartum glucose testing rates.

Use of mobile health technology

SMS reminders

A systematic review assessing the importance of reminder systems concluded that irrespective of the type of reminder sent to the patient or physician, this kind of proactive system showed an effect in increasing the rates of follow up (34). The DIAMIND trial, one of the first published randomized controlled trials examining the efficacy of SMS reminders for increasing postpartum screening, showed a higher rate of screening than in many previous studies. The women in the intervention group received a SMS reminder at 6 weeks' postpartum, with a further reminder at 3 and 6 months, if needed, whereas the control group received one text reminder at 6 months' postpartum. With the primary outcome being OGTT attendance at 6 months' postpartum, the authors observed that 77% of women in the intervention group and 76% of women in the control group came for the OGTT at 6 months' postpartum. The South Australian GDM Recall Register, which was established in 2002, merged with the National Gestational Diabetes Register prior to the start of the DIAMIND trial. Of women in both study arms, >87% of them had reported to have been offered to join the Australian National Gestational Diabetes Register, of whom 83% had joined and received reminders at 12 to 16 weeks from the register. The fact that these women were followed up with, not just by the DIAMIND trial, but were also being sent reminders from the national registries, could have positively influenced the improved postpartum OGTT follow-up rates. The authors noted that in such trials with behavioural outcome, participation in research itself could contribute to the observed frequency of the behavioural outcome (35).

Presumably, the increased awareness of type 2 diabetes and the importance of postpartum testing prompted both study groups to participate in the testing. The researchers of the DIAMIND trial further assessed the views of these women who participated in the trial on their preferred type of postpartum reminder system. Most of the women preferred SMS over e-mail letters or voice calls (36). Given the increasing use of cell phones and access to Internet, electronic reminders are likely to improve postpartum attendance rates in the future.

Mobile application on smartphones

Yet another way to implement a proactive system would be by maximizing the current innovations in the field of mobile applications. With the emergence of smartphones and mobile apps with their greater reach, it is now possible to access large numbers of patients cost effectively and easily. With the increasing number of users across the globe, use of mobile health (mHealth) technology, specifically mobile applications on smartphones to deliver individual-level care, above and beyond the traditional clinic-based care, provides a unique opportunity to communicate with and motivate women to return for their postpartum follow up (37). Results from randomized controlled trials that involve mobile phone application-based interventions, and Bluetooth-enabled glucose meters, show promising results for self-management of diabetes (38,39). Adolescents and young adults with type 1 diabetes represent a unique population. With a higher percentage of mobile phone users falling under this age group, it is of interest to researchers to investigate the impact of real-time, multimedia approaches to diabetes self-management in this population. A recent review consolidated evidence from several systematic reviews on the effectiveness of mHealth interventions for patients with diabetes. It concluded that mHealth interventions represent a promising approach for self-managing diabetes (40).

Currently, very few mHealth-based studies involving pregnant women with GDM are being carried out (41). A recent systematic review meta-analysis discussed 10 studies that have assessed the effective of eHealth technologies, such as SMS-based intervention, biosensor/activity monitors, such as pedometers, web-based dietary intervention and interactive communication between participant and health-care professionals on weight management in pregnant and postpartum women. The authors concluded that the use of these technologies was associated with a clinically significant weight reduction during the postpartum period (41).

Indeed, mHealth could help to connect to patients, improve the delivery of health care and maintain a close communication with women who otherwise tend to get lost to follow up after delivery. Such technology, however, needs to be designed with care, especially for pregnant women. Although there are several mHealth apps publicly available on Apple and Google Play Store, access to quality information and guidance from certified professionals who are trained to provide individual counselling and education is very limited. Future studies should investigate the safety and clinical effectiveness of mobile apps and build evidence on the optimal type of mHealth intervention for different types of patients.

The Women in India With GDM Strategy Project

The Women in India with GDM Strategy (WINGS) project developed a model of care for women with GDM in low-resource settings. The project was conducted in Chennai, India. The model of care was developed using best practice of care with the aim of establishing guidelines for GDM. To ensure that the model was culturally appropriate and practically feasible, the model of care was implemented in Chennai to assess its impact (42). The model tried to address some of these critical gaps in a low-resource context, in accordance with the recommendations outlined in the IDF's Global Call to Action and Policy Brief on Diabetes in Pregnancy. Under the model of care, women with GDM were followed up with throughout their pregnancy by health-care professionals who were trained under the project. They were educated about GDM and its impact on their health and their babies through face-to-face counselling with nutritionists and health-care professionals. Women were provided educational booklets and were motivated to track their dietary pattern and physical activity. The model was found to be effective in reducing the rate of both maternal and neonatal complications in women with GDM, to levels similar to women with normoglycemia (43).

One of the most important results from the project was the 95.8% postpartum follow-up rate achieved (44). After delivery, women were followed up with through telephone calls and reminded about returning back to the hospital for postpartum testing. For women who were unable to make the trip to the hospital because of the demands of a newborn, postpartum testing was arranged for them at their respective homes. As is the situation in several parts of India, many women moved to their mother's place for delivery. Foreseeing this, demographic details about the women's family and contact telephone number were collected during the study. The women's family was contacted and details about delivery, maternal and neonatal status were collected through telephone. Some of these women who were not expected to return back to Chennai for several months after the delivery were requested to undergo the testing for diabetes in a hospital or laboratory close to their home. Women who had left the country after delivery were contacted through WhatsApp and e-mail and reminded about undergoing testing, to which they complied and sent back their OGTT results. Ultimately, thanks to all these efforts, a 95.8% postpartum follow-up rate was achieved (44). The WINGS GDM model of care, therefore, proved to be successful to screen and manage women with GDM in India.

Conclusions

In view of the rapid conversion to type 2 diabetes after GDM, it is important to emphasize the value of postpartum screening with cultural adaptations to achieve the same in different populations. Barriers to postpartum screening at both individual and health-care provider levels must be addressed to improve compliance rates and ensure that women with a previous history of GDM do not undergo subsequent pregnancies with undetected diabetes. Staying updated on the current recommendations; providing dedicated teams of professionals to provide personalized counselling; implementing home care services wherever possible; introducing proactive systems, such as recall registries, and using reminder systems are some ways in which the health-care system can address the low postpartum follow-up rates. Women must be given adequate information about the impact of GDM on their health, which could help improve postpartum follow-up testing. Future research on GDM should focus on the impact of introducing mHealth application into clinical practice. Studies that test such mHealth interventions should be designed with input and feedback from both end users (women with GDM) and health-care providers.

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Conflicts of interest: None.

Author Contributions

B.B. and V.M. drafted the initial manuscript, which was validated by R.M.A., M.D. and R.U. in subsequent versions.

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