An innovative mobile application for gestational diabetes health education during the COVID-19 pandemic

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Submitted to: Journal of Medical Internet Research
on: March 23, 2021

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Abstract

In the integrated management of gestational diabetes mellitus (GDM), health education plays an important role and directly affects patients' blood glucose level control, pregnancy, and neonatal outcome. The rapid growth of the Internet has ushered in an era of big data and the rational use of the Internet. We developed an innovative mobile application (app) combining a teaching model of the flipped classroom and GDM management, which allows pregnant women to learn about and help prevent GDM. This app can overcome the treatment barriers for those patients that cannot go to the hospital, enhance health promotion efforts, and improve GDM management.

(JMIR Preprints 23/03/2021:28964)
DOI: https://doi.org/10.2196/preprints.28964

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Original Manuscript

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In the integrated management of gestational diabetes mellitus (GDM), health education plays an important role and directly affects patients' blood glucose level control, pregnancy, and neonatal outcome. The rapid growth of the Internet has ushered in an era of big data and the rational use of the Internet. We developed an innovative mobile application (app) combining a teaching model of the flipped classroom and GDM management, which allows pregnant women to learn about and help prevent GDM. This app can overcome the treatment barriers for those patients that cannot go to the hospital, enhance health promotion efforts, and improve GDM management.

Keywords**:** gestational diabetes, mobile app, flipped classroom, the Internet, health education

Introduction
Gestational diabetes mellitus (GDM) refers to the first appearance of glucose tolerance during pregnancy.[1] GDM can cause many complications and adverse pregnancy outcomes; for example, pregnant women might experience cesarean section or premature delivery, intrapartum injury, and preeclampsia, and newborns might suffer from macrosomia, neonatal hypoglycemia, or shoulder dystocia.[2,3]

Pregnant women suffering from GDM are more likely to develop type 2 diabetes[4] and other cardiovascular diseases[5] than normal pregnant women, and their children are more likely to develop metabolic diseases, such as obesity and diabetes.[6] Given such increasing prevalence and non-ignorable short- and long-term maternal-fetal impairments, GDM has become one of the most concerning pregnancy complications in obstetrics. Since the implementation of the two-child policy in China, the proportion of elderly parturient women has increased significantly, with the incidence of GDM in mainland China increasing to 14.8%, according to the latest systematic review and meta-analysis.[7] There is still a need to improve health education for pregnant women with GDM along with the continued implementation of the two-child policy.

Multiple studies have shown that effective health education for pregnant women can help control the blood glucose level of GDM patients and thus reduce the occurrence of GDM and the incidence of adverse pregnancy outcomes.[8-11]

Limitation of the traditional model of GDM education
Traditional gestational diabetes education commonly includes special care to provide balanced meals for standard gestational diabetes; basic knowledge of gestational diabetes; reasonable and effective exercise; and a 2-h practical experience in measuring blood glucose before meals and after meals. However, in this traditional teaching model, patients might not necessarily receive the health knowledge they need, so it is necessary to change the traditional teaching model.

Furthermore, the traditional model of GDM education is usually conducted offline. However, in the context of the ongoing COVID-19 epidemic, the continued development of offline courses is not practical. During an epidemic, pregnant women should avoid unnecessary hospital visits and minimize the risk of cross-infection, yet health care during pregnancy remains an important task. Personalized medical guidance for patients with GDM should be considered essential and cannot be

halted during an epidemic. Therefore, it is imperative to develop an online education platform to deliver teaching and training.

A new model of GDM health education

In recent years, the flipped classroom has become a popular teaching model. This teaching method flips the traditional process and no longer relies on the passive indoctrination of the instructor. This flipped mode enables active learning by providing a before-class preview, which can facilitate a learner-led classroom. This flipped classroom can help improve learners' motivation and encourage them to pursue higher learning goals.[12] It turns passive learners into active learners, leads them to preview before class, and takes the lead in the classroom, mobilizing learners' enthusiasm to achieve good teaching results.

For GDM patients, prior to the classroom, they are given relevant health education materials and tasks, such as multimedia teaching, recipe formulation, and blood glucose recording. In the classroom, patients share recipes and records that are equivalent to companion education through group discussion, and health educators only act as assistants to provide necessary help and guidance, which transforms the main role of the participants. Thus, each pregnant woman's subjective initiative can be fully supported.

It should be noted that adult education theory is different from school-age education. Adults learn on-demand and are more enthusiastic about learning on their own, rather than passively receiving knowledge from teachers. Therefore, it is useful to apply the flipped classroom model – which includes peer education, group discussion, case teaching, audience interaction, and experience practice – to carry out the GDM health education model for adult learners.

Due to the COVID-19 epidemic, onsite education has been forced to adapt to online programs, such as health education of GDM. In the current big data era, the use of an app is more convenient than ever before, and this convenience has prompt us to develop a useful app that can be used to conduct online health education for patients with GDM.

When pregnant patients agree to participate in this project, they need to sign an informed consent form in the hospital before starting the online program on the app. At the first outpatient visit, patients can join the research group by scanning the doctor's QR code on a medical advice assistant application. After registering on the official account, patients need to fill in their basic personal and demographic information and complete a dietary review, a nutritional supplement survey, and other questionnaires on second-hand smoke exposure, physical activity during work, and physical activity during pregnancy. All information will be uploaded to the data-protected Scientific Research Cloud Platform (Fig. 1), and they will be reviewed and summarized into a detailed and complete report by a dedicated person. The platform will also record the patient's weight and blood glucose concentration and generate a table for observation and research (Fig. 2 and 3).

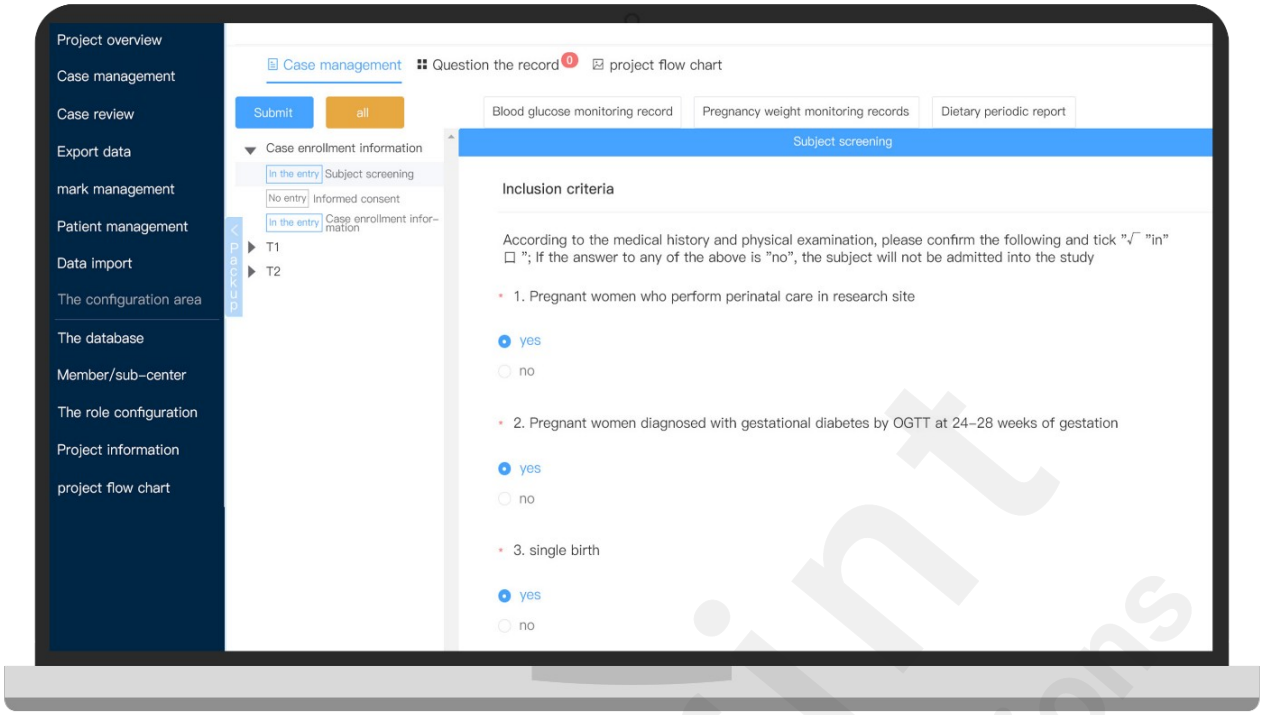

Figure 1. The interface of the Scientific Research Cloud Platform.

Figure 2. Blood glucose monitoring record sheet.

Figure 3. Weight record sheet.

The implementation of this new model requires mutual effort from both the doctors and patients. For doctors, they need to group participating patients, make appointments for group teaching, and provide GDM patients with relevant health education materials and tasks, as well as electronic materials, such as multimedia teaching, formula formulation, and online blood glucose records. For patients, they need to learn the basic knowledge of gestational diabetes, nutrition, exercise, and blood glucose monitoring on the app (Fig. 4) by themselves before participating in the class. At the same time, patients are required to record their exercise and diet 3 days before class and upload them to the app for mutual evaluation. Patients can choose whether to purchase a blood glucose meter by themselves to monitor their blood glucose levels 2-h after three meals each day. The blood glucose test operation can be learned through online video teaching.

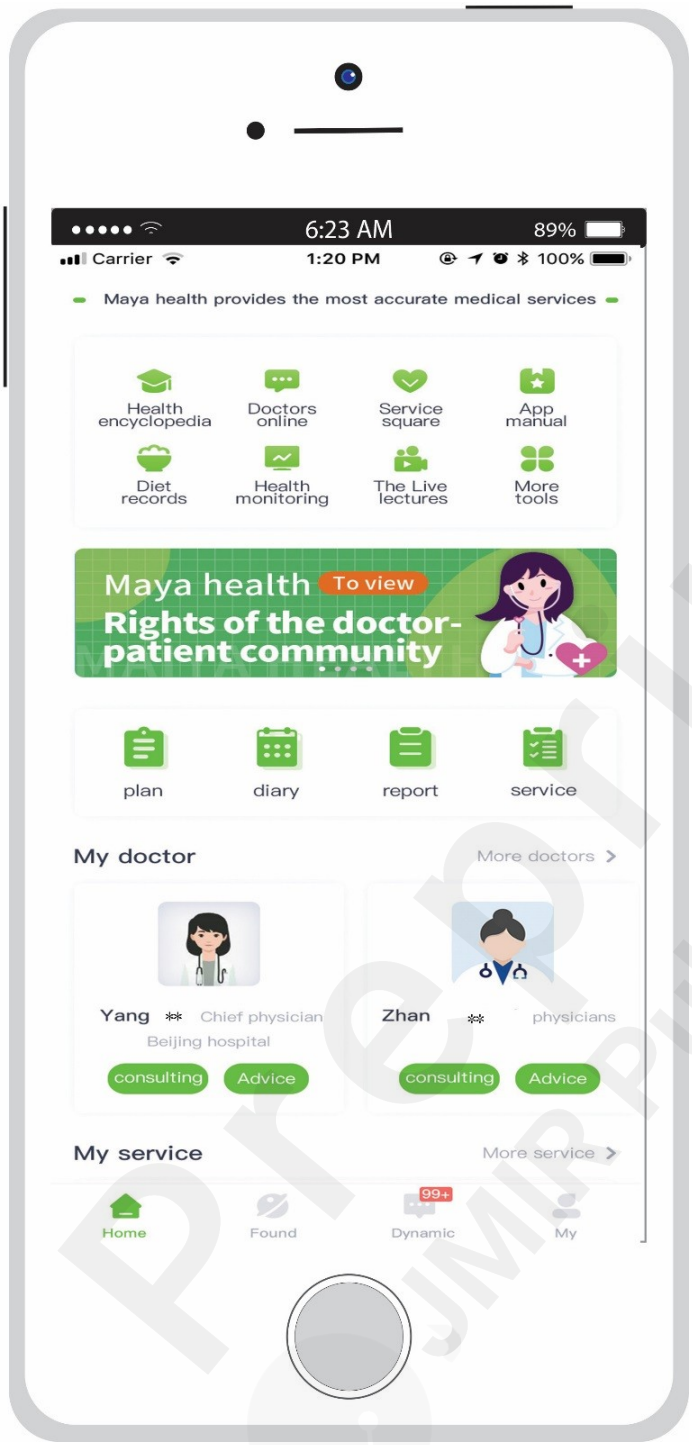

Figure 4. The main interface of the app/application.

The training and evaluation of the instructors on the app are rigorous. All the instructors who coordinate the flipped classroom have received training, and only started to work after passing the assessment. They implement the courses in accordance with standardized courses, and perform the quality control of physical examinations and blood glucose monitoring, which are all implemented in accordance with relevant clinical standards. After completion of the course, several assessments are conducted: the instructor's self-evaluation and the participants' satisfaction with the course, the mastery of gestational diabetes-related skills, and the improvement of knowledge.

After class, patients can join the doctor-patient community using the app, which is assisted by the research team and health managers. The main parts of the community include top news; topic notification; health knowledge where including pictures and videos; essence, which is the better

patient check-ins or posts set by health managers; patient stories, “Excellent cases” configured by health managers; questions posted by patients, where they can check the answers of doctors and health managers; and “Mine”, the content that patients posted to the app. The establishment of a doctor-patient community has many advantages, including increased patient activity and a reduced number of people who leave the group, separating WeChat and doctor-patient work, assisting in the management of patients and reducing the work of community management, activating peer education of patients and independent learning, and developing an active community, transforming services, and creating live lectures for patient education.

Some hospitals in Beijing have completed the standardized model of flipped classrooms, recorded a series of flipped classroom video materials, and compiled GDM-related electronic materials to facilitate online previews from patients, their families, and medical staff. Regardless of ongoing epidemic control or a normal state of medical services, multimedia and smart medical care can support patients. The application of online flipped classrooms in gestational diabetes health education is an attempt to digitalize patient support.

Future prospects

Due to the harm of GDM to pregnant women, not only will app and assistant applications be developed in the future, but also scientific research platforms, pregnancy nutrition diagnosis tools, and treatment systems. Meanwhile, the GDM flipped classroom model will be carried out through standardized online promotion, and GDM flipped classroom questionnaires will be designed to evaluate the effects of blood glucose and weight control, which carry out the quality control of questionnaires. Ultimately, GDM health management could be incorporated into routine diagnosis and treatment.

The form of education during the epidemic can have a meaningful impact on patients, and dietary patterns and blood glucose control measures have been experientially promoted. The short-term effect is obvious, but the promotion of health education needs to be greatly strengthened over the long term. Therefore, follow-up work is needed to maintain the effect of health education, and the follow-up method needs to be further explored. Also, we recommend that the health administration department accelerate the application of online flipped classrooms in gestational diabetes health education, as well as encourage further research on this approach. This model of combining GDM-related health education with a mobile app can be applied to other disciplines.

At the same time, the China Maternal and Child Health Collaboration Network[13] (a network comprised of people from administrative departments, maternity and child hospitals, and communities) has been formed to integrate social resources. This will help advance a societal understanding of maternal health and child nutrition.

Conclusion

The implementation of the online GDM flipped classroom is an innovative attempt in this field. The described approach is particularly relevant in the context of the ongoing global pandemic because it can accelerate knowledge transfer, improves the patient’s learning motivation, and has a health promotion effect. It also boosts the patient’s self-management efficiency. Video resources achieve the sharing of educational resources and effectively amplify the effect of education because they are easy to share. In the flipped classroom, the teachers’ teaching ability can be enhanced because the increased demand from patients poses a challenge to teachers. The development of mobile healthcare could help promote doctor-patient interaction. This is likely to have a positive impact on patients’ condition monitoring and treatment adjustment.

Conflicts of Interest

None declared.

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Abbreviations

GDM: Gestational diabetes mellitus

app: application

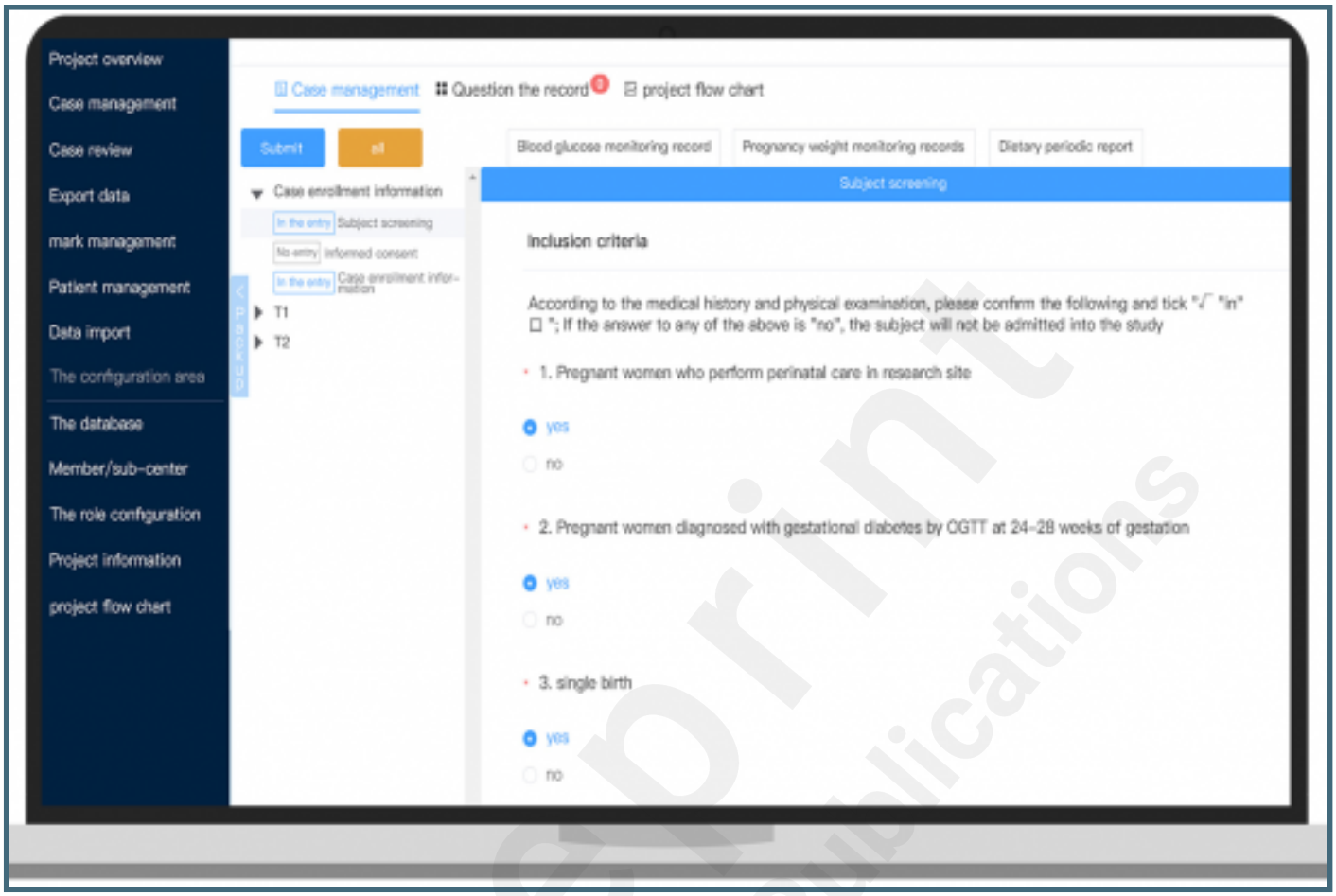
Thanks

Thanks to Beijing Malt Health Management Co., Ltd. for its help with the figure.

Supplementary Files

Figures

The interface of the Scientific Research Cloud Platform.



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