

Remote health care of gestational diabetes in the era of the COVID-19 pandemic: A web monitoring application

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Abstract:

The advent of the Covid-19 pandemic has led states around the world to impose several preventive measures in order to limit the spread of the infection, particularly among vulnerable people, including pregnant women. Indeed, a limitation of access to prenatal care has been observed at the level of recognized health structures, such as health centers; birthing homes; hospitals, general medicine or obstetrics gynecology practices. These systematic effects on the continuity of prenatal care as well as on the follow-up of gestational diabetes can lead to serious consequences for the mother/newborn couple. In this context coinciding with the era of digital health and from a reactive perception to overcome crisis situations, an innovative alternative is proposed by the development of a computer application allowing the realization of remote care. It is a means of communication between the carer and the patient and a facilitator of follow-up of gestational diabetes. It is applicable in both the public and private sectors and does not require a lot of resources or a high intellectual level.

Keywords: gestational diabetes, computer application, remote care, prenatal care.

1. Introduction

The association of diabetes and pregnancy is a frequent gestational situation that constitutes a real public health problem in Morocco as well as in many regions around the world [1]. It affects not only people in high-income countries, but also progressively people in low- and middle-income countries [2]. It is a very high-risk pregnancy due to inherent maternal and fetal complications, which can jeopardize both the functional and vital maternal-fetal prognosis [3].

The presence of diabetes during pregnancy can correspond either to pre-pregnancy diabetes diagnosed before pregnancy or to gestational diabetes. The latter is defined according to the WHO as a disorder of glucose tolerance leading to hyperglycemia of variable severity, beginning or first diagnosed during pregnancy, regardless of the necessary treatment and evolution in the postpartum. Classically, it appears between the 24th and 28th week of amenorrhea, following insulin resistance in pregnant women [4-5].

Of course, there is agreement on the need for screening for gestational diabetes as well as strict monitoring and codified management of any diabetic pregnancy [6]. However, many controversies still persist on the subject, particularly concerning the screening methods and diagnostic criteria for gestational diabetes, as well as the therapeutic objectives to target to limit complications [7-9]. In addition, data from the literature show a variable prevalence depending on the population and the test chosen [3]. In France, the average prevalence is between 2 and 6% [10]. At the national level, the studies carried out highlight prevalences ranging between 7.7% [11] and 24.5% [12].

The management of gestational diabetes (GD) is programmed as part of the overall management of pregnant women at the level of prenatal consultations, which are four in number. They are organized at the level of basic health centers and birth centres. They include, among other things, carrying out standard biological tests for pregnancies that are progressing normally and screening for certain risk factors, including diabetes, as well as carrying out additional tests for high-risk

pregnancies [13]. These are first-level health care services provided by doctors, nurses and midwives. The latter are generally the first point of contact with pregnant women [14-15].

The outbreak of the COVID-19 pandemic due to the corona virus has significantly affected the lifestyles of different populations around the world [16-17]. Indeed, the confinement imposed by the authorities of the various countries in order to fight against the spread of this pandemic [18], has induced several changes both in access to healthcare structures and in the continuity of assuming responsibility vis-à-vis -to vulnerable categories such as diabetic pregnant women. However, access to care is a primary concern for the various international and national health organizations. Indeed, to make the health system an efficient system and a model of care delivery in the face of the Covid-19 pandemic situation, all health actors (public authorities, doctors and patients) are called upon to work in harmony adopting "remote care" to ensure more equitable access to health care and services. This cannot be done without the adoption of a new care alternative [19]. In this perspective, the present work represents a digital alternative for the remote management of the GD.

2. Materials & Methods

The tool developed in this work is to fill the gap at the national level to overcome barriers to continuity of antenatal care for pregnant women with gestational diabetes, especially in times of crisis like the COVID-19 pandemic. A dynamic web solution accessible to the various stakeholders is therefore proposed as a tool for the care and monitoring of pregnant women with gestational diabetes according to the guidelines of the Moroccan Ministry of Health, through circular 013/2020 of March 03, 2020, with the aim of screening and management of gestational diabetes at the level of the health establishments of the Ministry of Health. This will allow traceability, archiving and real-time monitoring of operations. The tool developed will also serve as a dashboard and data ensuring the interaction between the healthcare professional and the client, on a permanent basis. Technically, it is a dynamic web application made by open source software.

It should be noted that the first version called "SDG" Gestational Diabetes Monitoring was designed in the French language, which is mastered by all health professionals. An eventual version will include several languages to facilitate use on a wider international scale.

3. Results

3.1 Description of the application

3.1.1 Caregiver profile

This profile is reserved for the caregiver: doctor, midwife, nurse or dietician, with a unique and confidential password, access is made through an authentication page to secure the application and data and also guarantee confidentiality. After a successful access, a dashboard is displayed, it contains five sections: 1) the first is reserved for the active woman; 2) the second concerns the different centers in case the caregiver takes care of diabetic pregnant women affiliated to other health structures, health center, private practice or others; 3) the third section represents the total of women followed; 4) the activity by center and by month; and 5) the distribution of women followed by health center.

Using the section reserved for the active woman, the caregiver can add a pregnant diabetic woman, this procedure goes through steps namely: 1) add the personal information (last name first name, ID card number...), 2) the caregiver adds the contact information of the pregnant diabetic woman related to address, phone number and email, 3) in this step the user adds the pregnancy information: gestational age, parity, number of children, ..., 4) this stage of the registration is reserved for various medical information, namely: (a) pathologies from which the woman suffers; (b) declared food allergies; (c) blood characteristics (group and rhesus); (d) existing immunity (toxoplasmosis and rubella); (e) anthropometry (weight, height and BMI), and 5) this is the last step of the registration of the pregnant diabetic woman through the introduction of the name of the health facility. In fact a user name and password are generated by the system, the expiration date of the account that is calculated on the basis of the gestational age. The data is saved, followed by the printing of a card for the registered woman.

The dashboard allows the user to visualize some information about the beneficiaries of the program, starting with the name and surname, then the date of birth, the health center where the pregnant diabetic woman should be followed up, her address, the probable duration of the delivery and other details necessary for the follow-up, namely a) the profile of the pregnant diabetic woman; b) the graph of the glycemic analyses performed which illustrates the glycemic balance over time compared with the standards of the follow-up of the GDM decreed by the Moroccan Ministry of Health (figure 1); c) the window of the glycemic measurements which allows to look for more details on the aberrant glycemic

measurements, in order to anticipate complications; d) the following window also allows to look for the causes of hyperglycemic peaks related to the meals taken (figure 2). This window is also useful to diagnose the dietary balance, to check the dietary discipline and also to detect the dietary aberrations committed, and e) the last window is reserved for the weight. It allows the user to enter the weight by gestational period in order to know the weight gain of the pregnant diabetic woman.

The dashboard also contains a parameter section that allows the user to add a new health structure, health center or private practice.

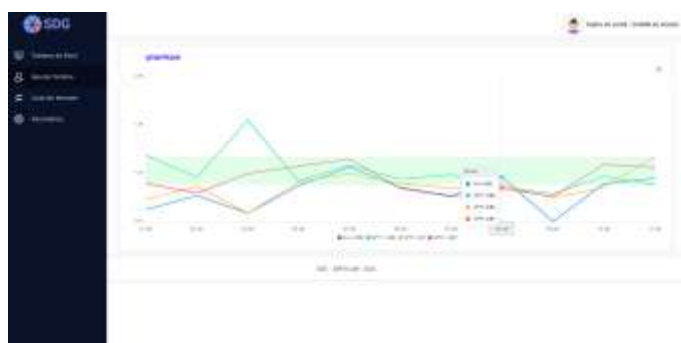


Figure 1: Graph (Blood glucose measurements for each woman)

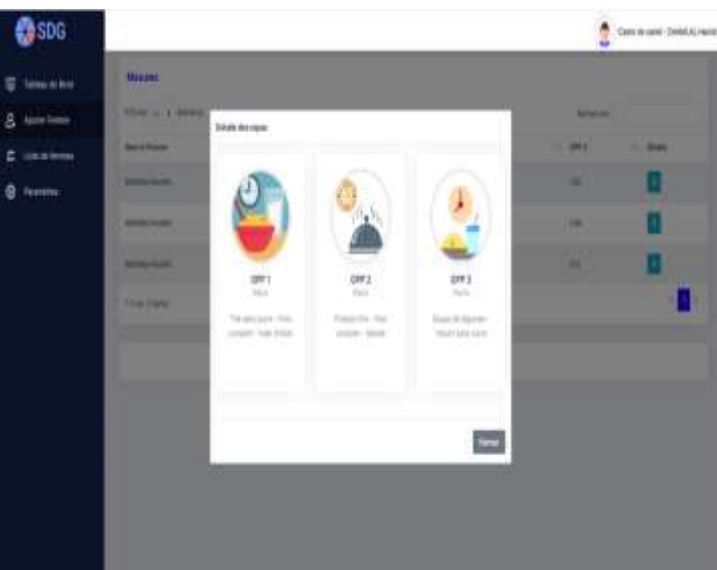


Figure 2: Details of the day's meals

3.1.1 Profile of the pregnant woman

The authentication page allows to secure the application and the data and also to guarantee the confidentiality. The access is reserved to the pregnant diabetic woman by a unique and confidential password delivered by the caregiver in

the form of an identification card. After successful access, a dashboard is displayed containing three sections: 1) the first section is reserved for data recording (figure 3), relating to fasting blood glucose (FBG), postprandial blood glucose measured two hours after breakfast (PBG1), postprandial blood glucose measured two hours after lunch (PBG2), postprandial blood glucose measured two hours after dinner (PBG3). In addition to the blood glucose tests, the woman is asked to fill in a field with details of the meals eaten, which can facilitate the monitoring task afterwards. 2) The second section concerns the graphical representation (figure 4) which is generated automatically, allowing the pregnant diabetic woman to have an overall view of the blood glucose fluctuations over time. This is a warning signal and a self-assessment tool that is easy to read and interpret. In other words, any value above the green band reflects a glycemic peak and any other value below the green band represents hypoglycemia; 3) the last section deals with the recommendations necessary to bring the diabetic pregnancy up to standard. This last section contains a main window that allows the pregnant diabetic woman to consult the standard recommendations on the dietary plan, such as favoring foods with a low glycemic index and consuming foods rich in dietary fiber. This section provides food choices that can guide the pregnant woman's consumption in order to achieve a balanced diet. Moreover, regular physical activity is also an essential element in establishing a healthy lifestyle. In this sense, the section gives examples of physical activity during pregnancy, subject to medical authorization.

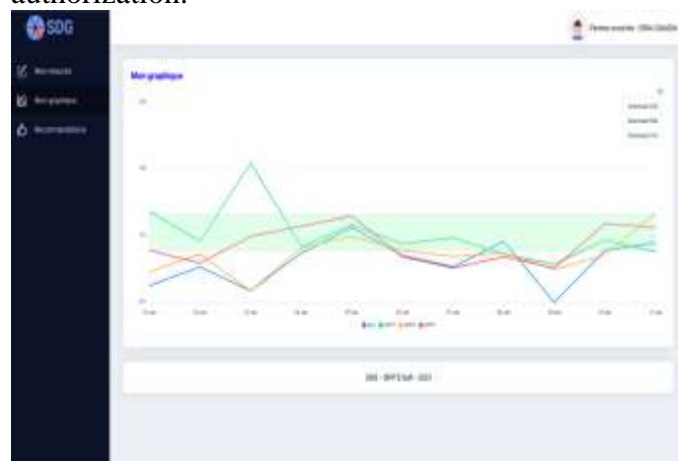


Figure 3: Graph (Blood glucose measurements)

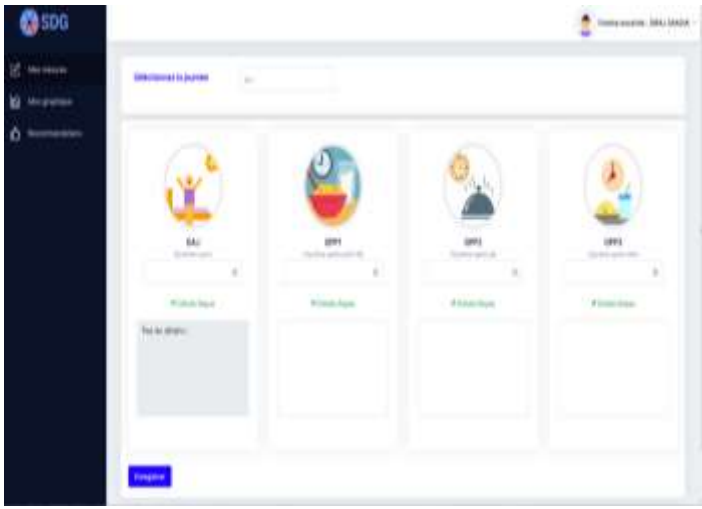


Figure 4: Entering blood glucose measurements and meal details.

4. Conclusion

The context of the COVID-19 pandemic has caused many after-effects in all categories of the Moroccan population both locally and nationally, a situation that has prompted deep reflection in order to find alternatives to manage the supply of care in crisis situation. The digitization of health is no longer a choice but a necessity, especially since Morocco has always been a leader in several areas. The web solution developed in this article would make it possible to solve the obstacles of physical accessibility of diabetic pregnant women while maintaining continuity of care and monitoring of women in real time.

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6. **Conflict of interest:** The authors state that there is no conflict of interest.

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