NATIONAL CLINICAL GUIDELINES

THE DIAGNOSIS & MANAGEMENT OF DIABETES IN PREGNANCY

Ministry of Public Health

P.O. Box 42,
Doha, Qatar
Phone: (+974)4 407 0969
Email: clinicalguidelines@moph.gov.qa

Valid From: 29th March 2021
Date of Next Revision: 29th March 2023

المبادئ الإرشادية السريرية لدولة قطر
NATIONAL CLINICAL GUIDELINES FOR QATAR

وزارة الصحـــــة العامـــــة
Ministry of Public Health
State of Qatar • دولـــة قطـــر

Version History

Version	Status	Date	Editor	Description
1.0	Final	24th April 2017	Guidelines Team	Final version for publication.
2.0	Updated	29th March 2021	Guidelines Team	Updated version for publication.

Citation

Suggested citation style:

Ministry of Public Health Qatar. National Clinical Guideline: The Diagnosis and Management of Diabetes in Pregnancy. (2021).

Abbreviations

The abbreviations used in this guideline are as follows:

ACE	Angiotensin Converting Enzyme
ACR	Albumin-Creatinine Ratio
AFI	Amniotic Fluid Index
ARBs	Angiotensin Receptor Blockers
BG	Blood Glucose
BMI	Body Mass Index
CGMS	Continuous Glucose Monitoring System
CTG	Cardiotocography
DKA	Diabetic Ketoacidosis
eGFR	Estimated Glomerular Filtration Rate
FBG	Fasting Blood Glucose (Venous)
GDM	Gestational Diabetes Mellitus
HBA_{1C}	Glycated Haemoglobin
HHS	Hyperglycaemic Hyperosmolar State
IOL	Induction of Labour
IUFD	Intrauterine Fetal Death
IUGR	Intrauterine Growth Restriction
MDI	Multi-Dose Injection
NPH	Neutral Protamine Hagedorn

OGTT	Oral Glucose Tolerance Test
PCOS	Polycystic Ovary Syndrome
SMBG	Self-Monitoring of Blood Glucose
T1DM	Type 1 Diabetes Mellitus
T2DM	Type 2 Diabetes Mellitus
TSH	Thyroid Stimulating Hormone
VRII	Variable Rate Insulin Infusion

View Pathway

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1 Information about this Guideline

1.1 Objective and Purpose of the Guideline

The purpose of this guideline is to define the appropriate diagnosis and management of diabetes mellitus in pregnancy. The objective is to improve appropriate investigation, prescribing and referral of patients presenting to provider organisations in Qatar. It is intended that the guideline will be used primarily by physicians, nurses and health educators in primary care.

It is intended that the guideline will be used primarily by midwives, nurses and all physicians responsible for women with gestational diabetes or those with diabetes who become, or are intending to become, pregnant.

1.2 Scope of the Guideline

Aspects of care covered in this guideline include the following:

- Assessment and management of diabetes mellitus in pregnancy including:
  - Pre-conception counselling care.
  - Screening for diabetes in pregnancy.
  - Management of gestational diabetes and women with pre-existing diabetes mellitus.
  - Intrapartum and postnatal considerations.
  - Management of common complications.

1.3 Editorial Approach

This guideline document has been developed and issued by the Ministry of Public Health of Qatar (MOPH), through a process which aligns with international best practice in guideline development and localisation. The guideline will be reviewed on a regular basis and updated to incorporate comments and feedback from stakeholders across Qatar.

The editorial methodology, used to develop this guideline, has involved the following critical steps:

- Extensive literature search for well-reputed published evidence relating to the topic.
- Critical appraisal of the literature.
- Development of a draft summary guideline.
- Review of the summary guideline with a Guideline Development Group, comprised of practising healthcare professionals, subject matter experts, evidence based medicine experts and patient representatives, from across Qatar.
- Independent review of the guideline by the National Clinical Guidelines & Pathways Committee, appointed by the MOPH, from amongst stakeholder organisations across Qatar.

Whilst the MOPH has sponsored the development of the guideline, the MOPH has not influenced the specific recommendations made within it.

1.4 Sources of Evidence

The professional literature has been systematically queried using specially developed, customised, and tested search strings. Search strategies are developed to allow efficient yet comprehensive analysis of relevant publications for a given topic and to maximise retrieval of articles with certain desired characteristics pertinent to a guideline.

For each guideline, all retrieved publications have been individually reviewed by a member of the Editorial Team and assessed in terms of quality, utility, and relevance. Preference is given to publications that:

1. Are designed with rigorous scientific methodology.
2. Are published in higher-quality journals.
3. Address an aspect of specific importance to the guideline in question.

Further information about the literature search and appraisal process is included in the appendix.

1.5 Evidence Grading and Recommendations

Recommendations made within this guideline are supported by evidence from the medical literature and where possible the most authoritative sources have been used in the development of this guideline. In order to provide insight into the evidence basis for each recommendation, the following evidence hierarchy has been used to grade the level of authoritativeness of the evidence used, where recommendations have been made within this guideline.

Where the recommendations of international guidelines have been adopted, the evidence grading is assigned to the underlying evidence used by the international guideline. Where more than one source has been cited, the evidence grading relates to the highest level of evidence cited:

- **Level 1 (L1):**
  - Meta-analyses.
  - Randomised controlled trials with meta-analysis.
  - Randomised controlled trials.
  - Systematic reviews.

- **Level 2 (L2):**
  - Observational studies, examples include:
    - Cohort studies with statistical adjustment for potential confounders.
    - Cohort studies without adjustment.
    - Case series with historical or literature controls.
    - Uncontrolled case series.
  - Statements in published articles or textbooks.

- **Level 3 (L3):**
  - Expert opinion.
  - Unpublished data, examples include:
    - Large database analyses.
    - Written protocols or outcomes reports from large practices.

In order to give additional insight into the reasoning underlying certain recommendations and the strength of recommendation, the following recommendation grading has been used, where recommendations are made:

- **Recommendation Grade A (RGA):** Evidence demonstrates at least moderate certainty of a net benefit from the recommendation.
- **Recommendation Grade B (RGB):** Evidence is insufficient, conflicting, or poor and demonstrates an incomplete assessment of net benefit vs harm; additional research is recommended.
- **Recommendation Grade C (RGC):** Evidence demonstrates potential harm that outweighs benefit; additional research is recommended.
- **Recommendation of the GDG (R-GDG):** Recommended best practice on the basis of the clinical experience of the Guideline Development Group members.

1.6 Guideline Development Group Members

The following table lists members of the Guideline Development Group (GDG) nominated by their respective organisations and the National Clinical Guidelines & Pathways Committee. The GDG members have reviewed and provided their feedback and approval of the guideline document. Each member has completed a declaration of conflicts of interest, which has been reviewed and retained by the MOPH.

Guideline Development Group members		
Name	**Title**	**Organisation**
Prof Abdul-Badi Abou-Samra	Director, Qatar Metabolic Institute, Chairman of Medicine, AHS Professor of Medicine	Hamad Medical Corporation & Weill-Cornell Medicine - Qatar
Dr Alia Aleidi AlRuwaili	Senior Consultant Family Medicine	Primary Health Care Corp
Ms Naglaa Alsharkawy	Senior Diabetes Nursing Educator	Hamad Medical Corporation
Dr Ahmed M. Hussein Babiker	Head of Registration Section & Clinical Pharmacist	Dept of Pharmacy and Drug Control, MOPH[1]
Dr Mohammed Bashir	Senior Consultant Endocrinologist	Hamad Medical Corporation
Dr Stephen Beer	Senior Consultant Endocrinologist/ Diabetologist	Hamad Medical Corporation
Dr Suhail A. R. Doi[2]	Head, Department of Population Medicine, College of Medicine	Qatar University
Dr Michel Makhlouf	Acting Executive Chair – Women's Services, Senior Attending Physician MFM	Sidra Medicine
Dr Mohsin Saleh Ahmed Mismar	Community Medicine Consultant, Head of Screening Programs Monitoring and Evaluation	Primary Health Care Corp
Dr Gbemisola Okunoye	Senior Attending Physician – Obstetrics, Assistant Professor of Obstetrics & Gynaecology	Sidra Medicine
Dr Hessa Ibrahim Shahbic	Sr. Consultant in Community Medicine, Assistant Director of Medicine for Women Health Clinical Affairs Department	Primary Health Care Corp
Dr Faten Al Taher Mohd Taha	Senior Consultant OB-GYN, Women's Wellness and Research Center	Hamad Medical Corporation
Dr Mahmoud Ali Zirie	Senior Consultant & Head of Endocrinology, Director of National Diabetes Center, Hamad General Hospital,	Hamad Medical Corporation

[1] Dr Ahmed Babiker attended the MOPH in his capacity as a Clinical Pharmacist and advisor on the availability of medications in Qatar.

[2] This GDG member was funded by Programme Grant #NPRP 10-0129-170274 from the Qatar National Research Fund.

1.7 National Clinical Guidelines & Pathways Committee Members

The following table lists members of the National Clinical Guidelines & Pathways Committee (NCGPC), appointed by the MOPH. The NCGPC members have reviewed and provided their feedback and approval of the guideline document. Each member has completed a declaration of conflicts of interest, which has been reviewed and retained by the MOPH.

National Clinical Guidelines & Pathways Committee (NCGPC) Members		
Name	**Title**	**Organisation**
Ms Huda Amer Al-Katheeri	Chair of the NCGPC, Director of Strategic Planning & Performance Department	Ministry of Public Health
Shk Dr Mohammed Hamad J. Al Thani	Co-Chair of the NCGPC, Director of Public Health	Ministry of Public Health
Dr Hani Ben Hassen Al Kilani	Senior Consultant, Executive Director for Corporate Clinical Policy and Guidelines	Hamad Medical Corporation
Prof Anthony Akobeng	Chair Clinical Practice Guidelines Committee	Sidra Medicine
Dr Alshaymaa Mohammed A. M. Al-Motawa	Consultant Family Medicine	Qatar Petroleum
Dr Basil Bashqawi	Accreditation Coordinator, Dept of Health Professions	Ministry of Public Health
Dr Abi Khalil Charbel	Associate Professor of Medicine Consultant Cardiology	Weill Cornell Medicine-Qatar
Dr Paul Dijkstra	Director of Medical Education	Aspetar
Dr Mohammed Elrishi	Senior Consultant Endocrinologist	Al Ahli Hospital
Dr Dahlia Mustafa Hassan	Senior Consultant Family Medicine	Primary Health Care Corp
Dr Ghassan Youseph Hommos	Senior Consultant Endocrinology	Al Emadi Hospital
Dr Egon Toft	VP and Dean	College of Medicine, Qatar University

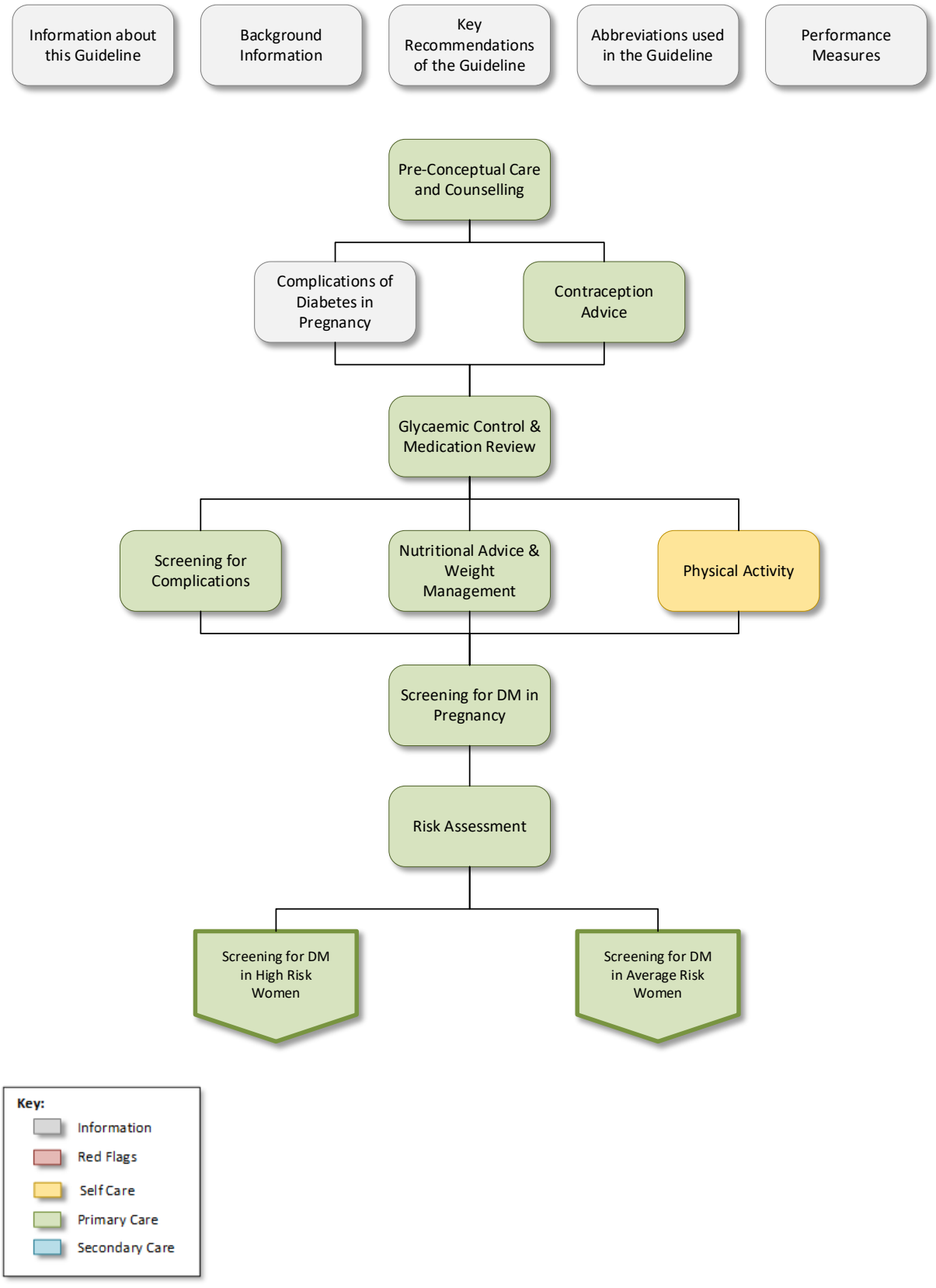
1.8 Responsibilities of Healthcare Professionals

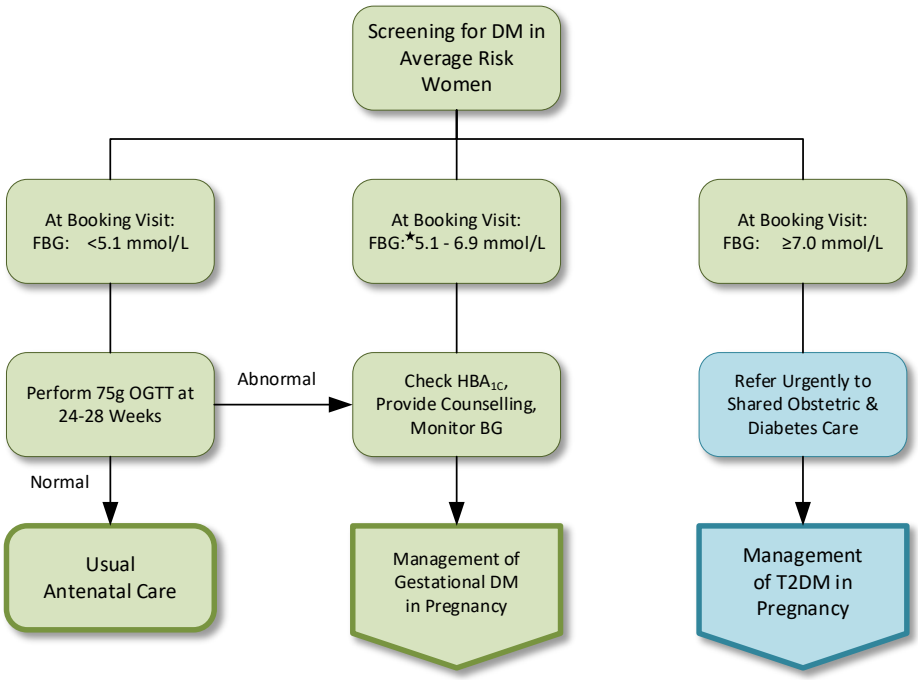
This guideline has been issued by the MOPH to define how care should be provided in Qatar. It is based upon a comprehensive assessment of the evidence as well as its applicability to the national context of Qatar. Healthcare professionals are expected to take this guidance into account when exercising their clinical judgement in the care of patients presenting to them.

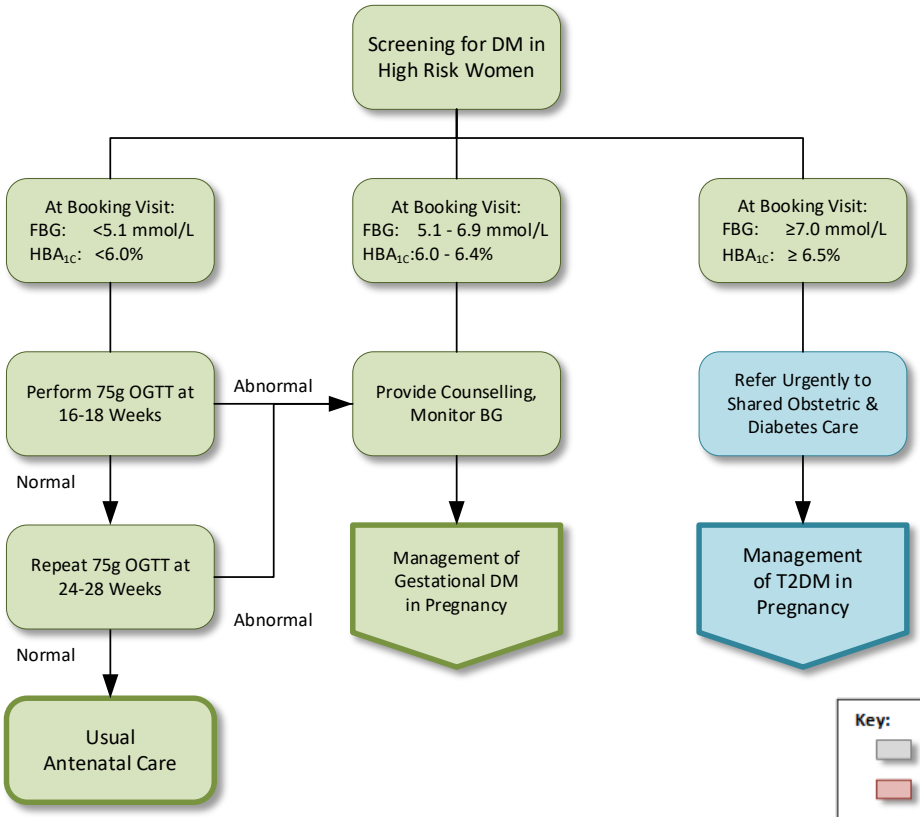
The guidance does not override individual professional responsibility to take decisions which are appropriate to the circumstances of the patient concerned. Such decisions should be made in consultation with the patient, their guardians, or caregivers and should consider the individual risks and benefits of any intervention that is contemplated in the patient's care.

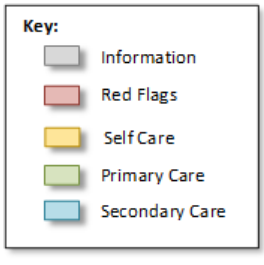
2 Diabetes in Pregnancy Pathway

Click on a box below to see the relevant page of the Pathway.

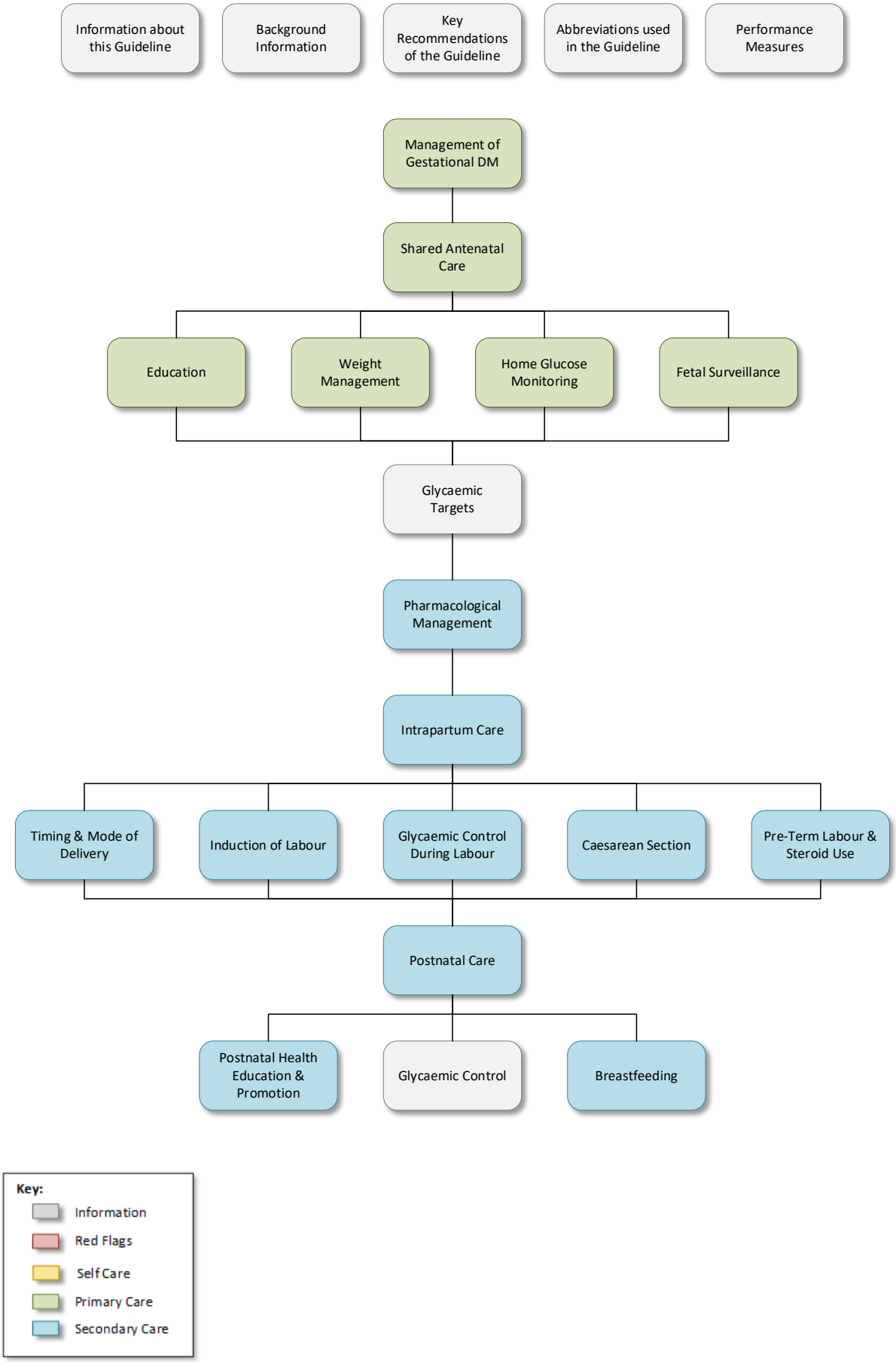


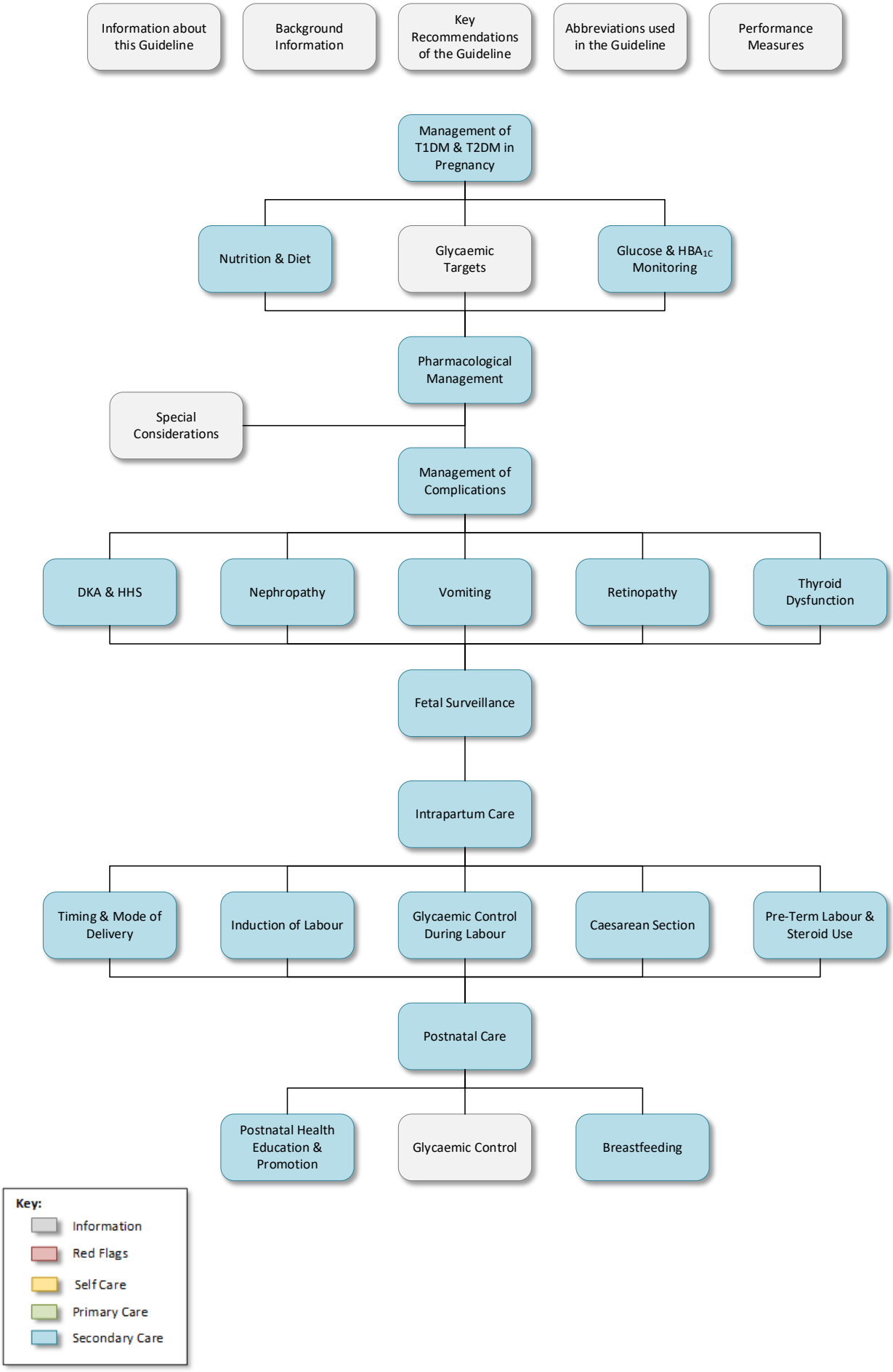






*If FBG is 5.1-5.3, consider following OGTT at 16-18 weeks [**R-GDG**].


Information about this Guideline
Background Information
Key Recommendations of the Guideline
Abbreviations used in the Guideline
Performance Measures
Management of Gestational DM
Shared Antenatal Care
Education
Weight Management
Home Glucose Monitoring
Fetal Surveillance
Glycaemic Targets
Pharmacological Management
Intrapartum Care
Timing & Mode of Delivery
Induction of Labour
Glycaemic Control During Labour
Caesarean Section
Pre-Term Labour & Steroid Use
Postnatal Care
Postnatal Health Education & Promotion
Glycaemic Control
Breastfeeding
Key:
Information
Red Flags
Self Care
Primary Care
Secondary Care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Glycaemic Targets
Glucose & HBA1C Monitoring
Pharmacological Management
Special Considerations
Management of Complications
DKA & HHS
Nephropathy
Vomiting
Retinopathy
Thyroid Dysfunction
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Postnatal Care
Postnatal Health Education & Promotion
Glycaemic Control
Breastfeeding
Key:
Information
Red Flags
Self Care
Primary Care
Secondary Care

3 Key Recommendations of the Guideline

The key recommendations of this guideline are:

Pre-Conceptual Care (*Section 5*):

- Women of childbearing age with known diabetes should receive pre-conceptual care [1] [**L2, RGA**].
- Pre-pregnancy care should be part of their routine diabetes care irrespective of the setting [**R-GDG**].
- Care in a specialist pre-conception clinic should be provided jointly by the adult diabetes services and the maternity service for women wishing to become pregnant [**R-GDG**].
- Aim to keep HBA_{1C} <6.5%, prior to conception, if it can be achieved without problematic hypoglycaemia [1–3] [**L2, RGA**].
- If HBA_{1C} is ≥10% the absolute risk of congenital malformation increases significantly and women should therefore be advised not to become pregnant [2,3]. The risk of malformations may also be increased at lower HbA1c levels [**R-GDG**].
- Patients with T2DM should be managed with [1–3]:
    - Diet alone; or
    - Diet plus metformin; or
    - Metformin plus Insulin.
    - NB: Metformin has been shown to be safe and efficacious during pregnancy [4–6].
    - The safety profile of other oral hypoglycaemic agents is not known and should be stopped prior to conception [7–10].
- Insulin use in pregnancy [2,3,7–11]:
    - Rapid-acting insulin analogues - aspart and lispro, are approved in pregnancy and should be continued. They are more advantageous than soluble human insulin during pregnancy in reducing the risk of hypoglycaemia.
    - Insulin glulisine is not approved in pregnancy.

Screening for Diabetes in Pregnancy (*Section 6*):

- See *Sections 6.1-6.3* for screening tests to be undertaken in average-risk and high-risk women during pregnancy.
- See *Section 6.4* for referral criteria for women who are diagnosed with GDM or diabetes during pregnancy.

Management of Gestational Diabetes Mellitus (GDM) (*Section 7*):

- Antenatal care for women with GDM should be provided by a multidisciplinary team [**R-GDG**].
- Change in lifestyle is essential in the management of women with GDM, and in some cases may be the only treatment required [1,2] [**L1**]:
    - Women should adhere to the acceptable weight gain limits in *Section 7.3* during pregnancy in order to minimise the risk of complications, but active weight loss should not be attempted [**R-GDG**].
    - All patients with GDM should be referred to a dietitian for dietary planning [1,2] [**L2**].
- Every patient should have a reliable and recently calibrated glucometer at home [2].
- Patients on diet management alone, metformin therapy or single dose of basal insulin, should be advised to monitor their BG levels, 4 times per day [2].
- Patient on multi-dose injections of insulin should be advised to monitor their BG levels, up to 6-7 times per day [2,12].
- If achievable without causing problematic hypoglycaemia, control should aim for [2,11,13,14] [**L1, RGA**]:
    - Fasting BG ≤5.3 mmol/L (<95 mg/dL).
    - 1 hour after meals ≤7.8 mmol/L (140mg/dL).
    - 2 hours after meals ≤6.7 mmol/L (<120 mg/dL).

- Regular monitoring of HBA_{1C} is not recommended after measurement at initial diagnosis [2] [**L2**].
- Metformin should be offered to patients with GDM if BG targets are not being achieved using diet and exercise within 1-2 weeks [2,15] [**L1, RGA**] (see *Section 7.7.1*).
- Insulin should be started if glycaemic control cannot be achieved with Metformin; when Metformin is contraindicated or not acceptable to patients [2] (see *Section 7.7.2*).

Fetal Surveillance in Women with GDM (*Section 7.6*):

- Fetal surveillance includes [2]:
    - A viability scan and confirmation of gestational age, preferably at 7-9 weeks, but no later than 12 weeks, where possible.
    - Nuchal translucency scan at 11-13 weeks.
    - Fetal anomaly scan at 18-20 weeks.
    - Fetal growth and amniotic fluid volume assessment at 28-32 weeks and again at 36 weeks.
    - Further scans should depend upon glycaemic control and clinical judgment.
    - Maternal surveillance of fetal movements from 24 weeks onwards [**R-GDG**].

Management of Women with T1DM or T2DM in Pregnancy (*Section 8*):

- Every patient should have a reliable and recently calibrated glucometer at home [2].
- Patients on diet management alone, metformin therapy or single dose of basal insulin, should be advised to monitor their BG levels, 4 times per day [2].
- Patient on multi-dose injections of insulin should be advised to monitor their BG levels, up to 6-7 times per day [2,11].
- If achievable without causing problematic hypoglycaemia, control should aim for [2,11,13,14] [**L1, RGA**]:
    - Fasting BG ≤5.3 mmol/L (<95 mg/dL).
    - 1 hour after meals ≤7.8 mmol/L (140mg/dL).
    - 2 hours after meals ≤6.7 mmol/L (<120 mg/dL).
- HBA_{1C} should be measured in the first clinic review and then at least once in each trimester or more frequently e.g. monthly [2,11,16,17].
- The HBA_{1C} target is ≤6.5% [1].
- A multi-dose injection (MDI) regimen is recommended for the majority of patients [2,10,18].
- Patients with T2DM taking Metformin can be continued on their treatment as usual [2] [**L2**].
- Patients should be empowered and taught how to adjust their own insulin doses.
- Aspirin is recommended 100 mg daily from 13 weeks onward to all women with pre-existing T1DM or T2DM [19] [**L1, RGA**].

Fetal Surveillance in Women with T1DM or T2DM in Pregnancy (*Section 8.6*):

- Fetal surveillance includes [2]:
    - A viability scan and confirmation of gestational age, preferably at 7-9 weeks, but no later than 12 weeks, where possible.
    - Nuchal translucency scan at 11-13 weeks.
    - Fetal anomaly scan at 18-20 weeks.
    - Third trimester ultrasound assessment for [2]:
        - Fetal growth.
        - Assessment of liquor volume and fetal movements.
        - Estimation of fetal growth should be performed on a 4-weekly basis from 24 weeks, in order to assess fetal growth velocity.
        - More frequent ultrasound and fetal assessment will be determined by glycaemic control, fetal status or maternal health.

Intrapartum Care (*Section 10*):

- Women with well controlled T1DM or T2DM:
  - Consider fetal testing with [**R-GDG**]:
    - Cardiotocography (CTG) scans twice a week.
    - Amniotic fluid index (AFI) once a week.
  - Advise delivery by induction of labour (IOL) or elective caesarean section (if indicated) [2]:
    - At 38-39 weeks [**R-GDG**]:
      - If there are no metabolic or other maternal or fetal complications and the diabetes is well controlled.
    - Before 38^{+0} weeks:
      - If metabolic or other maternal or fetal complications are present (including poor maternal glycaemic control).
- Women with GDM:
  - Advise delivery no later than 40^{+6} weeks, if glycaemic control is satisfactory [2].
    - Offer elective delivery by IOL or caesarean section if delivery has not occurred by then.
  - If glycaemic control is unsatisfactory plan for delivery, as for women with T1DM or T2DM in pregnancy, described above.

Glycaemic Control During Labour (*Section 10.2*):

- Hourly BG monitoring is recommended, aiming to keep BG between 4-7 mmol/L [2] [**L2**].
- For patients using insulin [2]:
  - Should be allowed light diet if desired.
  - Variable rate insulin infusion (VRII), should be considered (as shown in Table 10.2) in the following situations:
  - Patients with T1DM.
  - All other patients with diabetes in pregnancy if the capillary BG is ≥7 mmol/L for two consecutive hours.
- For patients who are diet-controlled or using Metformin [2]:
  - VRII should only be commenced if the BG is ≥7 mmol/L for two consecutive hours.
- See *Sections 10.3* and *10.4* for recommendations in women undergoing induction of labour or elective caesarean section.

Women in Pre-Term Labour (Section 10.5):

- Diabetes is not a contraindication for steroid use [2].
- In the absence of contraindications, steroids should be given to women with diabetes in pregnancy in pre-term labour up to 36 weeks gestation [2].

Postnatal Care and Advice (*Section 11*):

- See recommendations in *Section 11.*

4 Background Information

4.1 Definition

Gestational diabetes mellitus (GDM) is defined as carbohydrate intolerance of variable severity, with onset or first recognition during pregnancy, that is neither pre-existing type 1 or type 2 diabetes [1].

Diabetes may predate conception and be either known to the patient or discovered during pregnancy [1,13,20]. Women who are discovered to have diabetes in the first trimester of pregnancy are classified as having diabetes in pregnancy, rather than GDM [1,13,20].

4.2 Epidemiology

The worldwide prevalence of hyperglycaemia in pregnancy is rising with the increasing prevalence of diabetes globally [20]. In 2015, the International Diabetes Federation estimated that 16.2% of all live births in women aged 20-49, were affected by hyperglycaemia [20].

The prevalence of GDM in Qatar may be as high as 16.3%, this is similar to developed countries such as Canada (17.8%) and France (12.1%) [21].A Qatar-based study demonstrated that 45% of GDM is reported in women between the ages of 35-45 years [21].

It is expected that over the next 20 years the regions of the Middle East and North Africa will see the largest increase in the population of female diabetes patients [22]. 60% of women diagnosed with GDM subsequently develop type 2 diabetes (T2DM) within 4 years after delivery, increasing to 70% after 10 years [23].

5 Peri-Conception Counselling and Care

5.1 Pre-Conceptual Care

Women of childbearing age with known diabetes should receive pre-conceptual care [1] [**L2, RGA**]. Pre-pregnancy care outlined below should be part of their routine diabetes care irrespective of the setting. However, for women who cannot be managed in a primary care setting, referral to a specialist pre-conception clinic should be made [**R-GDG**].

Care in a specialist pre-conception clinic should be provided jointly by the adult diabetes services and the maternity service for women wishing to become pregnant [**R-GDG**].

The role of pre-conceptual care is as follows [1,13]:

- Health education and counselling on the risk of diabetes in pregnancy
- Metformin is not useful in pregnancy to prevent development of GDM and is not indicated for this purpose [24] [**L1**]
- Review medical and obstetric history.
- Advise on glycaemic control to optimise $HBA_{1C.}$ in women with pre-pregnancy diabetes
- Review medications in women with pre-pregnancy diabetes.
- Screen for and manage complications related to existing diabetes or gestational diabetes
- The complications of diabetes in pregnancy, should be explained to the patients (see Table 5.2(1) below).

NB: 3-6 months' attendance for pre-pregnancy care is typically required to optimise glycaemic control and address all other issues [**R-GDG**].

5.2 Complications of Diabetes in Pregnancy

The table below outlines the possible complications to both mother and child as a result of maternal diabetes in pregnancy [2,13].

Maternal Complications	Fetal or Neonatal Complications
• Metabolic complications: ○ Elevated average plasma glucose ○ Unmet glycaemic targets ○ Adverse events related to therapy (hypoglycaemia and others) ○ Weight gain in pregnancy • Pregnancy related complications: ○ Assisted labour / Delivery (including caesarean). ○ Pre-term delivery. ○ Peri-partum infection. ○ Pregnancy induced hypertension or eclampsia/pre-eclampsia.	• Fetal or neonatal complications: ○ Birth weight abnormalities (LGA or SGA). ○ Hypoglycaemia within 1 h of birth. ○ Neonatal death ○ Stillbirth ○ NICU admission. Note: The care team should look out for diabetes complications in women with pre-existing diabetes such as retinopathy (new /worsening), nephropathy (new/worsening) or diabetic ketoacidosis (DKA). In addition congenital malformations increase if pre-existing diabetes is uncontrolled during early pregnancy (see section 5.4).

Table 5.2(1): Maternal and Fetal/Neonatal Complications of Diabetes in Pregnancy (Adapted from [2,13,25].

[2,132,132,132,132,132,132,132,132,132,132,132,132,132,132,132,132,132,132,132,132,132,131,3]Serious clinically significant hypoglycaemia is defined as a blood glucose (BG) of <3.0 mmol/L (54 mg/dL), while the BG alert value is

defined as ≤3.9 mmol/L (70 mg/dL) [26]. The table below outlines the thresholds for the classification of hypoglycaemia [26].

Level	Glycaemic Criteria	Description
Level 1: Glucose Alert Value	≤3.9 mmol/L (70 mg/dL)	Sufficiently low glucose for treatment with fast-acting carbohydrate and dose adjustment of glucose-lowering therapy
Level 2: Clinically Significant Hypoglycaemia	<3.0 mmol/L (54 mg/dL)	Sufficiently low to indicate serious, clinically important hypoglycaemia
Level 3: Severe Hypoglycaemia	No specific glucose threshold	Hypoglycaemia associated with severe cognitive impairment requiring external assistance for recovery

Table 5.2(2): Classification of Hypoglycaemia [26].

5.3 Contraception Advice

Discuss family planning [1] [**L1**]:

- Avoidance of unplanned pregnancy should be an essential component of diabetes education from adolescence for all women with diabetes [2].
- The need for preparation for pregnancy and pre-conceptual counselling should be emphasised during each and every diabetes annual review appointment.
- Prescribe contraception until HBA_{1C} has been optimised [1,2] [**L1**]:
    - Choice of contraception should be based on the patient's preferences and risk factors.
    - Oral contraceptives may be used in the absence of contraindications e.g. cardiovascular disease, hypertension, proliferative retinopathy or nephropathy.
        - In such patients, consider the use of the progesterone-only pill or *Mirena* coil.
- Before discontinuing contraception [2]:
    - Offer the patient pre-conception care and advice as above.

5.4 Pre-existing Diabetes and Medication Review

Emphasise the importance of glycaemic control:

- Aim to keep HBA_{1C} <6.5%, prior to conception, if it can be achieved without problematic hypoglycaemia [1–3] [**L2, RGA**].
    - Good glycaemic control is necessary to reduce the risk of congenital abnormalities, miscarriage, stillbirth and neonatal death [1–3].
    - However, explain that risks can be reduced but not entirely eliminated [2].
- If HBA_{1C} is ≥10% the absolute risk of congenital malformation increases significantly and women should therefore be advised not to become pregnant. The risk of malformations may also be increased at lower HbA1c levels [**R-GDG**]. The patient should be informed of the associated risks should pregnancy occur (see Table 5.2(1) above) [2,3].
- Patients with T2DM should be managed with [1–3]:
    - Diet alone; or
    - Diet plus metformin; or
    - Metformin plus Insulin.

- NB: Metformin has been shown to be safe and efficacious during pregnancy [4–6] whilst the safety profile of other oral hypoglycaemic agents is not known and should be stopped prior to conception [7–10].

Insulin Use in Pregnancy [2,3,7–11]:

- Rapid-acting insulin analogues - aspart and lispro, are approved in pregnancy and should be continued. They are more advantageous than soluble human insulin during pregnancy in reducing the risk of hypoglycaemia.
- Insulin glulisine is not approved in pregnancy.
- Intermediate-acting insulin (neutral protamine Hagedorn (NPH)) and basal insulin detemir are both approved in pregnancy.
- Insulin glargine initiation during pregnancy is not recommended currently. Patients whose diabetes are well controlled on insulin glargine, do not need to discontinue it during pregnancy [10] [**L2, RGA**].
- Continuous subcutaneous infusion of insulin (insulin pump) may be considered for those otherwise unable to meet glycaemic targets. Patients should be referred to an endocrinologist with experience in pump management [**R-GDG**].

Other Medications [1–3,12,27]:

- Angiotensin converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs) should not be used during pregnancy. They should be discontinued before conception or as soon as pregnancy is confirmed [1,28] [**L1, RGC**]. Alternatives include: labetalol, nifedipine and methyldopa [2] [**L2, RGA**].
- Statins should be discontinued before conception, or as soon as pregnancy is confirmed [2].

5.4.1 Monitoring Blood Glucose in the Pre-Conception Period

Advise the patient of the following [2,13]:

- Newer reliable glucometers or recently calibrated glucometers should be used and the patient's monitoring technique should be reviewed [**R-GDG**].
- Women should be encouraged to record their blood glucose (BG) measurements at a minimum of 3-4 times per day up to a maximum of 6-7 times per day.
- The ideal frequency of BG measurement will depend on the insulin regimen used and the frequency of hypoglycaemia. At a minimum this should include fasting measures and two hours after meals.
- If nocturnal hypoglycaemia is suspected, patients should be advised to measure their BG levels during the night also.
- See section 7.5 for glycaemic targets in pregnancy.

5.5 Nutritional Advice and Weight Management

Nutritional advice:

- It is good clinical practice to provide dietary advice before, during and after pregnancy. The diet should be based on low glycaemic index foods which are not excessive in fat [2].
- Obese and overweight women should be encouraged to achieve a normal body mass index (BMI) when reasonable [2,3,29] or significant weight reduction, such as 5-10% of body weight [**R-GDG**], prior to pregnancy.
- Women with diabetes who are planning to become pregnant should be advised to take folic acid (5 mg/day) starting at least 3 months prior to conception and continuing until 12 weeks of gestation, to reduce the risk of neural tube defect [3] [**L2**].

5.6 Physical Activity and lifestyle counselling

Physical activity in non-diabetic patients:

- Pre-conception physical activity reduces the risk of GDM [30].
- In-pregnancy provision of 30-50 minutes of moderate intensity physical activity in-facility at least three times a week for those at higher risk for GDM (Table 6.1 for definition of high risk) can help to avert GDM development [31] [**L1**]. This should start before the 20th week of gestation [31].
- Physical activity is also an important part of a healthy pregnancy, and once pregnant, regular participation should be encouraged [32].
- Lifestyle counselling in pregnancy does not reduce the incidence of GDM [33–36] [**L1**].

Physical activity in patients with pre-existing diabetes [1]:

- At least 150 mins per week of moderate-intensity aerobic exercise (50-70% of maximum heart rate) is recommended:
    - Spread-out over at least 3 days per week.
    - Ensure there are no more than two consecutive days without exercise.
- In patients with T2DM, if there are no contraindications, resistance training is recommended twice per week.
- Patients with type 1 diabetes (T1DM), should be advised about [12]:
    - Safe pre-exercise BG levels (typically ≥100 mg/dL depending on the individual and type of physical activity); and
    - Appropriate adjustment of insulin and meals/snacks to reduce hypoglycaemia.
    - Having a simple carbohydrate food readily available before, during, and after exercise for prevention or treatment of hypoglycaemia.

5.7 Screening for Complications

Nephropathy [1,10,37,38]:

- There is a strong association between pre-existing nephropathy and a poor pregnancy outcome.
- Worsening nephropathy and superimposed pre-eclampsia are amongst the most common causes of pre-term delivery in women with diabetes.
- The following tests should be undertaken in all women:
    - Albumin-creatinine ratio (ACR).
    - Serum creatinine and eGFR.
- Patients with an abnormal ACR, confirmed on repeated testing, should be referred to a diabetologist for specialist review [**R-GDG**].
- If the eGFR is <40 ml/min/m^2 prior to conception, the woman may experience irreversible further decline in renal function as a consequence of the pregnancy [20]. Such patients should be referred to a nephrologist for review [**R-GDG**].

Retinopathy [1,2,39]:

- Retinopathy can deteriorate significantly during pregnancy.
- Fundal examination is advised prior to conception, if not performed in the last 6 months.
- Patients with active retinopathy should be under the care of an ophthalmologist [**R-GDG**].

6 Screening for Diabetes in Pregnancy

6.1 Screening for Diabetes in Pregnant Women

Screening tests to detect undiagnosed T2DM or GDM should be undertaken as follows [**R-GDG**]:

Target population	Time of screening	Test*
Average-risk women: • All pregnant women without the risk factors listed for High-risk women below.	At booking visit:	**Fasting BG**
	At 24-28 weeks:	If the booking visit test is normal: **Perform 75g OGTT**
High-risk women: Women with any of the following should be considered to be at high risk of having undiagnosed diabetes or for developing GDM in the current pregnancy: • Women with a history of GDM. • Women with a history of impaired fasting glucose and/or impaired glucose tolerance. • History of unexplained stillbirth, IUFD or unexplained neonatal death or birth of baby with malformations associated with diabetes. • History of macrosomic baby weighing ≥4kg. • Women with the following pre-pregnancy results: ○ **HBA_{1C}:** 5.7% - 6.4%. ○ **Fasting BG:** 5.6 - 6.9 mmol/L (100-125mg/dl). ○ **OGTT at 2hrs:** 7.8 - 11.0 mmol/L (140-199 mg/dl). • Pre-pregnancy BMI of >25 kg/m^2 (have a lower threshold in South Asian women). • Women with a history of PCOS. • Other rare high-risk patient e.g. long term steroid users.	At booking visit:	**Fasting BG and HBA_{1C}**
	At 16-18 weeks:	If the booking visit tests are normal: **Perform 75g OGTT**
	24-28 weeks: (preferably at 24 weeks)	If the prior tests are normal: **Perform 75g OGTT**
Patients who have undergone weight reduction surgery: • Low/average risk women	24-26 weeks	A week of **SMBG**
• High risk women	14-16 weeks	A week of **SMBG**

Table 6.1: Screening Algorithm for Diabetes in all Pregnant Women [Adapted from [13]]. * In women who have excessive vomiting in early pregnancy, fasting BG may be unreliable. Ensure to confirm no vomiting prior to test to avoid false positive results [**R-GDG**].

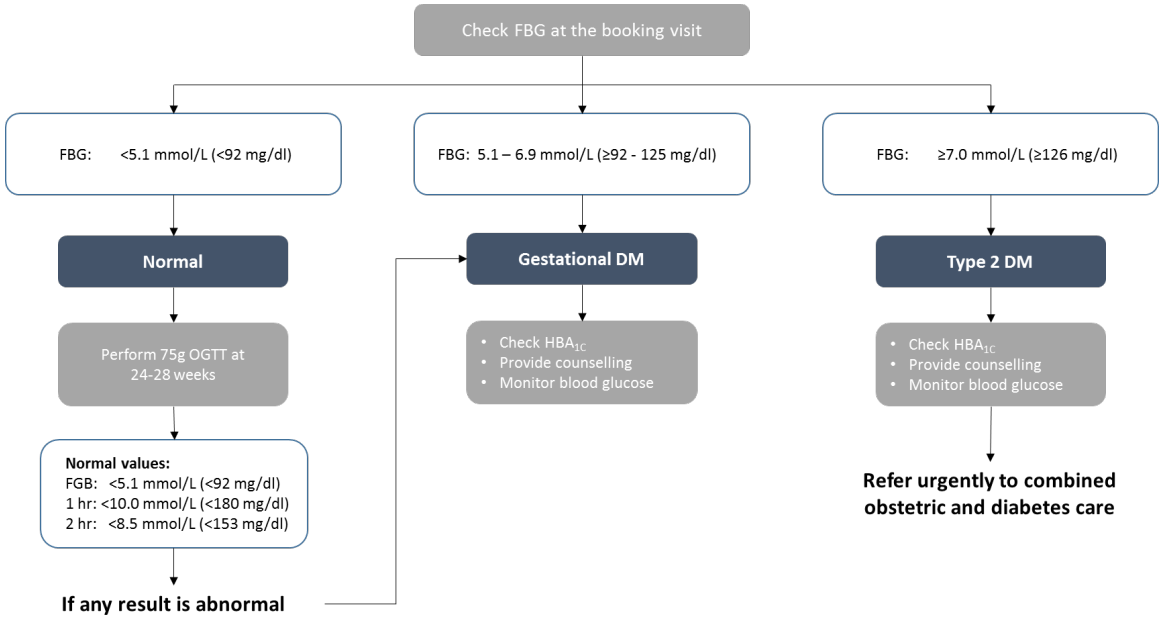
The above table defines the groups of pregnant women who should be considered to be at average or high risk of having undiagnosed T2DM in pregnancy, or for developing GDM. The algorithms in the following sections outline the testing and diagnosis sequence for both low-risk and high-risk women.

NB: There is currently no data to support universal screening for GDM after 32 weeks gestation, as there are no proven benefits of interventions for either the mother or the offspring [**R-GDG**]. The decision to screen for GDM after 32 weeks gestation, should be individualised to the patient by the treating physician based on the presence of risk factors and/or features to support diabetic fetopathy; and whether the diagnosis of GDM will make any difference to the outcomes.

Options for screening may include venous fasting BG alone with or without BG testing 2 hours after food. If these are normal, then self-monitoring of blood glucose (SMBG) over a 4 day period, could be used in high risk subjects [**R-GDG**].

View Pathway

6.2 Screening Algorithm for Average-Risk Women



FBG: Venous Fasting blood glucose (fasting for >8hours)

Fig 6.2: Screening and Diagnosing GDM [40–42] and T2DM in Average-Risk Women [Adapted from [13]]. If FBG is 5.1-5.3 mmol/L, consider following OGTT at 16-18 weeks [**R-GDG**].
NB: Patients who do not tolerate OGTT should be screened with serum fasting BG and capillary SMBG for 3 consecutive days [**R-GDG**].

6.3 Screening Algorithm for High-Risk Women

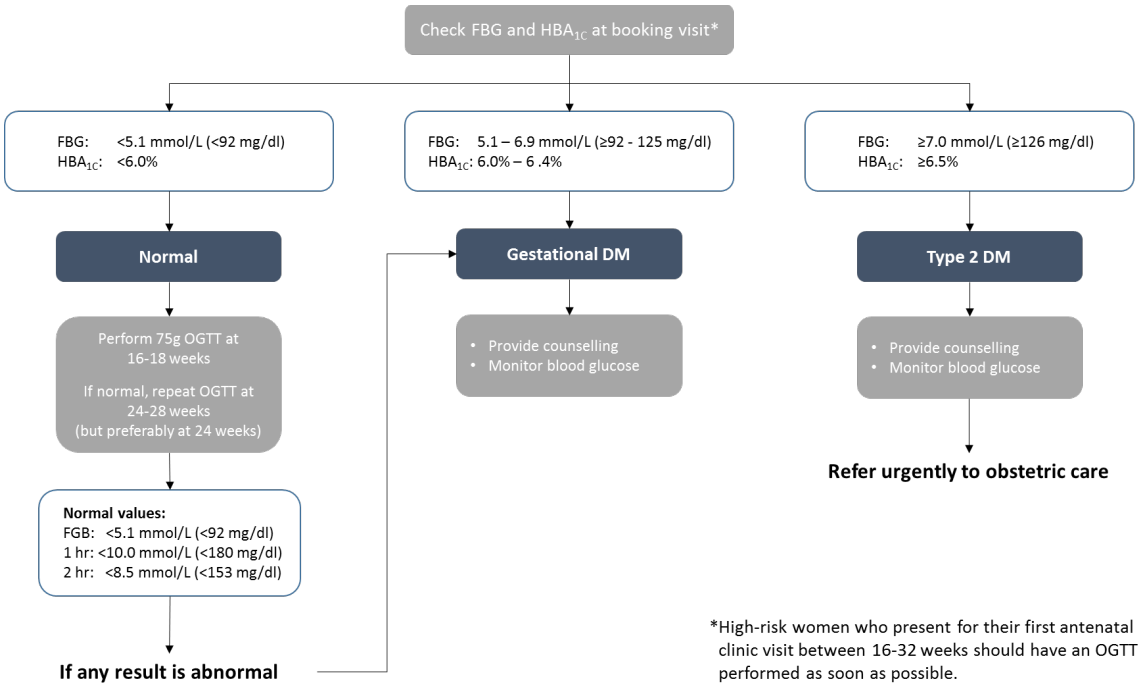


Fig 6.3: Screening and Diagnosis of GDM and T2DM in High-Risk Women [Adapted from [13]].
NB: Screening in patients with a history of bariatric surgery (less than 18 months from surgery date), should be performed using fasting glucose and HBA_{1C} as the OGTT is not reliable in this group [**R-GDG**].

View Pathway

6.4 Referral Criteria to Specialist Care:

Referral to the Emergency Department [**R-GDG**]:

- If signs of DKA, hyperglycaemic hyperosmolar state (HHS) or persistent hyperglycaemia despite treatment, are present.
- If ultrasound in the third trimester shows intrauterine growth restriction (IUGR) or fetal compromise.

Urgent Referral to Specialist Antenatal Care [**R-GDG**]:

- A pregnant woman who is a known diabetic or is diagnosed as T2DM during her first screening.
- GDM patients who do not meet glycaemic targets within 2 weeks with dietary management (i.e. ≥20% of readings outside the normal range).
- Patients with GDM who are morbidly obese (BMI ≥40kg/m^2).
- GDM Patients who are ≥28 weeks gestation and who have 2 hours postprandial glucose levels of ≥10 mmol/L (180mg/dL) on 3 consecutive days require urgent referral to a specialist physician within a maximum of 3 days. If this is not possible, the patient should be sent to the emergency room to seek advice from an endocrinology consultant.

Routine Referrals to Specialist Care:

- Refer all patients with pre-gestational diabetes to an ophthalmologist for retinal assessment [**R-GDG**].

7 Management of Gestational Diabetes Mellitus

7.1 Antenatal Care

Antenatal care for women with GDM should be provided by a multidisciplinary team consisting of [**R-GDG**]:

- Family physician/obstetrician and endocrinologist if needed.
- Health counsellor/educator.
- Dietician.

Note [3]:

- The frequency of antenatal visits is decided on an individual basis, typically every 1-3 weeks after diagnosis.
- At each visit the following should be checked, in addition to routine antenatal care:
    - Blood pressure
    - Urine dipstick primarily for proteinuria.
    - Body weight.
    - Review of SMBG.

7.2 Education

All patients should receive counselling and education (supported by an information leaflet) that explains the following [**R-GDG**]:

- Health education and counselling on the risks to both mother and baby, associated with GDM in pregnancy (see Table 5.2(1)).
- The symptoms of hypoglycaemia.
- The role of diet, weight gain during pregnancy and exercise.
- The importance of good maternal glycaemic control to avoid complications.
- Education about oral hypoglycaemic agents (including action, side effects, etc.) and insulin injection when needed, e.g. in case of fail on diet.
- The possibility of transient morbidity in the baby during the neonatal period, which may require admission to the neonatal unit.
- The risk of the baby developing obesity and/or diabetes in later life.
- The benefits of exercise, in the absence of contraindications, of 15-30 minutes per day.

Change in lifestyle is essential in the management of women with GDM, and in some cases may be the only treatment required [1,2] [**L1**].

7.3 Weight Management

Women should adhere to the following acceptable weight gain limits during pregnancy in order to minimise the risk of complications, but active weight loss should not be attempted [**R-GDG**].

Weight category	Pre-Pregnancy BMI	Acceptable weight gain by gestation			
		<20 weeks		≥20 weeks	
Underweight	<18.5	4.0 - 6.0kg	(0.2-0.30 kg/wk)	8.0 - 12.0kg	(0.4-0.6 kg/wk)
Normal	18.5 - 24.9	4.0 - 5.5kg	(0.2-0.25 kg/wk)	7.5 - 10.5kg	(0.35-0.5 kg/wk)
Overweight	25.0 - 29.9	2.0 - 3.0kg	(0.1-0.15 kg/wk)	5.0 - 8.0kg	(0.25-0.4 kg/wk)
Obesity Class I	30.0 - 34.9	0kg		5.0 - 8.0kg	(0.25-0.4 kg/wk)
Obesity Class II & III	≥35	0kg		0 - 5.0kg	(0-0.25 kg/wk)

Table 7.3: Acceptable Weight Gain for Women with GDM by Pre-Pregnancy BMI and Gestational Age [**R-GDG**].

Caloric intake [10,32]:

- Is the best predictor of weight gain during pregnancy.
- Calculate the appropriate caloric intake based on the patient's pre-pregnancy BMI, their current pregnant BMI and the acceptable weight gain during pregnancy.
- Caloric intake should increase in the second and third trimesters [32] [**L3, RGA**]:
- Additional calorie consumption in obese pregnant women may not be necessary [26]:
    - Obese women may reduce their calorie intake during pregnancy by 30% compared to their pre-pregnancy intake [10] [**L1, RGA**], with a minimum intake of 1600-1800 kcal/day [10,13,43].

Dietary advice:

- Offer advice surrounding diet and exercise at the time of GDM diagnosis [2] [**L1, RGA**].
- Advise the patient to eat a healthy diet during pregnancy [2] [**L1, RGA**].
- Emphasise the benefit of foods with a low glycaemic index [2] [**L1, RGA**].
- All patients with GDM should be referred to a dietitian for dietary planning [1,2] [**L2**].
- Women with GDM should adhere to the healthy eating recommendations for all pregnant women [32] [**L2**].
- Eat small, frequent meals with protein to reduce the risk of postprandial hyperglycaemia and pre-prandial starvation ketosis [32] [**L2**].
- Advice should be tailored to each patient's individual needs, culture, and preferences [32] [**L2**].

Carbohydrate intake:

- It is recommended that women with GDM, limit carbohydrate intake to 35% - 45% of total calorie intake [2,13,43] with a minimum of 175 g carbohydrate per day distributed in three small to moderate sized meals and 2-4 snacks [**R-GDG**].
- Limit breakfast carbohydrate amount to as little as 15-30 g, due to hormonal surges and insulin resistance in the morning hours. Fruit and milk should be avoided at breakfast [**R-GDG**].
- Ensure to add evening snacks to avoid ketosis overnight. A bedtime snack (if recommended) should include 1-2 servings of high-fibre carbohydrates with 1-2 servings of protein. Evaluate the need for this snack based on fasting blood sugar levels [**R-GDG**].
- Patients should consider meeting carbohydrate requirements using the following foods [32]:
    - Vegetables.
    - Legumes.
    - Whole grains.
    - Complex carbohydrates.
- Discourage the consumption of simple carbohydrates [32].
- Substituting low-glycaemic load foods for higher-glycaemic load foods as the carbohydrate effect on blood glucose differs among types of food. Low glycaemic index foods often have higher fibre content. Up to 28 g of fibre intake per day is recommended for pregnant women [**R-GDG**].

Protein [32]:

- Women who are pregnant should consume around 1.1 g/kg of protein per day in the second and third trimesters [32] [**L3, RGA**]. Recommend a minimum of 15-20% of total calories [44,45] and 71 g of protein per day [**R-GDG**].
- This is higher than for non-pregnant women (0.8 g/kg/day).
- Patients should consider meeting protein requirements from animal, fish, or plant sources.

Fat [32]:

- Of total calories 30-40% should be from fat [46,47]and less than 10% of calories should be from saturated fats [48].
- Trans-fatty acids should be avoided.
- The diet should contain 13 g/day of omega-6, and 1.4 g/day of omega-3.

7.4 Home Glucose Monitoring

Home Glucose Monitoring:

- Every patient should have a reliable and recently calibrated glucometer at home [2].
- Patients on diet management alone, metformin therapy or single dose of basal insulin, should be advised to monitor their BG levels, 4 times per day, including [2]:
    - Fasting; and
    - 1 hour or 2 hours post-meals.
- Patient on multi-dose injections of insulin should be advised to monitor their BG levels, up to 6-7 times per day to include [2,11]:
    - Fasting.
    - Pre-meals.
    - 1 hour or 2 hours post-meals; and
    - Before bed-time.

7.5 Glycaemic Targets

Glycaemic Targets:

- Should be individualised taking into account the risk of hypoglycaemia [2].
- Patients on Insulin should keep their capillary BG >4 mmol/L (72 mg/dl) [2] [**L3**].
- If achievable without causing problematic hypoglycaemia, control should aim for [2,11,13,14] [**L1, RGA**]:
    - Fasting BG should be ≤5.3 mmol/L (<95 mg/dL) [2,11,13,43,45,48–53] [**R-GDG]**
    - 1 hour after meals ≤7.8 mmol/L (140mg/dL) [2,11,13,43,49,50,54] [**R-GDG]**
    - 2 hours after meals ≤6.7 mmol/L (<120 mg/dL) [11,13,41,43,45,47,51,52,54,55] [**R-GDG]**
- Regular monitoring of HBA_{1C} is not recommended after measurement at initial diagnosis [2] [**L2**].

7.6 Fetal Surveillance

Fetal surveillance:

- Ultrasound surveillance during the 3rd trimester, starting from 28 weeks and every three to four weeks until delivery is recommended in order to estimate the effect of glycemic control on fetal growth and amniotic fluid volume [50].

- The frequency and methods of fetal monitoring are determined by maternal glycaemic control and the existence of other pregnancy complications [**R-GDG**].
- Biophysical profile testing and multi-vessel Doppler studies may be considered in cases of poor growth (IUGR) or when there are co-morbid conditions, such as pre-eclampsia [**R-GDG**].

For women diagnosed with GDM in the first trimester (undiagnosed pre-existing diabetes should be considered). Fetal surveillance includes [2]:

- A viability scan and confirmation of gestational age, preferably at 7-9 weeks, but no later than 12 weeks, where possible.
- Nuchal translucency scan at 11-13 weeks.
- Fetal anomaly scan at 18-20 weeks.
- Fetal growth and amniotic fluid volume assessment at 28-32 weeks and again at 36 weeks.
- Further scans should depend upon glycaemic control and clinical judgment.

In the event of identified macrosomia, a clear management plan should be drawn by a consultant obstetrician to address timing of follow-up scans, fetal surveillance, timing and mode of delivery [2].

Women with GDM should be advised to monitor fetal movements from 24 weeks and report any concerns immediately to the healthcare team [**R-GDG**].

7.7 Pharmacotherapy for GDM

Management of blood glucose:

- Diet and physical activity should be the first step in management [1,2].
- If patients fail to achieve the glycaemic targets outlined in *Section 7.5* within 1-2 weeks, then medication should be commenced [41,48].
- Most GDM guidelines [13,43,45,49,51,56,57] have recommend Insulin as the preferred treatment or first-line therapy for persistent hyperglycaemia when lifestyle measures are insufficient to achieve good glycaemic control.
- More recent data suggests that metformin and glibenclamide are at least equivalent to insulin for choice of initial therapy [15] [**L1**].
- Metformin seems the most optimal choice of the two oral therapies (metformin and glibenclamide) when each was compared against insulin in terms of less hypoglycaemia and less hypertensive disorders in pregnancy [15] [**L1**]

7.7.1 Metformin

Metformin [4,15]

- Should be offered:
  - To patients with GDM as first line if BG targets are not being achieved using diet and exercise within 1-2 weeks [1,2,15] [**L1, RGA**].
- May be preferred to insulin for maternal health if it controls BG sufficiently [1,15] especially in women [2,53,54,58]:
  - Declining insulin therapy
  - Not affording insulin therapy
  - Unable to safely use insulin.
  - With suspected severe insulin resistance.
- Patients should be advised that [1] [**L2**]:
  - Oral agents cross the placenta.

    - No adverse effects on the fetus have been demonstrated, however long-term studies are in progress.
- Commence treatment at 500mg bd and titrating to a dose of 1g bd over 3-7 days, as tolerated [**R-GDG**].
- Contraindications should be carefully reviewed before prescribing [**R-GDG**]. Metformin should not be initiated in patients with the following conditions and must be stopped if already initiated [28,59] [**L1, RGC**]:
    - Severe renal dysfunction.
    - High liver enzyme.
    - Hypertension.
    - Pre-eclampsia.
    - Patients at risk of or with actual IUGFR.
- For more details, review the NCG on The Management of Obesity in Adults by MOPH [60].

7.7.2 Insulin

Offer insulin treatment [2] [**L1, RGA**]:

- Insulin should be started if metformin is contraindicated or is not acceptable or tolerated by patients [2].
- In addition to metformin and diet and lifestyle changes if BG targets are not achieved [2] within one week on maximal doses of metformin [**R-GDG**].
- Refer to *Section 5.4* for further detail on the types of insulin that may be used in pregnancy.

8 Management of Type 1 and Type 2 Diabetes in Pregnancy

8.1 Nutrition and Diet

Pregnant women with diabetes should follow the same nutritional vitamin and mineral advice as for women without diabetes in pregnancy [2].

8.2 Glucose and HBA_{1C} Monitoring

Home Glucose Monitoring:

- Every patient should have a reliable and recently calibrated glucometer at home [2].
- Patients on diet management alone, metformin therapy or single dose of basal insulin, should be advised to monitor 4 times per day, including [2]:
  - Fasting; and
  - 1 hour or 2 hours post-meals.
- Patient on multi-dose injections of insulin should be advised to monitor their BG levels, up to 6-7 times per day to include [2,11]:
  - Fasting.
  - Pre-meals.
  - 1 hour or 2 hours after meals; and
  - Before bed-time.

Continuous Glucose Monitoring System (CGMS):

- CGMS should be considered for pregnant women on insulin therapy [4] [**L1**]:
  - Who have problematic hypoglycaemia.
  - Who have unstable BG levels.
  - If self-monitoring of BG has failed to assess glycaemic control; or
  - To gain more information about variability in BG.

Hypoglycaemia [2]:

- All patients should be advised about the risks of hypoglycaemia, and impaired awareness.
- Patients and at least one family member, ideally the husband, should be educated regarding treatment of hypoglycaemia.
- Women with insulin-treated diabetes should always have a fast-acting form of glucose available to them [2] [**L2**].
- Provide glucagon to pregnant women with T1DM for use if needed [2] [**L2**].
  - A family member should be educated on when and how to use glucagon.

HBA_{1C} Monitoring:

- HBA_{1C} should be measured in the first clinic review [2,11].
- Due to increases in red blood cell turnover associated with pregnancy, HBA_{1C} levels fall during pregnancy. HBA_{1C} should be used as a secondary measure and should not replace SMBG [14].
- HBA_{1C} should be measured at least once in each trimester or more frequently e.g. monthly [2,16,17].
- The frequency of monitoring should be judged by the treating physician [**R-GDG**].

8.3 Glycaemic Targets

Glycaemic Targets:

- Should be individualised taking into account the risk of hypoglycaemia [2].
- Patients on Insulin should keep their capillary BG >4 mmol/L (72 mg/dl) [2].
- If achievable without causing problematic hypoglycaemia [2,11,14] [**L1, RGA**]:
    - Fasting BG ≤5.3 mmol/L (≤95 mg/dL).
    - 1 hour after meals ≤7.8 mmol/L (140mg/dL).
    - 2 hours after meals ≤6.7 mmol/L (≤120 mg/dL).
- The HBA_{1C} target is ≤6.5% [1].

8.4 Pharmacological Management

Treatment [2,10,18]:

- A multi-dose injection (MDI) regime is recommended for the majority of patients.
- Patients with T2DM taking Metformin can be continued on their treatment as usual [2,61] [**L2**].
- Patients should be empowered and taught how to adjust their own insulin doses.
- Frequent telephone contact with the diabetes educators is encouraged for those who need support with dose adjustment.
- A fall in insulin requirement in pregnancy could indicate placental insufficiency. This should not be considered an automatic indication for immediate delivery, but an indication for closer monitoring [**R-GDG**].

Insulin Pump Therapy in T1DM [2,62]:

- Women with T1DM who are pregnant or are contemplating pregnancy should be considered pre-conceptually for insulin pump therapy, if they fail to achieve their target HBA_{1C}, given that any improvement in control could have significant benefits for fetal and maternal outcomes.
- Women who conceive on MDI should be offered insulin pump therapy during pregnancy if targets for glycaemic control are not achieved (HBA_{1C} <7.0%; BG of 4.4-6.1 mmol/L, before meals, <8.6mmol/L, 2 hours after meals) or problematic hypoglycaemia occurs.
- For women using continuous insulin infusion pumps, targets for assessment of glycaemic control during pregnancy are the following [63]:
    - Target range: 63-140 mg/dL and percent of readings: >70%.
    - Below target level: <63 mg/dL and percent of readings: <4%; <54 mg/dL and percent of readings <1%.
    - Above target level: >140 mg/dL and percent of readings <25%.
- The decision as to whether to continue pump therapy post-partum should be made on an individual basis [62].

8.5 Management of Complications

8.5.1 Vomiting

Patients with diabetes in pregnancy are prone to ketosis in the presence of recurrent vomiting [2]. Such patients should be instructed on how to cope with it and, in cases of severe vomiting, should be hospitalised [2].

Bolus doses on insulin can be given 15-20 minutes after food to avoid hypoglycaemia in cases of recurrent vomiting [**R-GDG**].

8.5.2 Nephropathy

Pre-existing nephropathy is associated with a poor pregnancy outcome [37,38]. The incidence of worsening chronic hypertension or pregnancy-induced hypertension/pre-eclampsia is high (40-70%) in women with both incipient and overt nephropathy [2].

All patients should undergo the following:

- Screening for albumin excretion at booking and/or in the first or second trimester [2].
    - NB: Proteinuria increases transiently during pregnancy, returning to pre-pregnancy levels within 3 months of delivery.

Women with nephropathy [**R-GDG**]:

- Monitor using a morning urine sample for ACR.
- For high-grade proteinuria (particularly if the patient is suspected of having nephrotic syndrome):
    - A 24-hour urine collection for proteinuria may be requested.

Consider referral to a nephrologist if [**R-GDG**]:

- Serum creatinine is abnormal (≥ 120 µmol/l); or
- The urinary ACR is > 30 mg/mmol; or
- Total protein excretion exceeds 2g/day.

8.5.3 Retinopathy

Pregnancy is a risk factor for the development and progression of diabetic retinopathy. This may progress into sight threatening disease and can cause devastating visual impairment [38].

Retinal assessment by an ophthalmologist, should be conducted as follows [2]:

- All women with pre-existing diabetes should have retinal assessment in the first trimester and at 28 weeks.
- Women with diabetes, first diagnosed during pregnancy, should have retinal assessment performed as soon as possible.
- If retinopathy is noted, then close follow-up throughout pregnancy and for 1 year postpartum, is required.

NB: Diabetic retinopathy should not delay rapid optimisation of glycaemic control and should not be considered a contraindication to vaginal delivery [**R-GDG**].

8.5.4 DKA and HHS

Women should be educated about DKA and HHS and its prevention through SMBG, appropriate diet, suitable pharmacological therapy and sick-day management. Euglycaemic ketoacidosis is also well recognised in pregnancy [1].

Consider the following [1]:

- Investigation for DKA or HHS, is indicated in women who present with nausea, vomiting, abdominal pain and hyperglycaemia.
- If diagnosed, admit the patient to a high dependency unit in accordance with hospital guidelines and include continuous fetal monitoring after 24 weeks gestation.
- Immediate delivery may not be necessary as fetal heart rate abnormalities may immediately resolve with correction of the metabolic state.

8.5.5 Thyroid Dysfunction

All women with T1DM should be screened for thyroid dysfunction with thyroid stimulating hormone (TSH) levels and thyroid peroxidase antibodies during the first trimester of pregnancy [12] [**L1, RGA**].

8.5.6 Preeclampsia

As aspirin can reduce the risk of preterm preeclampsia in women who are at high-risk of preeclampsia, it should be offered 100 mg daily from 13 weeks onward to all women with pre-existing T1DM or T2DM [19] [**L1, RGA**].

Aspirin has no effect on the risk of term preeclampsia [19] [**L1**].

8.6 Fetal Surveillance

Fetal surveillance:

- The frequency and methods of fetal monitoring are determined by maternal glycaemic control and the existence of other pregnancy complications [**R-GDG**].
- Biophysical profile testing and Doppler velocity studies to assess umbilical blood flow and middle cerebral artery blood flow may be considered in cases of excessive or poor growth or when there are co-morbid conditions, such as pre-eclampsia [2].

For women with T1DM or T2DM diagnosed in pregnancy:

- Fetal surveillance includes [2]:
    - A viability scan and confirmation of gestational age, preferably at 7-9 weeks, but no later than 12 weeks, where possible.
    - Nuchal translucency scan at 11-13 weeks.
    - Fetal anomaly scan at 18-20 weeks.
    - Third trimester ultrasound assessment for [2]:
        - Fetal growth.
        - Assessment of liquor volume and fetal movements.
        - Estimation of fetal growth should be performed on a 4-weekly basis from 24 weeks, in order to assess fetal growth velocity.
        - More frequent ultrasound and fetal assessment will be determined by glycaemic control, fetal status or maternal health.

In the event of identified macrosomia:

- Clinicians should be aware that the accuracy of fetal weight estimation is ± 20% in term babies and that accuracy decreases with increasing birth weight [**R-GDG**].
- A clear management plan should be put in place by a consultant obstetrician. This plan should address timing of follow-up scans, fetal surveillance and timing and mode of delivery [2].
- Sonographic estimation of fetal weight should be combined with the clinical judgment of an obstetrician experienced in the management of pregnancies complicated with diabetes when evaluating the most appropriate mode of delivery for the patient [**R-GDG**].

Unexpected intrauterine death [**R-GDG**]:

- Remains a significant contributor to perinatal mortality in pregnant women with diabetes.
- Conventional tests of fetal wellbeing (umbilical artery Doppler ultrasound, CTG and other biophysical tests) have been shown to have poor sensitivity for predicting such events.
- It is recommended that patients need to be sensitive in perceiving the fetal movements.

- In the event of any changes in the character of the fetal movements (in terms of quantity or quality) the patient should report to the hospital emergency department for CTG and evaluation [**R-GDG**].

9 Special Considerations

Fasting during Ramadan [64]:

- All pregnant women with either GDM or diabetes in pregnancy who are managed with insulin therapy or sulfonylureas, are regarded at very high risk of complications and should be strongly advised not to fast.
- Pregnant patients who are managed with either diet alone or Metformin should be considered at high risk and also discouraged from fasting.
- If the patient insists on fasting, ensure the following are provided [64]:
  - Structured education and counselling, ideally at least 6-8 weeks before the start of Ramadan.
  - Close supervision by a multidisciplinary diabetes team.
  - Information and counselling on frequent SMBG.
  - Information and counselling to adjust medication doses in response to SMBG results.
  - Advice to break the fast if hypoglycaemia or hyperglycaemia occurs.
  - Advice to refrain from continued fasting if frequent hypoglycaemia or hyperglycaemia occurs, or there is a deterioration in other related medical conditions as a result of fasting.

Driving [**R-GDG**]:

- There are currently no regulations for diabetes and driving in the state of Qatar.
- Patients on insulin treatment during pregnancy are typically on a very intensive regimen which renders them at higher risk for recurrent hypoglycaemia and hypoglycaemia unawareness.
- Patients who have had one or more episodes of severe hypoglycaemia and/or, are suffering with hypoglycaemia unawareness should be advised not to drive during pregnancy.
- Safe driving advice:
  - Check capillary BG prior to starting a journey, do not drive till BG are >5.0 mmol/L.
  - Avoid long journeys or take frequent breaks.
  - Always keep hypo treatment handy in the car.
  - If you felt hypo; stop the car; take the switch off the ignition; correct the hypo and do not start driving till 45 minutes after normalising the BG.

10 Intrapartum Care

10.1 Timing and Mode of Delivery

In all cases of diabetes in pregnancy, delivery should take place in a hospital setting, under the supervision of an obstetrician with a neonatologist available if necessary. The frequency of fetal monitoring should be increased during the intrapartum period.

Women with GDM:

- Advise delivery no later than 40^{+6} weeks, if glycaemic control is satisfactory [2].
    - Offer elective delivery by IOL or caesarean section if delivery has not occurred by then.
- If glycaemic control is unsatisfactory plan for delivery, as for women with T1DM or T2DM in pregnancy, described above.

Women with T1DM or T2DM:

- Advise delivery by induction of labour (IOL) or elective caesarean section (if indicated) [2]:
    - At 38-39 weeks of pregnancy [**R-GDG**]:
        - If there are no metabolic or other maternal or fetal complications and the diabetes is well controlled.
    - Before 38^{+0} weeks:
        - If metabolic or other maternal or fetal complications are present (including poor maternal glycaemic control).

Elective Caesarean Section:

- May be considered in women with diabetes and estimated fetal weight ≥4500 grams [65,66].
- Women should however be counselled about the poor predictive ability of ultrasound estimates of fetal weight and the risk and benefits of caesarean delivery [65,66].
- In the absence of any complications and the presence of good glycaemic control, diabetes is not in itself a contraindication to attempting vaginal birth following previous caesarean section [2].

10.2 Glycaemic Control During Labour

During labour:

- Hourly BG monitoring is recommended, aiming to keep BG between 4-7 mmol/L [2] [**L2**].
- Patients using insulin:
    - Should be allowed light diet if desired.
    - Variable rate insulin infusion (VRII), should be considered (as shown in Table 10.2) in the following situations:
        - Patients with T1DM.
        - All other patients with diabetes in pregnancy if the capillary BG is ≥7 mmol/L for two consecutive hours.
- For patients who are diet-controlled or using Metformin [2]:
    - VRII should only be commenced if the BG is ≥7 mmol/L for two consecutive hours.

	Protocol A Insulin rate (ml/hr)	Protocol B Insulin rate (ml/hr)	Protocol C Insulin rate (ml/hr)
Blood glucose (mmol/L)	Prepare the infusion by adding 50 units of Actrapid to 50 mls of normal saline. Infuse Dextrose 5%/0.45 normal saline at a rate of 100 mls per hour.		
≤ 4.0	Stop the glucose infusion for 15 minutes and treat hypoglycaemia, preferably orally, but otherwise with 150-200 mls of 10% dextrose over 15 minutes or by temporarily increasing the glucose infusion rate to 150 mls/min.		
4.1 - 7.0	1	2	4
7.1 - 9.0	2	4	6
9.1 - 11.0	3	6	8
11.1 – 13.0	6	8	10
≥ 13.1	8	10	12

Table 10.2: Variable Rate Insulin Infusion [**R-GDG**].

10.3 Induction of Labour

Instructions for IOL in patients with diabetes in pregnancy (where IOL is indicated) [2]:

- Patients on Metformin should omit their morning dose.
- Patients on basal-bolus insulin should [**R-GDG**]:
    - Receive their basal insulin as normal the night before the IOL.
    - Patients on morning basal insulin doses should receive half their regular dose on the morning of the induction. This is particularly important in patients with T1DM.
    - All other insulin doses should be omitted the next morning.
    - Start VRII infusion at on the morning of the IOL, if BG is >7.0 mmol/L on two consecutive readings.

10.4 Caesarean Section

Instructions for caesarean section in patients with diabetes in pregnancy (where caesarean section is indicated) [2]:

- Patients on Metformin should omit the dose the night before and the morning dose and should not be started on VRII.
- Patients on basal-bolus insulin should:
    - Receive their basal insulin as normal the night before the caesarean.
    - Patients on morning basal insulin doses should receive half their regular dose on the morning of the induction. This is particularly important in patients with T1DM.
    - All other insulin doses should be omitted the next morning.
    - Start VRII on the morning of the surgery.
- Intra-operatively BG monitoring:
    - Measure at least once every 60 minutes, if epidural anaesthesia is used and every 30 minutes if general anaesthesia is used [3].

10.5 Pre-Term Labour and the Use of Steroids

Women in pre-term labour [2]:

- Diabetes is not a contraindication for steroid use.
- In the absence of contraindications, steroids should be given to women with diabetes in pregnancy in pre-term labour up to 36 weeks gestation.

Steroid administration [2]:

- Women with insulin-treated diabetes who are given steroids, should be admitted to the antenatal unit.
- If the patient is nil-by-mouth:
  - Start on IV insulin and dextrose infusion, using the above VRII protocol.
- Patients on insulin:
  - Pre-meal short acting insulin doses should be increased by 30%.
  - Pre-meal insulin doses should also be adjusted for any existing pre-meal hyperglycaemia (as shown in Table 10.5 below) [**R-GDG**].
  - This may need to be continued for at least 24 hours after the last dose of corticosteroid.
- Patients with GDM, not on insulin:
  - Should be admitted for 2 hourly glucose monitoring if their SMBG results are >8 mmol/L.
  - If BG continues to rise, follow the subcutaneous sliding scale in Table 10.5 and consult the diabetes team.

Blood glucose monitoring [**R-GDG**]:

- BG is likely to increase 9-15 hours after the first steroid injection.
- Glucocorticoids worsen postprandial hyperglycaemia. Therefore, up to 50% increase in pre-meal insulin dose may be required [**R-GDG**].
- If the BG level is >12 mmol/L, monitor the fetus by CTG until normoglycaemia is achieved.
- The insulin regimen should be closely monitored and adjusted by diabetes team during woman's admission.

	Pre-Meal Supplemental Subcutaneous Insulin Sliding Scale Use only bolus insulin (i.e. aspart (Novorapid) or lispro (Humalog)	
Blood Glucose (mmol/L)	**Patients with Insulin-Treated Diabetes**	**Patients with GDM on Diet-Control**
< 4.0	Treat hypoglycaemia then give 20% of usual insulin dose	No insulin required
4.0 - 8.0	Usual dose	No insulin required
8.1 - 10.0	Usual dose + 2 units	3 units
10.1 - 12.0	Usual dose + 4 units	5 units
12.1 - 14.0	Usual dose + 6 units	7 units
14.1 - 16.0	Usual dose + 8 units	9 units
>16	Check ketones and start IV insulin infusion	Check ketones and start IV insulin infusion

Table 10.5: Pre-meal supplemental subcutaneous insulin sliding scale [**R-GDG**].

11 Postnatal Care

11.1 Neonatal hypoglycaemia

Neonatal blood sugar should be tested within one to two hours of birth for neonatal hypoglycaemia (< 2.6 mmol/L), for infants with blood glucose levels < 2.6 mmol/L, supplementary breastfeeds where possible is recommended [55].

11.2 Glycaemic Control

Women with pre-existing insulin-treated diabetes [2]:

- Following delivery, insulin requirements decline rapidly.
- For women with T1DM [2]:
    - A postpartum insulin regimen should be prescribed prior to delivery if possible.
    - This should commence immediately following the third stage of labour.
- For women with T2DM (insulin-treated) [2]:
    - The doses of insulin should be discussed with the diabetologist.

Women with T2DM diabetes, who were not treated with insulin prior to pregnancy [2]:

- If treated with insulin during pregnancy, women may be switched back to oral hypoglycaemic agents following delivery.

Women with GDM [2,10]:

- Insulin therapy should be discontinued immediately postpartum.
- SMBG should be discontinued, once BG levels return to normal.
- T2DM should be suspected and investigated, if hyperglycaemia persists
- Women with GDM have a 35–50% chance of recurrence in future pregnancies.
- All women should have 75g OGTT performed 4-12 weeks post-partum [**R-GDG**].
    - Patients who missed the OGTT within the 12 weeks check should have a HBA_{1C} performed [**R-GDG**].
- Perform annual monitoring of HBA_{1C} or Fasting BG.
- It is recommended for women who were diagnosed with prediabetes to follow intensive lifestyle interventions with or without metformin to prevent diabetes [1].

11.3 Breastfeeding

Women with GDM should be encouraged to breastfeed their infants as soon as possible after delivery and at frequent intervals (every 2-3 hours) and to continue for at least 3–4 months postpartum to avoid neonatal hypoglycaemia and/or prevent childhood obesity and diabetes in the offspring and to reduce risk of type 2 diabetes and hypertension in the mother [1,11,32,46,50,51,53].

Women should be advised [2,32]:

- There is an increased risk of hypoglycaemia while breastfeeding.
- Mothers may require less insulin due to the calories expended with breastfeeding and may require a carbohydrate-containing snack before or during breast feeding.
- Diabetes medications which were discontinued for safety reasons in the pre-conceptual or antenatal period should continue to be avoided during lactation.
- Women should be advised to maintain frequent contact with the diabetes service during the postpartum period to allow for glycaemic assessment and insulin dose adjustment.

- Metformin, glibenclamide and insulin are all considered compatible with breast feeding and if needed can be restarted [**R-GDG**].
- Women who intend to formula-feed their infant may recommence diabetes therapy as per their pre-pregnancy management.

11.4 Postnatal Health Education and Promotion

Women with pre-existing diabetes:

- Health education should emphasise the importance of [1,2] [**L2**]:
  - Achieving and maintaining an ideal body weight.
  - Sustaining optimal glycaemic control.
- Appropriate lifestyle changes should be advocated e.g. [1]:
  - Smoking cessation.
  - Healthy eating.
  - Physical activity.
- Pre-conceptual counselling for future pregnancies, should be discussed with the woman and her partner, with emphasis on the importance of tight glycaemic control and high dose folic acid supplementation in the pre-conception and early pregnancy period [2].
- Methods of contraception agreeable with the woman and her partner should be discussed and prescribed as appropriate [2].
- Referral to routine diabetes care should be made in the postnatal period [**R-GDG**].

The mothers should be encouraged to stay for at least 24 hours after birth [**R-GDG**].

Babies of women with diabetes [**R-GDG**]:

- Should stay with their mothers unless there is a clinical complication or there are abnormal clinical signs that warrant admission for intensive or special care.
- Should be fed as soon as possible after birth (within 30 minutes) and then at frequent intervals (every 2–3 hours) until feeding maintains pre-feed capillary plasma glucose levels at a minimum of 2.0 mmol/litre.
- Should have their BG tested routinely at 2–4 hours after birth.

Consider admitting the babies of women with diabetes to the neonatal unit if they have [**R-GDG**]:

- Hypoglycaemia associated with abnormal clinical signs.
- Respiratory distress.
- Signs of cardiac decompensation from congenital heart disease or cardiomyopathy.
- Signs of neonatal encephalopathy.
- Signs of polycythaemia and are likely to need partial exchange transfusion.
- Need intravenous fluids.
- Need tube feeding (unless adequate support is available on the postnatal ward).
- Jaundice requiring intense phototherapy and frequent monitoring of bilirubinaemia.
- Been born before 34 weeks (or between 34 and 36 weeks if dictated clinically by the initial assessment of the baby and feeding on the labour ward).

Women with GDM:

- Education in the postnatal period should incorporate advice on [1,2]:
  - Diet
  - Physical activity.
  - Weight reduction or healthy weight maintenance.

- The increased risk of developing T2DM in the future should be emphasised. Risk factors for developing T2DM include [1,2] [**L1**]:
    - Pre-pregnancy overweight/obesity.
    - High BG levels at diagnosis of GDM.
    - High insulin requirements during pregnancy.
    - Early gestation at diagnosis of GDM.
    - The need for insulin treatment in pregnancy.
    - Pre-term delivery.
    - Post-partum OGTT results in keeping with pre-diabetes.
- Future pregnancy planning should include evaluation of glycaemic control and if present, hyperglycaemia should be treated prior to conception [2].
- Women with identified postnatal glucose intolerance or confirmed diabetes should be advised to seek pre-conceptual counselling for any future pregnancies [1].
- Methods of contraception agreeable with the woman and her partner should be discussed and prescribed as appropriate [2].

12 Key Considerations for Patient Preferences

Patient preferences refer to patient perspectives, beliefs, expectations, and goals for health and life, and to the steps employed by individuals in assessing the potential benefits, harms, costs, and limitations of the management options in relation to one another. Patients may have preferences when it comes to defining their problems, identifying the range of management options and selecting or ranking the outcomes used to compare these options.

It is important for healthcare professionals to develop an understanding of the patient as an individual and the unique way in which each person experiences a condition and its impact on their life.

The following recommendations are therefore made for physicians and other healthcare professionals regarding general principles of patient care in Qatar:

- **Respect Patients:** Treat patients with respect, kindness, dignity, courtesy and honesty. Ensure that the environment is conducive to discussion and that the patient's privacy is respected, particularly when discussing sensitive, personal issues. Ask the patient how they wish to be addressed and ensure that their choice is respected and used.

- **Maintain Confidentiality:** Respect the patient's right to confidentiality and avoid disclosing or sharing patients' information without their informed consent. In this context, students and anyone not directly involved in the delivery of care should first be introduced to the patient before starting consultations or meetings, and let the patient decide if they want them to stay.

- **Clarify Third-Party Involvement:** Clarify with the patient at the first point of contact whether and how they like their partner, family members or carers to be involved in key decisions about their care or management and review this regularly. If the patient agrees, share information with their partner, family members or carers.

- **Obtain Informed Consent:** Obtain and document informed consent from patients, in accordance with MOPH policy and guidance.

- **Encourage Shared Decision Making:** Ensure that patients are involved in decision making about their own care, or their dependent's care, and that factors that could impact the patient's participation in their own consultation and care including physical or learning disabilities, sight, speech or hearing impairments and problems with understanding, reading or speaking English are addressed.

- **Disclose Medical Errors:** Disclose errors when they occur and show empathy to patients.

- **Ensure Effective Communication:** Explore ways to improve communication including using pictures, symbols or involving an interpreter or family members. Avoid using medical jargon. Use words the patient will understand and confirm understanding by asking questions.

- **Ensure Continuity of Care:** Provide clear and timely sharing of patient information between healthcare professionals especially at the point of any transitions in care.

13 Performance Measures

A list of performance measures is given in the table below. Healthcare organisations are encouraged to monitor service performance using the indicator definitions below [67].

Number	Numerator	Denominator
DP001	Number in the denominator who undergo a 75g oral glucose tolerance test at 24-28 weeks of gestation.	Total number of pregnant women seen for antenatal care in the last 12 months ≥ 24 weeks gestation.
DP002	Number in the denominator who are prescribed 5 mg/day folic acid from at least 3 months before conception.	Total number of pregnant women diagnosed with diabetes who have been seen for antenatal care in the last 12 months.
DP003	Number int the denominator who have had a HBA_{1C} level measured at their booking appointment.	Total number of pregnant women in whom diabetes was diagnosed prior to the pregnancy, who were seen for antenatal care in the last 12 months.

Table 13.1: Performance measures [67].

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Appendix: Detailed Description of the Literature Search

A systematic search for existing literature on diabetes mellitus in pregnancy was performed in the period July 10th – August 24th, 2020.

All existing references were evaluated and where necessary and applicable, the latest version of the specific manuscript was used to update the guideline and replace the older reference. The search for clinical practice guidelines on diabetes mellitus management in pregnancy was performed in the *PubMed* database and websites of relevant organisations and societies including the *UK NICE*, the *International Diabetes Federation,* the *International Federation of Gynecology and Obstetrics* and the *American Association for Clinical Endocrinologists*. The present guideline is primarily based on *UK NICE* and the *American Diabetes Association* guidelines and is supplemented with other relevant studies.

Peer-reviewed scientific publications were found in PubMed and via *Google Scholar* Internet search engine. Non-peer reviewed studies were identified in *bioRxiv*. Books were checked on *Amazon* and via *Google* and *Google Scholar* search engines.

The included publications were identified using the terms "*diabetes*" and "pregnancy" and specified with the following terms in combinations:

Guideline, glucose, diabetes mellitus, prediabetes, preconception, intrapartum, prenatal, postnatal, contraception, classification, prevalence, epidemiology, risk, presentation, screening, history, examination, complication, investigation, diagnosis, referral, specialist, education, nutrition, weight, exercise, HbA_{1C}, therapy, pharmacological, insulin, metformin, nephropathy, hypertension, retinopathy, thyroid, induction, caesarean, steroids, breastfeeding, fasting, follow-up.

Figure A.1 on the next page demonstrates graphically the results of the search and application of exclusion criteria.

View Pathway

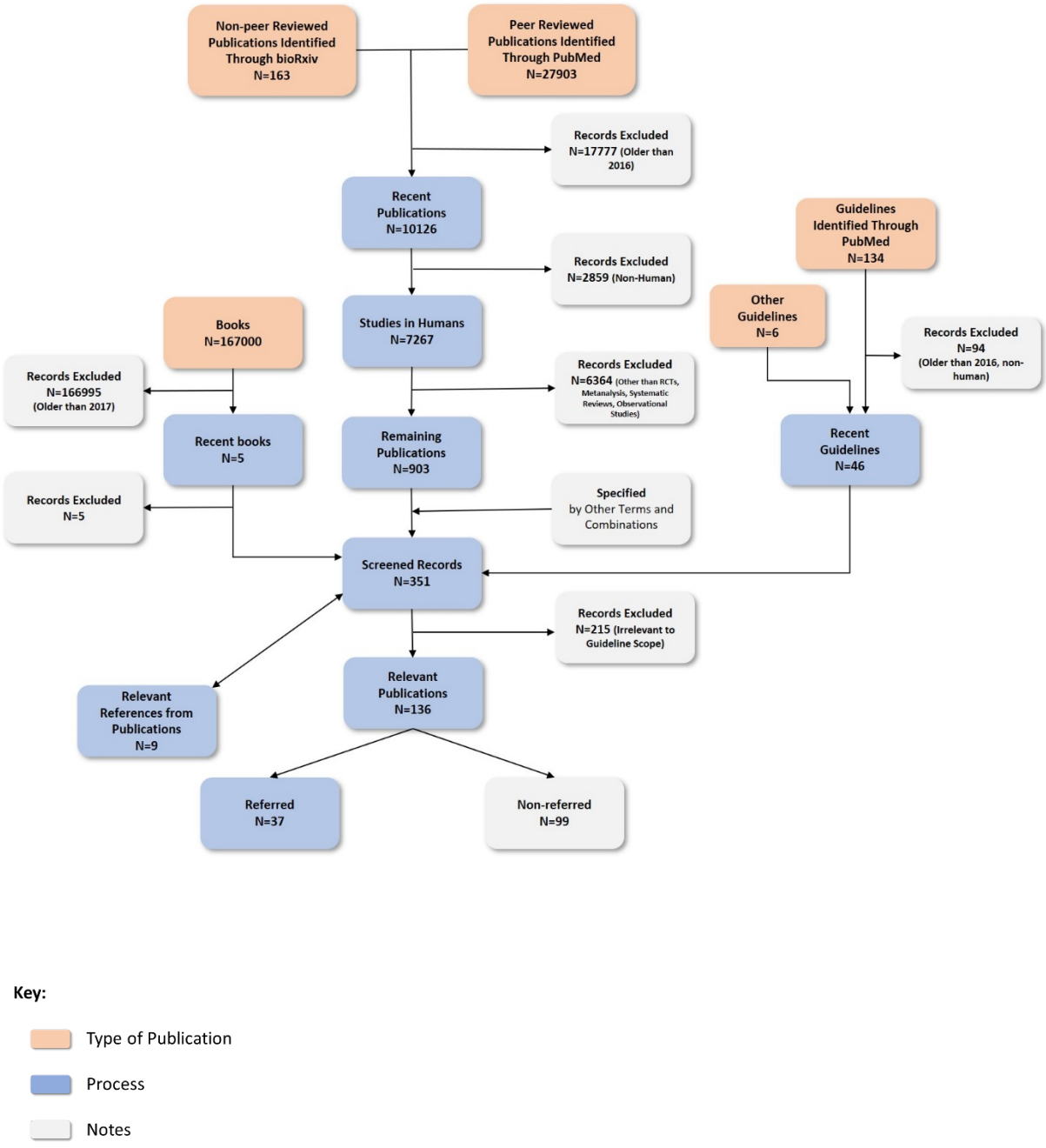

Fig A.1: Literature search results and application of exclusion criteria.

Acknowledgements

The following individuals are recognised for their contribution to the successful development of the National Clinical Guideline.

MOPH National Clinical Guidelines Team:

- **Ms Huda Amer Al-Katheeri**, *Director of Strategic Planning & Performance Dept, MOPH*.
- **Dr Nawal Al Tamimi,** *Head of Healthcare Quality & Patient Safety Dept, MOPH.*
- **Dr Rasha Bushra Nusr**, *Quality Improvement Senior Specialist, MOPH.*
- **Dr Rasmeh Ali Salameh Al Huneiti**, *Guideline & Standardisation Specialist, MOPH.*
- **Dr Bushra Saeed**, *Quality Improvement Coordinator, MOPH.*
- **Dr Mehmood Syed,** *Project Clinical Lead.*
- **Dr Samuel Abegunde,** *Physician Executive.*
- **Dr Natalia Siomava,** *Senior Medical Writer.*
- **Ms Rouba Hoteit,** *Medical Writer.*

Additional Contributors

- **Asma Syed Roshan**[*]**,** *Researcher, Department of Population Medicine, College of Medicine, Qatar University.*
- **Chang Xu**, *Research Associate, Department of Population Medicine, College of Medicine, Qatar University.*
- **Omran A.H. Musa**[*], *Research Fellow in Clinical Epidemiology, Department of Population Medicine, College of Medicine, Qatar University.*

[*] This contributor was funded by Programme Grant #NPRP 10-0129-170274 from the Qatar National Research Fund.

Please use the following email address to provide feedback on this guideline:
clinicalguidelines@moph.gov.qa