Queensland Clinical Guidelines

Translating evidence into best clinical practice

Maternity and Neonatal **Clinical Guideline**

Gestational diabetes mellitus (GDM)

Queensland Government

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Cultural acknowledgement

We acknowledge the Traditional Custodians of the land on which we work and pay our respect to the Aboriginal and Torres Strait Islander Elders past, present and emerging.

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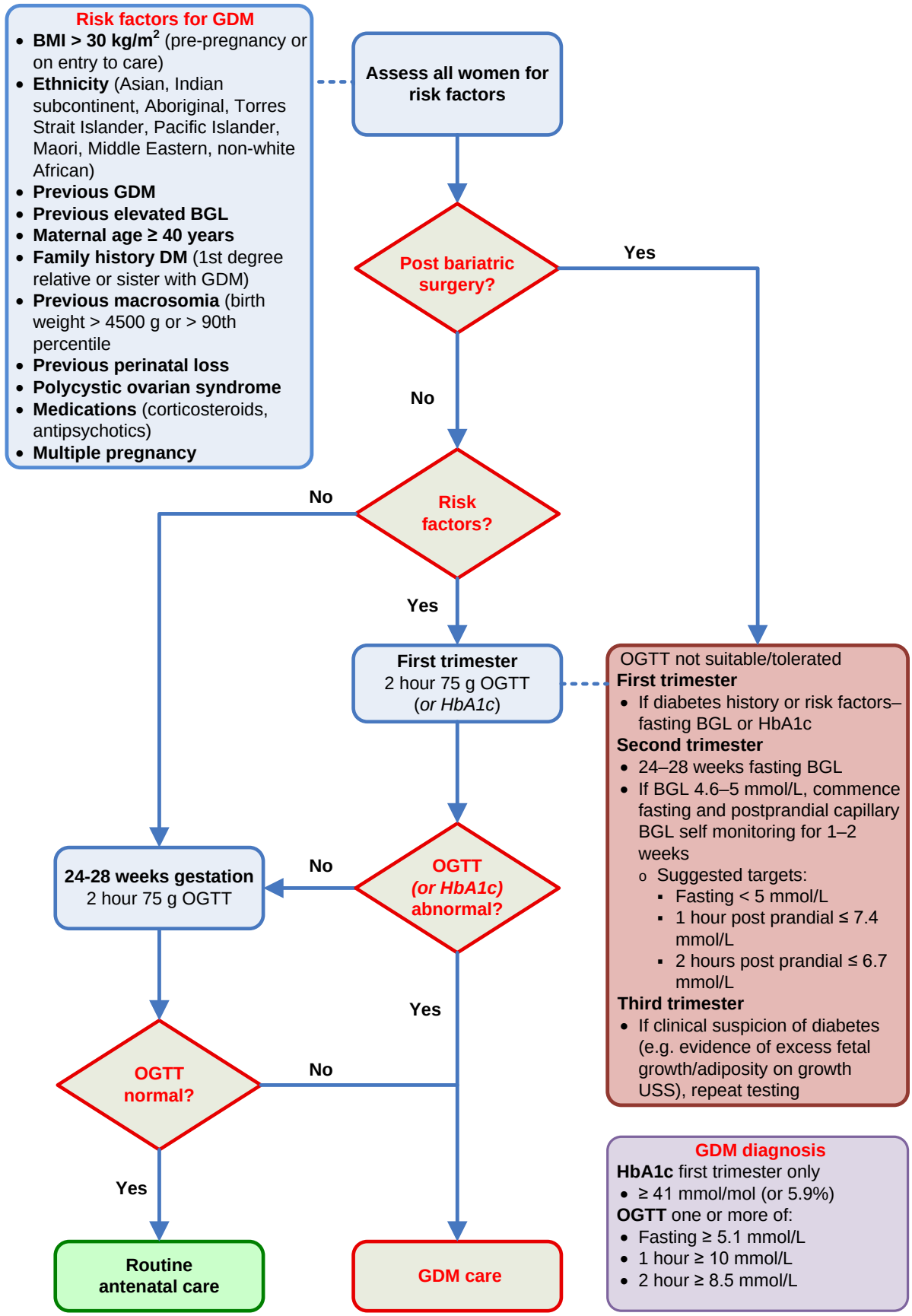
Flow Chart: Screening and diagnosis of GDM

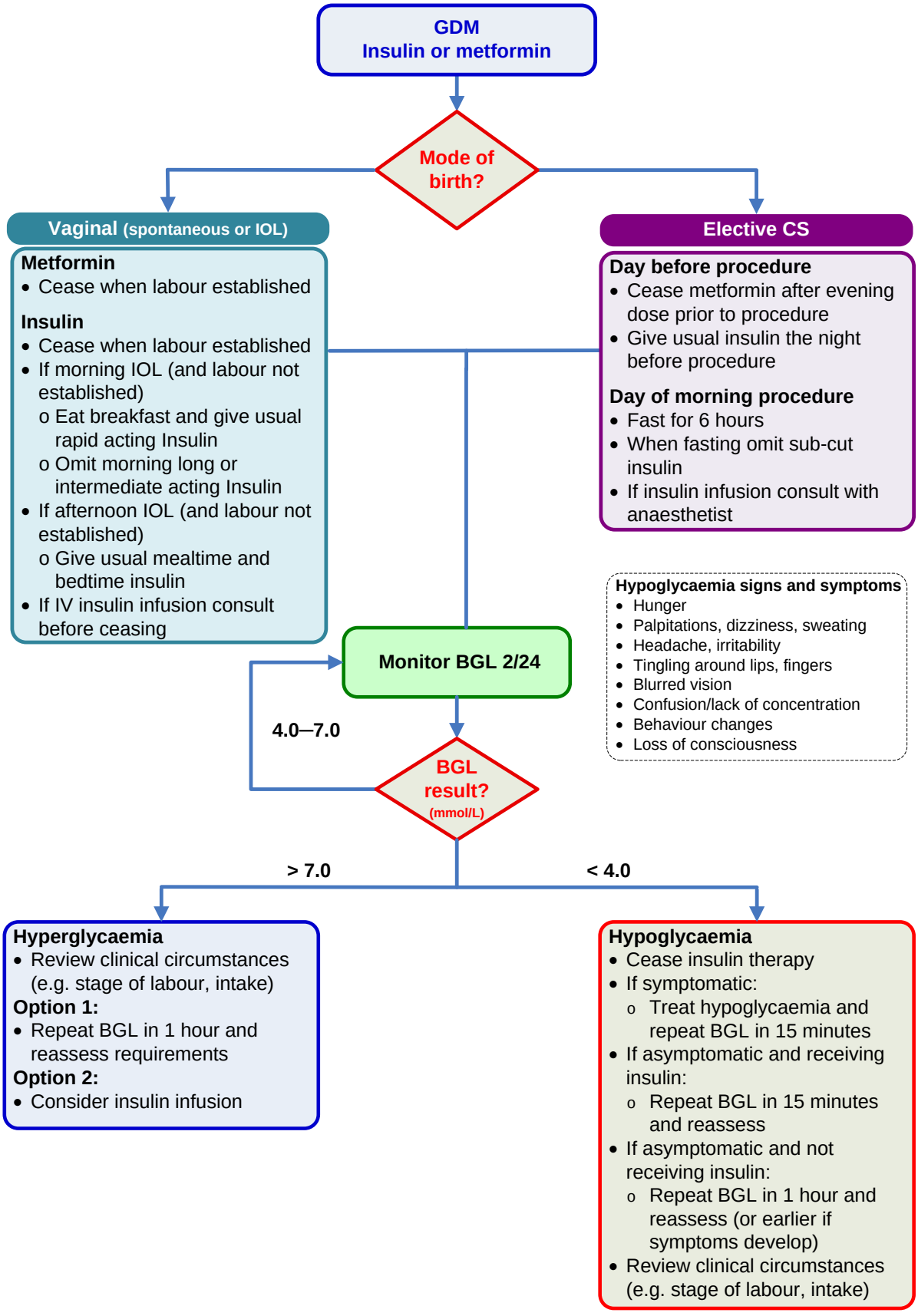


BGL: blood glucose level **BMI:** body mass index **DM:** diabetes mellitus **GDM:** gestational diabetes mellitus **HbA1c:** glycated haemoglobin **OGTT:** Oral glucose tolerance test **≥:** greater than or equal to **>:** greater than; **≤** less than or equal to

*Post malabsorptive bariatric surgery includes *Roux-en-Y*, laparoscopic sleeve gastrectomy, bilio-pancreatic diversion with duodenal switch; does not include adjustable gastric banding

Flowchart: F21.33-1-V9-R26

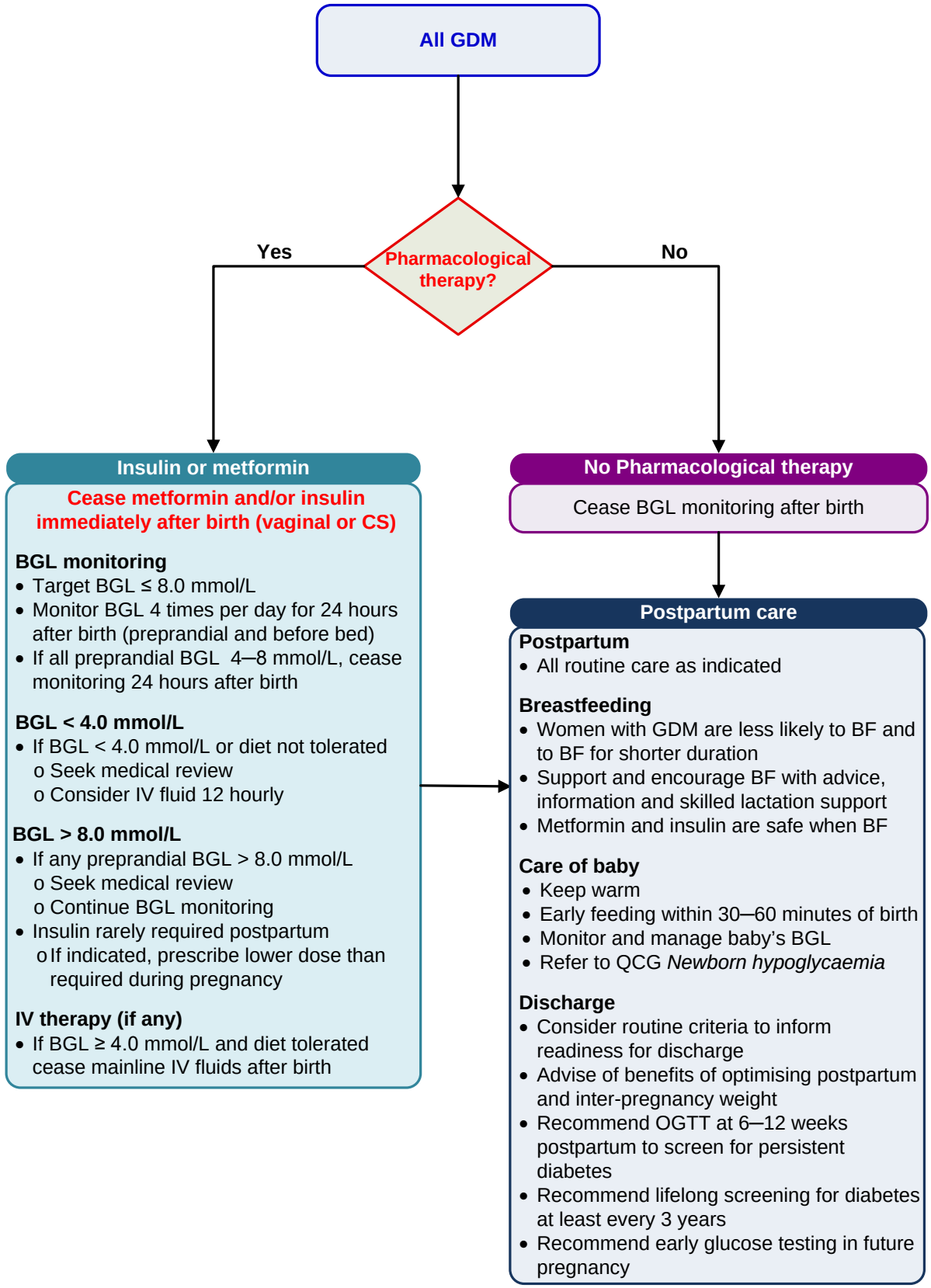
Flow Chart: Intrapartum management of women with GDM requiring metformin and/or insulin



BGL: blood glucose level **CS:** caesarean section **GDM:** gestational diabetes mellitus **IOL:** induction of labour
IV: intravenous **OGTT:** oral glucose tolerance test **QCG:** Queensland Clinical Guidelines **subcut:** subcutaneous
<: less than **>:** greater than

Flowchart: F21.33-2-V2-R26

Flow Chart: Postpartum care of women with GDM



BGL: blood glucose level **BF:** breast feed **CS:** caesarean section **GDM:** gestational diabetes mellitus **IV:** intravenous **OGTT:** oral glucose tolerance test **QCG** Queensland Clinical Guidelines **QID** 4 times per day **subcut:** subcutaneous **>:** greater than **≥:** greater than or equal to **<:** less than **≤:** less than or equal to

Flowchart: F21.33-3-V2-R26

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Abbreviations

AC	Abdominal circumference
ADIPS	Australasian Diabetes in Pregnancy Society
BGL	Blood glucose level
BMI	Body mass index
CI	Confidence interval
CS	Caesarean section
EFW	Estimated fetal weight
GDM	Gestational diabetes mellitus
GI	Glycaemic index
GWG	Gestational weight gain
HbA1c	Glycated haemoglobin
IFG	Impaired fasting glucose
IGT	Impaired glucose tolerance
IOL	Induction of labour
LGA	Large for gestational age
MNT	Medical nutrition therapy
NDSS	National Diabetes Services Scheme
OGTT	Oral glucose tolerance test–75 gram glucose load
PCOS	Polycystic ovarian syndrome
SGA	Small for gestational age
USS	Ultrasound scan

Definitions

Antenatal contact	In this guideline the term *antenatal contact* includes all forms of interaction between the pregnant woman and her care providers for the purpose of providing antenatal care. For example, telephone consults or SMS messaging, email, home visits, scheduled hospital appointments, videoconference or telehealth discussions.
Anti-insulin antibodies	Autoimmune marker of diabetes mellitus.
Dumping syndrome	Also known as postprandial syndrome. See below.
Gestational diabetes mellitus	In this guideline the term 'GDM' is used to refer to women with diagnostic criteria for both GDM and *Diabetes in Pregnancy* unless otherwise specified. Refer to Table 1. Diabetes classification.
Glutamic acid decarboxylase antibodies (GADA)	Autoimmune marker of diabetes mellitus
Impaired fasting glucose (IFG)	Diagnosed when the fasting BGL is higher than the normal range, but does not rise abnormally after a 75 gram glucose drink. Included in the definition of 'pre-diabetes'.
Impaired glucose tolerance (IGT)	BGL at 2 hours during an OGTT (oral glucose tolerance test) is higher than the normal range, but not high enough to diagnose type 2 diabetes. Included in the definition of 'pre-diabetes'.
Islet antigen-2 antibodies (IA-2A)	Autoimmune marker of diabetes mellitus.
Large for gestational age (LGA)	Fetal weight greater than the 90th percentile for gestational age. Consider parental ethnicity and anthropometry.[1]
Macrosomia	Birth weight greater than 4500 g.[1]
Multidisciplinary team	May include midwife, nurse practitioner, endocrinologist, obstetric physician, physician, dietitian, obstetrician, credentialled diabetes educator, general practitioner (GP), GP obstetrician, paediatrician/neonatologist, lactation consultant, Indigenous health worker, exercise physiologist or other health professional as appropriate to the clinical circumstances.
Postprandial syndrome	Occurs within 60 minutes of ingestion of food, usually rapidly absorbed carbohydrates resulting in dizziness, flushing and palpitations. Also called dumping syndrome.
Pre/postprandial	Before/after eating a meal.
Pre-diabetes	Blood glucose levels are higher than normal, but not at a level to diagnose type 2 diabetes. Includes impaired fasting glucose (IFG) and impaired glucose tolerance (IGT).
Psychosocial services	Any services, organisation (government or non-government) or health discipline that provides counselling, support, mental wellbeing assessment, psychiatric care, peer support, or other psychological or psychosocial care.
Small for gestational age (SGA)	Birth weight below the 10th percentile[1], not necessarily implying fetal growth restriction as baby may be constitutionally small.
Suspected fetal macrosomia	Ultrasound scan estimated fetal weight and/or abdominal circumference greater than 95th percentile for gestation.[2]

1 Introduction

Gestational diabetes mellitus (GDM) is one of the most common medical complications of pregnancy.[3-5] It is defined as glucose intolerance that is first diagnosed or recognised during pregnancy, and does not meet criteria for overt diabetes outside pregnancy. If glucose levels are high enough to be consistent with a diagnosis of diabetes outside pregnancy, the term 'Diabetes in Pregnancy' (DIP) is preferred. DIP commonly represents undiagnosed diabetes mellitus detected for the first time during pregnancy[6,7], but the diagnosis generally requires confirmation in the postpartum period. Although GDM usually resolves following birth, it is associated with significant morbidities for the woman and baby in the perinatal period, and in the long term.[5,8-17]

There is widespread (but not universal) consensus on the diagnostic criteria for GDM used in this guideline. This includes endorsement by a significant number of professional organisations including Australasian Diabetes in Pregnancy Society (ADIPS)[7], National Health and Medical Research Council[18], Australian College of Midwives, International Association of Diabetes and Pregnancy Study Group[19], Australian Diabetes Educators Association, The Royal Australian and New Zealand College of Obstetricians and Gynaecologists[20], The International Federation of Gynecology and Obstetrics[21] and the World Health Organisation.[4]

1.1 Prevalence

The number of women diagnosed with GDM is increasing. This may reflect the increase in both maternal age and body mass index (BMI) of the pregnant population, and/or be associated with changing definitions of GDM.[22]

- Queensland incidence of GDM (as at January 31 2020) was 13% in 2018[23]
- Australian incidence of GDM was 14% of women birthing in hospital in 2018[22]
- Incidence of GDM has tripled since 2000–2001[22]
  - The incidence of GDM increases with the level of socioeconomic disadvantage (21% compared with 13%)[24]
- Incidence of GDM for Aboriginal and/or Torres Strait Islander women was similar to the rate in non-Indigenous women (adjusted for differences in age structure of each group)[22]
- Older women (45–49 years) were more than four times likely to have a GDM diagnosis[24]
- Treatment in 2016–2017:
  - 32% required insulin therapy[24]
  - 8% required oral hypoglycaemia medications[24]

1.2 Diabetes classification

Table 1. Diabetes classification

Classification	Description
GDM[4,6]	• Glucose intolerance with onset or first recognition during pregnancy • Elevated plasma glucose levels less severe than overt diabetes • Refer to Table 10. Blood glucose level
Diabetes in pregnancy[4,6]	• Hyperglycaemia onset or first recognition during pregnancy • Plasma glucose levels exceed the threshold(s) for diagnosis of diabetes outside pregnancy • May indicate undiagnosed or pre-existing diabetes outside pregnancy, but a definitive diagnosis of non-gestational diabetes cannot be made until the postpartum period • Additional management (beyond that required for lower abnormal plasma glucose levels) is required • Refer to Table 10. Blood glucose level
***Type 1**[4,6]	• The body no longer makes its own insulin and cannot convert glucose into energy, resulting from β cell destruction that leads to near or absolute insulin deficiency • Commonly accompanied by autoimmune markers including anti-GAD, anti-IA-2A antibodies and anti-insulin antibodies • Daily insulin via injection or a continuous subcutaneous insulin infusion (CSII) pump is required • Diagnosis is usually established outside of pregnancy (before or after)
***Type 2**[6]	• Hyperglycaemia resulting from insulin resistance and/or insufficient production of insulin • Lifestyle modification (diet and physical activity) is the cornerstone of management • Oral hypoglycaemic medication and/or insulin therapy is usually required • If woman is on non-insulin injectables (e.g. GLP1 agonists) these are ceased at pregnancy diagnosis, due to lack of safety data for use during pregnancy • Diagnosis is usually established outside of pregnancy (before or after) or may present as diabetes in pregnancy (confirm diagnosis postpartum) o Elevated HbA1c in first trimester [refer to Table 10. Blood glucose level for diagnosis]
***Pre-diabetes**[6,25]	• A condition in which blood glucose levels are higher than normal but not high enough to be diagnostic of diabetes • Includes impaired fasting glucose (IFG) and/or impaired glucose tolerance (IGT) • Diagnosis is established outside of pregnancy (before or after)

*Management not discussed in this guideline

1.3 Clinical standards

Table 2. Clinical standards

Aspect	Consideration
Clinical care	• Develop locally agreed protocols to support management including[26]: o Consultation mechanisms, or processes with higher service capabilities including the use of telehealth o Standardised forms or communications that support care planning (e.g. peripartum insulin management plan) o Mechanisms for offering dietary advice, blood glucose monitoring and blood glucose lowering therapy as indicated • Support clinical staff to develop communication skills that enable positive and non-judgemental discussions about obesity and weight gain with pregnant women[27] • Consider access to local resources (e.g. anaesthetic services, dietetic services, consulting rooms) • Refer to QCG *Standard care* guideline[28]
Model of care	• Individualise care for the woman[18] o Provide common philosophy involving shared understanding of care pathways by all health care providers involved in the women's care[18,29] o Collaborative model of care that supports continuity of midwifery care improves maternal and neonatal outcomes and is suitable for high risk women[30,31] • Establish referral pathways and consultation mechanisms with higher level services as required[32] o Establish local criteria for low risk GDM model of care: o Consider local experience and expertise in management of GDM, as well as criteria that prompts a review or signals that a change in model of care may be required • The following groups of women are not suitable for care in a low risk model: o Pre-existing diabetes (type 1 or type 2) o Diagnosis of diabetes in pregnancy o GDM requiring pharmacological therapy o GDM with other medical or pregnancy complications • A multidisciplinary team approach is ideal[33,34] [refer to Definitions] • Women with well managed diet controlled GDM and no other risk factors for known complications, may be suitable for low risk models of care although closer surveillance/more frequent antenatal contact is still required • Midwifery[31] and general practitioner (GP) continuity of care models compliment high risk obstetric care • Increased breastfeeding rates have been reported in women with diabetes in pregnancy who receive consistent support[35]
Diabetes related products	• Establish access to free or subsidised blood glucose meter programs (e.g. via manufacturers) • Advise to register (requires approved clinician support) with National Diabetes Services Scheme (NDSS)[36] to access diabetes related products at subsidised cost o Free registration is open to all Australian citizens and others who are Medicare eligible[36] o Registration with National Gestational Diabetes Register aids accurate national data collection, and creates a recall system for women and their GP about the importance of postnatal oral glucose tolerance test (OGTT), and ongoing surveillance for type 2 diabetes

2 Risk assessment

Abnormalities of glucose tolerance have immediate, short-term, and long-term implications for the health of the woman and her baby[24], and may be prevented by adequate treatment.[6,14] Discuss with all women the benefits of achieving or maintaining a healthy lifestyle (e.g. nutrition, gestational weight gain and physical activity).[14,26]

2.1 Risk factors

Assess all women early in their pregnancy for risk factors associated with gestational diabetes.[7]

Table 3. GDM risk factors

Aspect	Risk factors
Context	• It is not known if all risk factors are of equivalent predictive value[7]
Ethnicity[1,7,37]	• Greater risk for women who are: o Asian o Indian subcontinental (India, Pakistan, Bangladesh, Nepal, Sri Lanka, Bhutan, and the Maldives) o Aboriginal and/or Torres Strait Islander o Pacific Islander o Maori o Middle Eastern o Non-white African
Maternal history	• Previously elevated blood glucose level[1,7,12] or previous GDM[1,12,37,38] • Maternal age greater than or equal to 40 years [7,37] • Obesity (BMI greater than 30 kg/m^2)[1,7,12,14,37] • Family history of diabetes mellitus (first degree relative with diabetes or sister with GDM)[1,14,37] • Previous large for gestational age (LGA) baby[7] [refer to Definitions] • Polycystic ovarian syndrome[1,7,12,37] • Previous perinatal loss[1,7,12,14,37] • Medications–corticosteroids[1,12], antipsychotics[7] • Multiple pregnancy[39]

2.2 Risk reduction

Table 4. Risk reduction

Aspect	Consideration
Context	• Incidence of GDM may be reduced by lifestyle interventions started before the 15th week of pregnancy (RR 0.80, 95% CI 0.66–0.97) when compared to standard care[40] o Not effective for women later in pregnancy[40] • Probiotics have not shown any proven role in GDM prevention in pregnant women who are overweight or have obesity[41] • Low vitamin D levels: o Have been associated with increased risk of developing GDM o Have been associated with sub-optimal blood glucose levels (BGL) in women with GDM in third trimester[15] o Require supplementation in women from populations at risk to reduce the risk of GDM[42,43] o If woman has a low baseline vitamin D (less than 50 nmol/L) supplementation may reduce the risk of GDM[44] • It is unclear if physical activity interventions/exercise during pregnancy prevent GDM, but they do limit excessive gestational weight gain (GWG), and reduce the risk of caesarean birth and of having a LGA baby[45,46]
Recommendation	• Advise women that regular physical activity and healthy eating before and during pregnancy help to limit excessive weight gain[47]

2.3 Risks from GDM

2.3.1 Maternal risks from GDM

Table 5. Maternal risks

Aspect	Consideration
Context	• There is a clear relationship between increased plasma glucose levels during pregnancy, and adverse maternal and fetal outcomes independent of other known factors for these outcomes[5,8,48] • Continuum of risk for adverse pregnancy outcomes is across maternal glucose levels and includes levels below diagnostic values for GDM[4,8,49] • There is variable quality and conflicting evidence about the degree of risk conferred by maternal hyperglycaemia on maternal and fetal outcomes[50]
Maternal short term risks	• Pre-eclampsia[8,12,14,24,48] • Induced labour[24,48] • Operative birth[12,15,24] • Hypertension in pregnancy[24] • Caesarean section[24,48] • Preterm labour and birth[24] • Polyhydramnios[51] • Post-partum haemorrhage[51] • Infection[51] • Birth trauma
Maternal long term risks	• Recurrent GDM in subsequent pregnancies[52,53] o Magnitude of risk increased with the number of prior pregnancies with GDM o Increased risk of developing GDM in second pregnancy (OR, 13.2; 95% CI, 12.0–14.6)[54] o Rate of GDM in second and third pregnancies 4.2–4.7%[54] • Progression to type 2 diabetes[11,15] o About 5–6.5% within 6 months of birthing[55] o 10.7% if untreated [OR 7.63; 95% CI, 5.33–10.95][5] • Risk of developing diabetes or pre-diabetes at mean of 11.4 years post GDM affected pregnancy[11] o 52.2% (OR 3.44, 95% CI, 2.85 to 4.14) • Increased risk of developing a disorder of glucose metabolism[11] (e.g. IFG, IGT or type 2 diabetes) • Development of metabolic syndrome[48] • Development of cardiovascular disease[15,56] • Renal disease[56]

2.3.2 Fetal baby risks from GDM

Table 6. Fetal/baby risks

Aspect	Consideration
Fetal/newborn baby short term risks	• Prematurity[8,15], especially if maternal hyperglycaemia severe and required treatment with insulin[13] • Macrosomia[8,12,15-17] especially if maternal hyperglycaemia severe and required treatment with insulin[13,16,48] • Increased newborn weight[8,57] and adiposity[57] • Birth trauma—risk increases as fetal growth accelerates and weight increases[8,12,16,17] o Bone fracture o Nerve palsy • Hypoglycaemia[8,15] • Respiratory distress syndrome[15,17] • Jaundice[8,16] • Hypocalcaemia[15] • Polycythaemia/hyperviscosity[58] • Cardiac anomalies including hypertrophic cardiomyopathy and consequent left ventricular outflow tract obstruction[59] • Stillbirth (late) if GDM is uncontrolled or not treated resulting in raised fasting plasma glucose[60]
Baby long term risks	• Increased risk for: o Impaired glucose tolerance[15] o Development of type 2 diabetes[15] o Overweight and obesity[5,11,15,61] • Insufficient evidence for which strategy for management of diabetes in pregnancy reduces long term risks for the baby[62]

3 Diabetes diagnosis

3.1 Diagnostic tests

Table 7. Diagnostic tests

Aspect	Consideration
Context	• Use a single set of diagnostic criteria for GDM and diabetes in pregnancy [refer to Table 10. Blood glucose level for diagnosis] • Some professional bodies recommend using non-pregnancy glucose reference ranges in first trimester—not endorsed by ADIPS[7] • Not all women with mild elevations of glucose (particularly fasting glucose) in early pregnancy will progress to severe glucose abnormalities[63] o Individualised management is required
OGTT	• Main value is to identify women with any degree of hyperglycaemia[19] • Suitable for use in the first trimester and at 24–28 weeks gestation o There is lack of evidence based targets for first trimester to diagnose GDM[14] • Diagnosis by OGTT results in better perinatal outcomes (e.g. LGA, neonatal unit admissions and neonatal hypoglycaemia) when compared with the two step glucose challenge test[64]
HbA1c	• HbA1c is only suitable in first trimester for women with risk factors[18], before erythrocyte formation starts to increase and basal glucose levels fall • Limited use for GDM diagnosis, management or postpartum assessment[7] because of low test sensitivity o Unlikely to identify women with milder degrees of hyperglycaemia, GDM or reflect rapidly developing insulin resistance o Only useful if woman also has fasting plasma glucose level (PGL) as each has a different sensitivity for GDM diagnosis • Known haemoglobinopathy may underestimate HbA1c due to increased red cell turnover[65] • Main value is to identify women likely to have pre-existing glucose abnormalities (e.g. type 2 diabetes) • Refer to Appendix A: Conversion table for HbA1c measurement
Plasma glucose	• Fasting (8–12 hours after eating) is used as it is less influenced by time and recent food intake[66] • Fasting PGL at 24–28 weeks gestation only recommended as suggested below*
Test type recommendation	• OGTT is the preferred diagnostic test for pregnant women with or without risk factors[7] • *During COVID-19 pandemic a modified two step testing protocol[67] was implemented to reduce community exposure risk, but requires further evaluation before adoption as standard care: o If fasting PGL ▪ Less than 4.7 mmol/L, normal result ▪ 4.7–5.0 mmol/L OGTT indicated ▪ Greater than 5 mmol/L, diagnostic of GDM • There may be circumstances where HbA1c and fasting blood glucose are appropriate **in the first trimester** including: o Woman is at high risk of underlying type 2 diabetes (e.g. Aboriginal and/or Torres Strait Islander) o If the woman is unable to tolerate the OGTT (e.g. due to morning sickness, hyperemesis) o Opportunistic care is appropriate due to potential for woman declining or unable to complete OGTT o OGTT is not practical due to clinical, geographical or logistical circumstances o May be suitable for women who have had bariatric surgery and are at risk of postprandial syndrome (“dumping syndrome”)[68] o Woman is taking metformin for polycystic ovarian syndrome (PCOS)[69]

3.2 Testing for GDM

Offer all women for GDM during pregnancy as outlined in Table 8. Testing for GDM. The oral glucose challenge test is no longer recommended.[4,7,19-21]

Table 8. Testing for GDM

Aspect	Consideration
Context	• Advise the woman having an OGTT to[66,70]: o Maintain a normal diet o Fast for 8–14 hours before the OGTT o Drink water during fasting to prevent dehydration o Continue any usual medications [refer to Maternal medications* below]
With risk factor(s)	• Perform an early OGTT (or HbA1c) with first antenatal bloods or at the first antenatal visit (in the first trimester)[7,19] • If the early OGTT (or HbA1c) is normal, repeat OGTT at 24–28 weeks gestation as for women with no risk factors[19]
Post-bariatric surgery	• If woman has had laparoscopic adjustable gastric banding (LAGB) or sleeve gastrectomy (SG) o Usual GDM testing[68] may be possible o OGTT at 24–28 weeks gestation o If gastric band is tight or the woman is vomiting, OGTT unlikely to be tolerated • If post malabsorptive BS (e.g. Roux-En-Y gastric bypass (RYGB), or biliopancreatic diversion)[68] an OGTT is not suitable due to altered gastric emptying including postprandial syndrome (“dumping syndrome”)[68] • In first trimester consider: o If history of diabetes or other risk factors[68,71], a fasting BGL and HbA1c o If HbA1c greater than or equal to 48 mmol/mol (6.5%), or fasting BGL is greater than or equal to 7.0 mmol/L[71] treating woman as if has type 2 diabetes o If history of diabetes, repeat HbA1c[71] • In second trimester consider: o Fasting BGL between 24–28 weeks gestation, and if BGL 4.6–5 mmol/L recommend fasting and postprandial BGL for one to two weeks[68] (self-monitoring) • In third trimester: o If evidence of excess fetal growth/adiposity is present on growth scan, repeat testing[71] [refer to Table 14. Fetal surveillance] • Refer to Queensland Clinical Guidelines: *Obesity in pregnancy*[72]
No risk factor(s)	• Routinely recommend an OGTT to all pregnant women, who are not known to have GDM, at 24–28 weeks gestational age[7,19]
Maternal medications*	• Do not perform an OGTT within one week of steroids (betamethasone/dexamethasone) administration • If receiving steroids monitor BGLs • If taking metformin for PCOS, OGTT results may be misleading
If OGTT declined	• Fasting glucose test may be an alternative although this will only give partial information on glucose metabolism • Refer to Table 7. Diagnostic tests

3.3 Diagnosis of GDM or diabetes in pregnancy

Table 9. Diabetes diagnosis

Aspect	Consideration
GDM	• Diagnosis is based on the results of the fasting 75 g OGTT during pregnancy o One or more elevated level(s) is sufficient for a diagnosis of GDM[7,19] • If fasting blood glucose test, or HbA1c (e.g. in woman who has had bariatric surgery or other reason), is an elevated value this is diagnostic of GDM[7,19] • Refer to Table 10. Blood glucose level for diagnosis
Diabetes in pregnancy	• Diagnosis based on glucose levels exceeding the threshold for diagnosis of diabetes[6,34] [refer to Table 10. Blood glucose level for diagnosis] • If diabetes in pregnancy: o Manage woman in a centre/clinic with experience in the management of pre-existing diabetes in pregnancy[1] (not suitable for a low risk model of diabetes care) o Consider screening for complications of diabetes (e.g. retinopathy and nephropathy) [1] o Higher risk of pregnancy complications[1] o Consider low dose aspirin for pre-eclampsia prevention[73] [refer to Queensland Clinical Guidelines *Hypertension and pregnancy*[74] o Postpartum testing required to confirm or exclude non-gestational diabetes[1]

3.4 Diagnostic BGL

Worldwide (including Australia), HbA1c measurement and reporting has been standardised using Systeme International (SI) units. Refer to Appendix A: Conversion table for HbA1c measurement

Table 10. Blood glucose level for diagnosis

Diagnosis	Test	Test result
***GDM[4,7,19,21]**	**BGL**	Plasma glucose level **(one or more)**
	Fasting	• 5.1–6.9 mmol/L
	1 hour	• Greater than or equal to 10.0 mmol/L
	2 hour	• 8.5–11.0 mmol/L
	HbA1c	• Limited evidence suggests that HbA1c greater than or equal to 41 mmol/mol and less than 48 mmol/mol in early pregnancy sufficient to diagnose GDM[75] • Lower values do not exclude GDM[76,77]
Diabetes in pregnancy (DIP)[4,7,19,21]	**BGL**	Plasma glucose level **(one or more)**
	Fasting	• Greater than or equal to 7.0 mmol/L
	1 hour	• *A one hour level is not used*
	2 hour	• Greater than or equal to 11.1 mmol/L
	Random	• Greater than or equal to 11.1 mmol/L • Confirm with additional standardised testing
	HbA1c	• Greater than or equal to 48 mmol/mol or 6.5% in early pregnancy[19,68]

*Refer also to Table 7. Diagnostic tests

4 Antenatal care

Objectives for antenatal care of women diagnosed with GDM:

- Effectively manage of the diabetes
- Monitor for maternal complications
- Prevent fetal/neonatal complications
- Provide routine antenatal care[33,34,78]

Refer to Table 2. Clinical standards.

4.1 Antenatal care

Table 11. Antenatal care

Aspect	Consideration
Antenatal contact	• Individualise the antenatal schedule of contact according to clinical circumstances[18,33] • If BGLs are suboptimal or there are complicating factors (e.g. hypertension, pre-eclampsia, macrosomia, intrauterine growth restriction) more frequent antenatal contact is required • GDM or DIP diagnosed before 16 weeks gestational age requires increased surveillance and monitoring, as likely to be pre-pregnancy pre-diabetes or diabetes[37] • Refer to Appendix B: Gestational weight gain
Initial clinical assessment all GDM	• All routine antenatal assessments are indicated throughout pregnancy • Develop an individualised plan of care with women whose pregnancy is complicated with diabetes[33] o Review and update the plan at frequent intervals • Recommend ultrasound scan (USS) at 28+0–30+6 weeks gestation[33] to asses fetal growth including fetal abdominal circumference (AC), and to establish a baseline for future evaluation • Order laboratory evaluation of serum creatinine
At GDM diagnosis	• Review history—previous GDM, medications • Refer for diabetes educator and dietitian consult within one week of diagnosis • Provide psychosocial assessment and support–refer as required • Commence BGL self-monitoring • Review pre-pregnancy BMI[1] and discuss individualised healthy weight gain targets in pregnancy • Discuss lifestyle factors including physical exercise and smoking cessation (if applicable) • Provide request forms for USS and laboratory investigations including serum creatinine at 28+0–30+6 weeks gestation • If pharmacological therapy commenced: o Follow-up contact within three days by health care provider o Weekly diabetes educator review • Review timing of next contact (at clinic, or by phone, telehealth or email) o Fortnightly until 36+0 weeks gestation o Weekly until birth o Increase as indicated • If obesity also present consider anaesthetist review [refer to Queensland Clinical Guidelines *Obesity in pregnancy*[72]]

4.2 Maternal care

Table 12. Maternal care

Aspect	Consideration
Monitoring	• Women with GDM require increased surveillance throughout pregnancy o Consider other risk factors to determine model of care and frequency of antenatal contact o Maintain a high index of suspicion for associated conditions (e.g. pre-eclampsia) o Refer to Table 5. Maternal risks • At each antenatal contact: o Reassess if increased antenatal contact with the multidisciplinary team members is required o Review BGL self-monitoring records o Assess psychosocial needs, and offer support or referral as appropriate for the woman—consider stress related to GDM diagnosis and management o Review lifestyle factors–weight gain trends, diet, exercise, smoking cessation (if applicable) o Test urine for proteinuria o USS scan as indicated [refer to Table 14. Fetal surveillance] • Women participating in Ramadan fasting will require a practical approach and close consultation with the health care team[79] o Ramadan fasting is associated with lower mean glucose levels and higher rates of hypoglycaemia than non-fasting women[80]
Weight	• Pre-pregnancy obesity and excessive GWG are independent risk factors for fetal macrosomia in women with GDM[81] • Compared to normal weight women without GDM[81] o Normal weight women with GDM are 1.94 times as likely (95%CI 1.43–2.68) to have LGA baby o Obese women with GDM are 5.47 times as likely (95% CI 4.34–6.90) to have LGA baby • Discuss GWG in a sensitive and non-judgemental manner that minimises maternal anxiety[27] o Refer to Table 5. Maternal risks • Calculate pre-pregnancy BMI at the first opportunity • Recommend and discuss desirable GWG and rate of GWG o GWG recommendations for the woman with GDM are the same as other pregnant women o Refer to Appendix C: Antenatal schedule of care o Refer to Queensland Clinical Guideline *Obesity in pregnancy*[72] • Weigh woman at each visit o Rapid GWG may indicate polyhydramnios o Inadequate GWG or weight loss may reflect inappropriate restriction of dietary intake and/or improved diet quality • If woman not already under dietetic care, consider referral to a dietitian • Refer to Australian Dietary Guidelines[72,82]
Urine testing	• Test urine at each antenatal visit[33] • Proteinuria may indicate other complications (e.g. pre-eclampsia or renal impairment or nephropathy)[83] • Glycosuria is not a reliable indicator of inadequate glycaemic management[84]

4.3 Special considerations

Table 13. Special considerations

Aspect	Consideration
Breastfeeding preparation	• Advise women of benefits of breastfeeding after GDM, including prevention of newborn hypoglycaemia, childhood obesity and diabetes for women and child[1] • Advise women who are considered low risk to express antenatally o Not recommended for women with a history of antepartum haemorrhage or placenta praevia, more than one previous caesarean section (CS), fetal growth restriction, documented macrosomia, polyhydramnios, hypertension, fetal compromise, or other serious maternal medical condition[85] • There was no harm identified in a study (DAME trial) of advising low risk women about the benefits of routine antenatal expression of breast milk[85] o There are potential benefits for the newborn baby[86] o For low risk women with GDM or DIP, advise about commencing hand expression (for 10 minutes no more than twice per day) from 36+0 weeks of gestation[85] o Refer to local policies and guidelines
Diabetes in pregnancy	• Review and/or recommend morphology USS as there may be an increased risk of fetal congenital anomaly[34] o If BGL above target levels in first trimester offer tertiary morphology USS • Test for retinopathy[33] as the presence of these are associated with a substantially increased risk of developing pre-eclampsia o Recommend optometrist or ophthalmologist review[6,34] • Test for microalbuminuria[26]as worsening nephropathy and super-imposed pre-eclampsia are most common cause of preterm birth in women with GDM[26] • Consider starting pre-eclampsia prophylaxis (aspirin and/or calcium supplement) prior to 16+0 weeks gestation[73] o Refer to Queensland Clinical Guidelines *Hypertension and pregnancy*[74]
Post bariatric surgery	• Screen for micronutrient deficiencies[71] • Refer woman early in pregnancy for specialist dietary advice to optimise micronutrient supplementation, dietary intake and symptom management[71] • If woman has had gastric banding surgery: o Increased risk of small for gestational age (SGA) baby [refer to Table 14. Fetal surveillance] o In first trimester, refer for management of gastric band in case of hyperemesis and to prevent nutrient deficiency[71] o In second and third trimesters assess GWG and fetal growth—band may require adjusting[71] o Refer to Queensland Clinical Guidelines *Term small for gestational age baby*[87]

4.4 Fetal surveillance

Table 14. Fetal surveillance

Aspect	Consideration
Context	• There is limited evidence or consensus regarding specific antepartum tests or their frequency, for fetal wellbeing[88] • Monitoring type and frequency is influenced by the presence of other pregnancy complications (e.g. antepartum haemorrhage, pre-eclampsia, fetal growth restriction) as well as severity of maternal hyperglycaemia[89] • Fetal AC on USS greater than or equal to 75th percentile for gestational age, measured at 29+0 to 33+6 weeks gestation, correlates with evidence of excess fetal growth/adiposity and an increased risk for birth of an LGA baby[90] o May require more intensive glucose lowering therapy[90] o If fetal USS shows normal growth is maintained, consider relaxing glycaemic targets[90]
Fetal growth and wellbeing	• Perform clinical assessment of fetal size and amniotic fluid volume[12,91] • Assess the fetal response to maternal GDM by USS measurement of fetal AC commencing at 28+0–30+6 weeks gestation[12,92] • Longitudinal growth assessment is superior to a single measurement late in pregnancy if abnormal on first scan • Accelerating AC especially if greater than 95th percentile is clinically significant • Consider 2–4 weekly USS for women with unstable diabetes or who require pharmacological therapy or comorbid risk factors (e.g. obesity, hypertension, LGA or SGA , previous stillbirth)[12] o If fetal growth restriction is suspected, follow usual imaging fetal surveillance including umbilical artery and middle cerebral artery Doppler[12] • If excessive fetal growth or AC above 75th centile is detected, consider more intensive management[90,93] which *may* include: o Lower blood glucose targets for glycaemic management o Addition of pharmacologic therapy o Altered frequency of scans and interpretation • Obstetric USS may be suboptimal in women with GDM and/or post-bariatric surgery o May affect accuracy of estimated fetal weight (EFW) ▪ EFW generally within 10% of actual birthweight o Remains clinically reliable to identify LGA and SGA

4.5 Psychosocial support and education

Table 15. Psychosocial support and education

Aspect	Consideration
Context	• Emotional well-being is an important part of diabetes care and self-management[94] • Rapport between the woman and the health care provider can enhance compliance[95] • Barriers to effective treatment response in women with GDM include depression, eating disorders, stress and anxiety[96]
Information and education	• Individualise the approach to management and consider[95] o Cultural/language background o Learning ability and style of learning (e.g. written information, visual) o Family and social circumstances • Provide women and their families comprehensive information about GDM to aid in self-management including[34]: o Implications of GDM for the woman and her baby (short and long-term) o Dietary and physical activity recommendations [refer to Table 18. Physical activity] o Self-monitoring of blood glucose procedures and targets o Advice about seeking urgent medical advice if they become hyperglycaemic or unwell o Importance of long term follow-up • Provide information about NDSS website for additional resources • Discuss risk of newborn hypoglycaemia, and need for BGL monitoring and management of baby after birth for at least the first 24 hours o Provide Queensland Clinical Guideline parent information *Newborn hypoglycaemia*[97]
Psychosocial support	• Support women to make positive lifestyle changes o Diagnosis of GDM and education about the short and long term risks of GDM and type 2 diabetes can motivate women to undertake long-lasting changes[98] • Perform a psychosocial assessment and refer women as required to social work or mental health services for support • Utilise strategies to support behaviour change including self-monitoring, goal setting, problem solving and motivational interviewing[99]

4.6 Self-monitoring

Results from BGL self-monitoring form only part of the clinical decision making regarding the need for pharmacological treatment for an individual woman. Also consider the potential for improved glucose control with medical nutrition therapy, enhanced physical activity and assessment of fetal growth. Refer to Table 14. Fetal surveillance, Table 17. Medical nutrition therapy and Table 18. Physical activity.

Table 16. Self-monitoring

Aspect	Consideration
Context	• Self-monitoring of BGLs before and after meals is a key part of the management of GDM • Self-monitoring of BGLs can improve glycaemic management by providing a baseline from which to evaluate the effectiveness of interventions • There is limited evidence about optimal treatment targets for self-monitoring capillary BGL[7] o The two major studies in this area[78,100] used different targets, and a systematic review[101] suggested the targets used were higher than the levels found in normal pregnancy • Targets currently recommended by ADIPS are not backed by strong evidence and are noted as an area for future research • Flash monitoring and continuous glucose monitoring are not Therapeutic Goods Administration (TGA) approved[102] for GDM management[103]
BGL self-monitoring	• Recommend BGL self-monitoring to the woman diagnosed with GDM • Blood glucose meter is for the woman's individual use only • Advise the woman to bring blood glucose meter and diary to each appointment for review and download of data • Provide individual or group teaching about self-monitoring of blood glucose by a clinician experienced in diabetes education including: o Importance of hand washing o Use of blood glucose meter o Use of lancet device and safe disposal of sharps o Recording of BGL results (e.g. BGL diary in paper or electronic form) o Potential causes of errors in monitoring techniques and results o Understanding results and the impact of exercise, dietary intake, stress and illness o Use of a food diary for improved awareness of dietary intake and effect on BGL • Initially, advise BGL self-monitoring four times per day, either: o Before breakfast and one hour postprandial (each main meal) or o Before breakfast and two hours postprandial (each main meal) • Reduce or increase BGL self-monitoring frequency depending on glycaemic targets achieved and progress of pregnancy (e.g. if woman is 37+0 weeks or more gestation, glycaemic targets are managed with diet, and baby is normally grown reduce BGL monitoring)
BGL targets	• Trend patterns and mean values of BGL are more important than individual results (which may reflect dietary or lifestyle related factors) • Suggested capillary BGL targets (not supported by strong evidence) are[7]: o Fasting–less than or equal to 5.0 mmol/L o 1 hour after commencing meal–less than or equal to 7.4 mmol/L o 2 hours after commencing meal–less than or equal to 6.7 mmol/L • If BGL is elevated on two occasions at the same test point within one week, review recent dietary modifications, physical activity interventions and pharmacologic interventions • If average BGL over one week is elevated (BGL at the same time each day) consider pharmacological therapy[90,101]

4.7 Medical nutrition therapy

The primary intervention for women diagnosed with GDM is to modify diet and physical activity.[45,91,104-107] The aim is to improve BGLs, maintain weight gain within recommended parameters, and promote a healthy and balanced lifestyle beyond pregnancy[108] that delays or avoids the subsequent development of type 2 diabetes.

Table 17. Medical nutrition therapy

Aspect	Consideration
Context	• Medical nutrition therapy (MNT) focuses on food choices for achieving optimal nutrition for maternal and fetal health[109] promoting appropriate GWG, achieving BGLs within target range and absence of ketones[110] • There is limited evidence about which types of dietary advice are most suitable for women with GDM[109,111] • MNT involves individualised advice based on nutritional assessment, but include as a minimum 175 g of carbohydrate per day[110,112] and a low glycaemic index (GI) diet[91] • One systematic review and meta-analysis demonstrated modified dietary inventions favourably influence birth weight[111]
Supplementation	• Vitamin D supplementation has been shown to reduce the risk of GDM[42,43] in women with low vitamin D levels (less than 50 nmol/L)[44] o Refer to Table 4. Risk reduction
Medical nutrition therapy (MNT)	• Refer women diagnosed with GDM to an accredited practising dietitian within one week of diagnosis[113] o Consider telehealth consultation if necessary • Provide dietary advice that is culturally appropriate and individualised[113] • Provide written information about: o Healthy eating (e.g. avoiding ultra-processed foods, increasing fibre intake and eating minimally processed foods) o Meeting the nutritional requirements of pregnancy (five food groups) o Carbohydrate foods and influence on BGLs o Aim for carbohydrate intake above 175 g per day[114,115], spread evenly and tailored to individual needs o GI and influence on BGLs[114] o Weight gain during pregnancy o Dietary restriction sufficient to cause weight loss is not recommended o Safe foods for pregnancy o Label reading o Maintenance of a food diary
Special consideration	• If woman has had bariatric surgery refer to specialist team for dietary advice: o Regarding monitoring and supplementation of macro and micronutrients o At the end of each trimester at a minimum
Schedule of dietetic visits	• Appointments may be in person, or by phone, telehealth or email • Consider minimum schedule of dietetic appointments recommended by American Dietetic Association Nutrition Practice Guidelines[113] o One hour initial counselling session o Two review appointments (minimum) one week after initial visit and then within 2–3 weeks[113] o Additional reviews scheduled 2–3 weekly based on clinical need o One postnatal follow up o Further review is recommended if pharmacological treatment is initiated • Women who receive at least three dietetic appointments are less likely to require pharmacotherapy[116]

4.8 Physical activity

Assess each woman individually and tailor recommendations for physical activity to suit her abilities and clinical circumstances.

Table 18. Physical activity

Aspect	Consideration
Context	• Physical activity is recognised as a helpful adjunctive therapy for GDM[106,113] • Women with GDM may experience greater blood glucose uptake and therefore lower BGLs through increased insulin sensitivity o Both aerobic and resistance training are benificial[117]
Intensity	• Assess levels of current physical activity[117] o If minimal, increase duration of moderate physical activity slowly o If already more active, maintain or lower intensity during pregnancy rather than attempting to progress to higher levels • Intensity can be assessed using rating of perceived exertion scales[117] o Physical activity of moderate intensity enables the woman to talk, but not sing whilst exercising[117] • Refer to Appendix D: Exercise and exertion for a guide to target heart rate ranges by age and BMI, and rating of perceived exertion
Duration	• Recommend 30 minutes of physical activity on most days of the week[113,118] • Physical activity may be broken into shorter periods of at least 10 minute periods of moderate effort[119]
Type	• Physical activity can include aerobic exercise (e.g. walking, stationary cycle, swimming, aquatic activities, conditioning machines, prenatal exercise classes) and light or moderate resistance exercises[118,120] • Discuss modifications to the physical activity program as pregnancy progresses (particularly in the third trimester as the body's centre of gravity is altered) • Avoid activities that[117,119,120] o Involve lying flat on the back o Increase the risk of falling or abdominal trauma, or require frequent changes in direction (e.g. contact sports, most racquet sports, horseback riding, water skiing) o Add extra load to the pelvic floor (e.g. bouncing or jumping) o Are at extreme altitudes (e.g. scuba diving, mountain climbing)
Recommendation	• Advise women that moderate physical activity is associated with a range of health benefits, improves BGLs and is not associated with adverse outcomes[106,117,118] o Growing body of evidence it may reduce the need for pharmacological intervention[106] • Advise women to[120]: o Avoid dehydration during and after physical activity o Wear loose light clothing to avoid over heating o Not to exercise when hungry, unwell or with an elevated temperature o Record daily activity and duration o Avoid exercising in high temperatures and humidity • Discuss contraindications and indications to stop physical activity o Refer to Table 19. Physical activity cautions and contraindications

4.8.1 Physical activity cautions and contraindications

Table 19. Physical activity cautions and contraindications

Aspect	Consideration
Contra-indications[118]	• Contraindications to physical activity include (but are not necessarily limited to) the following conditions: o Hemodynamically significant heart conditions o Restrictive lung conditions o Incompetent cervix/cerclage o Multiple gestation at risk for premature labour o Persistent second or third trimester bleeding o Placenta praevia after 26 weeks gestation o Premature labour during the current pregnancy o Ruptured membranes o Pre-eclampsia o Intrauterine growth restriction
Cease physical activity and seek advice from care provider[118,120]	• Advise women to stop physical activity and contact their health care provider if they are concerned and/or experience any of the following: o High heart rate o Dyspnoea prior to or during exertion o Dizziness, faintness, nausea o Headache o Decreased fetal movements o Uterine contractions, vaginal bleeding, amniotic fluid leakage o Back or pelvic pain o Chest pain o Muscle weakness o Calf pain or swelling or sudden swelling of ankles, hands and/or face • Refer to Appendix D: Exercise and exertion

5 Pharmacological therapy

Before commencing pharmacological glycaemic therapy, initiate BGL self-monitoring and review results. Individualise the period of BGL monitoring based on clinical circumstances and the degree of hyperglycaemia. Individualise decisions about medication commencement. Consider:

- Gestational age (e.g. anticipated date of birth, or if early pregnancy, hyperglycaemia requiring intensive management to achieve euglycaemia)
- Degree and pattern of hyperglycaemia (fasting or postprandial) to inform most appropriate type of pharmacological therapy
- Fetal growth (macrosomia or small for gestational age) and AC
- Maternal preference

5.1 Metformin

Table 20. Metformin

Aspect	Consideration
Context	• Women prefer metformin to insulin[121] • Women who do not achieve optimal BGLs with lifestyle modification (MNT and physical activity) have traditionally been started on insulin[122] • There is adequate evidence to consider the use of metformin as a treatment option in GDM[5,121,123] • Metformin crosses the placenta, but no evidence of teratogenesis [121,123] • Short term data on safe use in pregnancy and fetal development reassuring[121] • Long term follow up data of children exposed in utero is limited[121] o Impact of increased subcutaneous fat[124], systolic blood pressure, fasting glucose and increased height and weight is uncertain[121] • Metformin when compared to insulin is effective at lowering blood glucose, and is safe for pregnant women and their fetuses[121-123] • Up to 50% of women with GDM treated with metformin will require supplemental insulin to achieve glycaemic targets[125] • Lower rates of severe hypoglycaemia were found in the newborn babies of women who used metformin than in women using insulin [122]
Indications	• Average BGL over one week is elevated (BGL monitored at the same time each day) after consideration of dietary and physical activity factors • USS shows incipient fetal macrosomia (AC above the 75th percentile) at diagnosis or accelerating fetal growth to 95th percentile • Mild overall elevated BGL or elevated fasting BGL
Potential side effects	• Nausea, loss of appetite[126] • Diarrhoea[126]; vomiting[126] • Malabsorption of vitamin B12[126] (generally if longer term therapy) • May be associated with preterm birth prior to 37 weeks gestation[127]
Education	• Advise woman to take metformin after a meal[126]
Contraindications	• Conditions that may alter renal function[126] • Severe hepatic impairment[126] • FGR or SGA on USS • Persistent nausea and vomiting or other intolerable gastrointestinal effects • Consider ceasing if woman develops pre-eclampsia • Lactic acidosis • Severe sepsis
Administration	• Discuss with woman about metformin crossing the placenta and being a category C drug** in Australia • Commencement dose: 500 mg oral daily with food • Maximum dose: 2500mg (immediate release) or 2000 mg (XR) oral daily[126-128] • Titrate dose according to BGLs • Review BGLs within three days of commencement

*Refer to an Australian pharmacopoeia for complete drug information

** Category C drug Drugs which, owing to their pharmacological effects, have caused or may be suspected of causing, harmful effects on the human fetus or neonate without causing malformations. These effects may be reversible. Accompanying texts should be consulted for further details. [Source TGA 2020 July 1 https://www.tga.gov.au]

5.2 Insulin therapy

Table 21. Insulin therapy

Aspect	Consideration
Context	• Insulin therapy is safe to use in pregnancy[129-131] • Rapid acting analogues preferred for control of postprandial hyperglycaemia due to effects of more stable glycaemia and greater flexibility than human insulin[132] • There is no evidence for superiority of a specific insulin type or insulin regimen for GDM[89] • Approximately 27% of women diagnosed with GDM will require insulin therapy[133]
Indications	• Hyperglycaemia in excess of targets despite optimisation of non-pharmacological therapies[14] and/or metformin • Maternal preference
Potential side effects	• Hypoglycaemia[129] • Local (injection site) allergic reactions • Systemic reaction (e.g. skin eruptions, oedema[9,134])
Combination therapy	• Insulin added to metformin can improve BGLs[127]
Commencement	• Consult with expert clinician for calculating doses and ordering appropriate insulin therapy • Individualise dose for each woman as requirements vary • Provide details on how to seek advice if woman has any concerns with insulin therapy • Review BGLs with woman (e.g. by phone or email) within three days post insulin commencement • Refer to 5.2.1 Insulin type by glycaemic abnormality for type of insulin • Consider dietitian review to ensure appropriate carbohydrate intake
Titration	• Insulin requirements may be anticipated to rise throughout the third trimester as a result of increasing maternal insulin resistance o Tends to plateau at 36–38 weeks gestation[135] o Insulin dose can be titrated every two to three days as required with increments of 2–4 units (no greater than 20% dose increase) until targets are met, **or** the woman experiences hypoglycaemia more than 2–3 times per week **or** any episode of severe hypoglycaemia[135]

*Refer to an Australian pharmacopoeia for complete drug information

5.2.1 Insulin type by glycaemic abnormality

Table 22. Insulin type by glycaemia abnormality

Abnormality	Suggested insulin type	Action profile	
Elevated fasting glucose	• Single bedtime injection of **intermediate-acting** insulin* will often suffice	Onset Peak Duration	1.5 hours 4–12 hours Up to 24 hours
Postprandial hyperglycaemia	• Mealtime **rapid acting** insulin*	Onset Peak Duration	10–20 mins 1–3 hours 3–5 hours
Fasting *and* postprandial hyperglycaemia	• Basal-bolus insulin regimen o Mealtime **rapid acting** and bedtime intermediate-acting insulin* ***or***	As for elevated fasting glucose and postprandial hyperglycaemia	
	o Twice daily **mixed i**nsulin* (if woman is reluctant to inject four times per day)	Onset Peak Duration	30 minutes 2–12 hours 24 hours

*Refer to an Australian pharmacopoeia for complete drug information

5.3 Hypoglycaemia

Fasting BGLs tend to decrease in pregnancy and levels of 3.5 mmol/L may be physiologically normal and asymptomatic. Hypoglycaemia is uncommon in women with GDM, particularly those not receiving pharmacological therapy. In the absence of symptoms of hypoglycaemia, confirm the accuracy of results prior to initiating treatment.

Table 23. Hypoglycaemia in women receiving glucose lowering medication

Aspect	Consideration
Definitions	• **Mild hypoglycaemia:** o BGL less than 4.0 mmol/L and o May or may not be associated with symptoms of a low blood glucose level • **Severe hypoglycaemia:** o BGL is very low, generally less than 3.0 mmol/L and o May be associated with confusion and potentially loss of consciousness o Third party assistance may be required by the woman to manage the episode
Causes	• Excess physical activity • Too much insulin • Missed, delayed or inadequate carbohydrate with meal[129] • Alcohol intake (decreases blood glucose)[129]
Symptoms[129]	• Hunger • Light headedness/headache • Sweating/shaking/weakness • Tingling around the lips • Irritability • Blurred vision • Severe hypoglycaemia can lead to confusion and loss of consciousness and requires urgent medical treatment
Treatment	• Consume **one 15 g serve** of fast acting carbohydrates[136] (one of the following) o 5–7 glucose jellybeans ***or*** o Glass of soft drink (not diet) ***or*** o Half a glass of fruit juice ***or*** o Lucozade® 100 mL ***or*** o 3 heaped teaspoons of sugar or honey dissolved in water • If after 15 minutes symptoms persist or BGL remains less than 4.0 mmol/L repeat one serve of fast acting carbohydrates[136] • **Do not over-treat** with fast acting carbohydrates as this may lead to rebound hyperglycaemia • When BGL is 4.0 mmol/L or above eat longer lasting carbohydrate[136] o Eat a snack (e.g. sandwich or crackers, glass of milk) or usual meal if within 30 minutes o Avoid over treatment of hypoglycaemia resulting in hyperglycaemia o Document BGL and time of hypoglycaemic episode
Hypoglycaemia prevention	• Plan to eat regular meals with adequate carbohydrate serves • Be prepared and carry a food snack at all times (including while exercising) • Aim to take long or intermediate acting insulin at the same time each day • Identify causal factors of the hypoglycaemic episode and avoid/mitigate for the future • Carry blood glucose meter at all times so BGL can be checked if symptoms present

5.4 Education for safe self-administration of insulin therapy

Table 24. Education for safe self-administration of insulin

Aspect	Consideration
Safety	• Ideally provided by a credentialled diabetes educator or clinician trained in teaching self-administration of insulin[137] • Individual sessions (rather than group sessions) are preferable • Confirm type of insulin and dose ordered
Demonstrate	• Insulin delivery device • Applying needle to device • Priming device and dialling dose • Injection sites and rotation • Self-injection technique • Needle size • Degree of injection angle (if required) • Use of skin fold (if required)
Discussion points	• Hand washing • Insulin action and profile • Timing of injection • Recognition of hypoglycaemia symptoms and treatment o Refer to Table 23. Hypoglycaemia in women receiving glucose lowering medication • Potential side effects • Safe disposal of sharps • Safe driving[138] • Storage and handling of insulin • Expiry of insulin (opened and unopened) • Confirm and update NDSS registration to enable access to free insulin needles • Travelling—NDSS card or letter authorising woman to carry insulin and needles in hand luggage[138]

6 Birthing

The decision on timing and mode of birth is primarily intended to minimise the risk of intrapartum complications associated with the birth of a LGA or macrosomic infant.[139]

6.1 Considerations for birth

Table 25. Considerations for birth

Aspect	Consideration
Context	• There is little quality evidence to inform management between induction of labour (IOL) at term, expectant management or CS[140] • In one single centre study[141] (n=200), IOL at 38 weeks gestational age reduced birth weight (3,446 g versus 3,672 g; p < 0.01) and rates of macrosomia (15 versus 27%; p=0.05) compared to expectant management, with no increase in the rate of CS (25% in IOL group versus 31% in expectant management group; p=0.43) • The GINEXMAL multicentre randomised controlled trial (RCT) found no difference in birth outcomes regardless of active versus expectant management (n=425) with no difference in the incidence of CS (21% versus 22.3%)[142]
Fetal weight	• Degree of maternal hyperglycaemia is related to the risk of excessive fetal growth[143,144] • Macrosomia increases the risk of perinatal birth trauma and shoulder dystocia, including severe perineal tears, fractures to the baby and brachial plexus injuries[14] • Clinical assessment and obstetric USS estimation of fetal weight can be used effectively to exclude macrosomia • Prediction of accelerated fetal growth or LGA on USS biometry may have significant margins of error[145,146]
Antenatal corticosteroids	• If steroids are required for fetal lung maturity, monitor BGLs and consider admission and intensified insulin therapy
Communication	• Specific topics for discussion with the woman include: o Implications of GDM on birthing specific to her circumstances o Intrapartum management recommendations (if required) o Requirements for administration of pharmacological therapy (if any) when birth approaches/labour commences [refer to Section Table 27. Pharmacotherapy as birth approaches] • Document, regularly review and involve other members of health care team (e.g. anaesthetist if indicated) • Refer to Queensland Clinical Guidelines *Standard care* guideline[28]

6.1.1 Birth

Table 26. Birth

Aspect	Consideration
Timing of birth	• If well managed with MNT and no fetal macrosomia or other complications, wait for spontaneous labour (unless there are other indications for IOL)[88] • If suspected fetal macrosomia or other complications, consider birth from 38+0–39+0 weeks gestation[21,34,88] • RANZCOG recommend suspected fetal macrosomia alone is not an indication for IOL before 39+0 weeks gestation o Insufficient evidence that benefits of reducing shoulder dystocia risk outweigh early birth harm[2] • Consider risk of stillbirth with prolongation of pregnancy versus risk of preterm birth[88] • Pharmacological therapy alone is not an indication for birth before term • In most cases, women with optimal BGLs who are receiving pharmacological therapy do not require expedited birth before 39+0 weeks gestation[88]
Induction of labour	• There is no clear evidence that women with GDM and a normally grown fetus should have different indications for IOL than women without GDM[147] • Consider concomitant complications (e.g. pre-eclampsia, growth restriction, obesity) that influence the risk of stillbirth when counselling women about expectant management versus IOL
Mode of birth	• If fetal weight is estimated at: o Less than 4000 g, vaginal birth is usually appropriate o 4000–4500 g, consider other individual factors (e.g. maternal stature, obstetric and birth history, previous macrosomia with or without shoulder dystocia, limitations of estimating fetal weight) o More than 4500 g, consider elective CS[2,88]—counsel women about the risks and benefits[88] ▪ Insufficient data to determine if CS indicated to reduce birth trauma risk[146] • Women with GDM are at increased risk of instrumental extraction at birth due to shoulder dystocia compared to spontaneous vaginal birth[148] • X-ray pelvimetry is not recommended[148]

6.2 Pharmacotherapy as birth approaches

- Develop and document an individual pharmacotherapy plan considering the woman's individual circumstances
- If the woman is receiving intravenous insulin infusion for unstable BGL do not cease while glucose being administered when nil by mouth during the preoperative period

Table 27. Pharmacotherapy as birth approaches

Labour/birth	Metformin	Insulin
Spontaneous onset	• Cease metformin when in established labour	• Titrate insulin requirements according to BGL during labour
IOL	• Cease metformin when in established labour	**If morning IOL commencement** • Eat early morning breakfast • Administer usual dose of rapid acting insulin with breakfast • Omit long or intermediate acting insulin in the morning • Cease subcutaneous insulin when in established labour **If afternoon/evening IOL commencement** • Administer usual dose of rapid acting insulin with evening meal • If not in established labour, administer long or intermediate acting insulin before bedtime • Cease subcutaneous insulin when in established labour
Caesarean section	• Cease metformin evening before elective procedure (after evening dose)	• Administer usual rapid and intermediate/long acting insulin the night before o Consider individual woman's clinical situation including fasting BGL o May require reduced dose of intermediate/long acting insulin • Monitor BGL • Fast for six hours prior to elective CS o If fasting, omit all subcutaneous insulin on the morning of the CS

6.3 Intrapartum monitoring

Refer to the Queensland Clinical Guideline *Intrapartum fetal surveillance.*[149]

Table 28. Intrapartum monitoring

Aspect	Monitoring
All women	• Aim for BGL 4.0–7.0 mmol/L irrespective of GDM therapy during pregnancy[150] • Ensure adequate glucose during labour to meet high energy requirements • Recommend continuous cardiotocography (CTG) during labour for women with GDM if during pregnancy[151] o Insulin or metformin required or o Suboptimal BGLs or o Fetal macrosomia
If non-pharmacological therapy during pregnancy	• BGL on arrival then 4 hourly monitoring o Increase frequency according to BGLs o Refer to Table 29. Intrapartum BGL monitoring • It is uncommon to experience hypoglycaemia or to require insulin
If pharmacological therapy during pregnancy	• BGL on arrival, then 2 hourly monitoring o Increase frequency according to BGLs o Refer to Table 29. Intrapartum BGL monitoring o If required, insulin requirements are commonly lower during labour (usually no insulin necessary)

6.4 Intrapartum BGL management

The aim of intrapartum BGL management is to maintain optimal BGLs while avoiding hypoglycaemia. Maintain BGL during labour 4–7 mmol/L to minimise risk of neonatal hypoglycaemia.[1]

Table 29. Intrapartum BGL monitoring

Aspect	Consideration
BGL more than 7.0 mmol/L	• If BGL greater than 7.0 mmol/L seek medical review • Consider clinical circumstances (e.g. stage of labour, imminency of birth, intake, effects of increased stress levels) when determining management • Management may include: o Repeat BGL in 1 hour and reassess **or** o Consider insulin infusion
BGL less than 4.0 mmol/L or symptomatic	• Cease insulin therapy • If symptomatic, treat hypoglycaemia and repeat BGL in 15 minutes • If asymptomatic and receiving insulin, repeat BGL in 15 minutes and reassess • If asymptomatic and not receiving insulin, repeat BGL in 1 hour and reassess (or earlier if becomes symptomatic) • Refer to Section 5.3 Hypoglycaemia

6.4.1 Insulin infusion

An insulin infusion is **rarely** needed during labour for women with GDM. Seek expert opinion before commencement. If no local policy or procedure exists, the following example insulin infusion regimen may be considered, but individualised doses are required.

Table 30. Example insulin infusion

Aspect	Recommendation	
IV Infusion	• Administer via infusion pump	
Mainline	• Commence 1 litre glucose containing fluid at 80 mL/hour, for example: o Glucose 4%/sodium chloride 0.18% or o Compound sodium lactate (Hartmann's solution) with glucose 5%	
Sideline	• Add 50 units (0.5 mL of 100 units per mL) neutral insulin to 49.5 mL of sodium chloride 0.9% to give a concentration of 1 unit/mL • Flush line with insulin admixture down to connection port	
BGL monitoring	• Commence and adjust insulin infusion according to BGL • Monitor BGL hourly while insulin infusion being administered • Medical review two hours after commencement to assess individual requirements	
Insulin infusion starting doses and BGL targets	**Starting doses only–adjust according to individual needs**	
	BGL (mmol/L)	**Insulin infusion**
	4.0 mmol/L or less	• Discontinue infusion • Notify and review by medical officer
	4.1–6.0 mmol/L	• 1 mL/hour = 1 unit/hour
	6.1–8.0 mmol/L	• 2 mL/hour = 2 unit/hour
	8.1–10.0 mmol/L	• 3 mL/hour = 3 unit/hour
	10.1 mmol/L or more	• Continue infusion • Notify and review by medical officer

7 Postpartum care

Provide routine maternal postpartum care appropriate to the clinical circumstances, including continued BGL monitoring depending on therapy during the pregnancy.

Table 31. Postpartum BGL monitoring

Aspect	Consideration
Context	• There is limited evidence/consensus regarding the frequency and type of postpartum BGL monitoring for women with GDM who have been well managed during pregnancy with non-pharmacological therapy • Postpartum target BGL for all women with GDM is less than or equal to 8.0 mmol/L (preprandial)
Non-pharmacological therapy	• Cease BGL monitoring after birth
Pharmacological therapy	• Cease pharmacological therapy (metformin and insulin) immediately after birth (vaginal or CS) • Continue BGL monitoring four times per day for 24 hours (preprandial and before bed) • If all preprandial BGLs 4.0–8.0 mmol/L discontinue monitoring 24 hours after birth • If BGL greater than or equal to 4.0 mmol/L and diet tolerated, cease mainline IV fluids • If diet not tolerated or BGL less than 4.0 mmol/L, seek medical review o Consider glucose 4%/sodium chloride 0.18% or compound sodium lactate (Hartmann's solution) with glucose 5% IL IV 12 hourly
Elevated BGL	• If any preprandial BGL is greater than 8.0 mmol/L o Seek medical review o Continue BGL monitoring • Insulin is rarely required postpartum o If required, prescribe lower dose than required during pregnancy
Newborn baby care	• Keep baby warm • Support early feeding and skin to skin contact within first hour of life • Monitor BGL • Refer to Queensland Clinical Guidelines *Newborn hypoglycaemia*[152]

7.1 Breastfeeding

Table 32. Breastfeeding

Aspect	Consideration
Context	• Women with GDM are less likely to breastfeed (75% versus 86%) and continue for a shorter duration (9 versus 17 weeks) compared with women without GDM[153] o These values are even lower in women with GDM who require insulin therapy or who are obese[153,154] • Breastfeeding has short and long term benefits for women who have had GDM[1,155-157] o Longer duration of breastfeeding reduces risk of type 2 diabetes in women who have had GDM[158] ▪ One study found breastfeeding duration of three or more months reduced the risk of type 2 diabetes and delayed development of type 2 diabetes a further 10 years, compared with breastfeeding less than 3 months[159] o Exclusive breastfeeding for greater than one month reduces the recurrence rate of GDM[157] o Metabolic adaptations during lactation can reverse atherogenic and diabetogenic effects of pregnancy for the woman with DIP[160] • Metformin and insulin are both safe for breastfeeding women • Refer to Table 13. Special considerations
Recommendation	• Support and encourage women to breastfeed • Provide advice and information to the woman about the maternal and baby benefits of breastfeeding including: o Reducing risk of developing diabetes for the woman[1] and baby[1,85] o Prevention of neonatal hypoglycaemia o Reducing risk of childhood obesity[1] • Offer early additional skilled lactation support and assistance with breastfeeding to women with GDM[154] • Refer to the Queensland Clinical Guideline: *Establishing breastfeeding*[161]
Post-bariatric surgery[71]	• Recommend breastfeeding • Monitor maternal macro- and micronutrients during lactation under care of specialist team and general practitioner

7.2 Discharge planning

Consider routine criteria to inform readiness for discharge.

Table 33. Discharge planning

<table>
<tr><th>Aspect</th><th colspan="2">Consideration</th></tr>
<tr><td rowspan="5">Weight</td><td colspan="2">• Optimise postpartum and inter-pregnancy weight
• Risk of developing type 2 diabetes is greatly affected by body weight
• Significant increase in the odds of GDM occurring in subsequent pregnancies with each unit of BMI gained between pregnancies[162]</td></tr>
<tr><td>BMI gain</td><td>Increased odds of future GDM</td></tr>
<tr><td>1–1.9 kg/m^2</td><td>1.7</td></tr>
<tr><td>2.0–2.9 kg/m^2</td><td>2.5</td></tr>
<tr><td>3 kg/m^2 or more</td><td>3.4</td></tr>
<tr><td colspan="2">• Women who are overweight or obese at their index pregnancy, but who subsequently lose weight (approximately 2.0 kg/m^2) lower their future risk of GDM by almost 80%[163]
• Support women to maintain a healthy lifestyle that includes physical activity and maintenance of a healthy weight range and BMI after birth[164]</td></tr>
<tr><td>Referral and follow-up</td><td colspan="2">• Provide written advice to the woman’s primary health carer(s) (e.g. GP, midwife, diabetes educator) about maternal and/or neonatal outcomes
o Advise women to see their GP to be screened for persistent diabetes at 6–12 weeks postpartum using the OGTT and non-pregnancy diagnostic criteria[7,88,165,166]
o The National Gestational Diabetes Register sends reminders to women and their GPs to have diabetes checks postpartum
• Women with a history of GDM require lifelong screening for the development of:
o Type 2 diabetes/IGT/IFG
▪ If contemplating another pregnancy recommend OGTT or HbA1c annually[7,165]
▪ If no further pregnancies planned recommend diabetes or pre-diabetes screening at least every 3 years[165]
o Cardiovascular disease
• Women with a history of GDM found to have pre-diabetes, require lifestyle intervention counselling to assist in preventing progression to type 2[1]</td></tr>
<tr><td>Contraception</td><td colspan="2">• Suggest contraception until postpartum OGTT test is completed and continue until planning for next pregnancy
• Discuss risks and benefits of methods and women’s preferences
o Long acting reversible contraceptives provide a high degree of reliability and efficacy (e.g. progesterone injection, intrauterine device (IUD), progesterone implant)
• Consider increased risk of metabolic syndrome
• If other risk factors (e.g. hypertension) suggest IUD or progesterone only agent[4]</td></tr>
<tr><td>Future pregnancies</td><td colspan="2">• Advise women to plan in consultation with healthcare provider
• Provide advice about weight management before next pregnancy
• Screen prior to conception
• Manage glucose abnormality
• Recommend folic acid supplementation[1]
• Perform early glucose testing in a future pregnancy</td></tr>
<tr><td>Post bariatric surgery</td><td colspan="2">• Refer woman for band adjustment once lactation is established to minimise risk of micronutrient deficiencies[71]
• Continue specialist dietary advice to optimise macro- and micronutrient supplementation and dietary intake
• Refer to Queensland Clinical Guidelines Obesity in pregnancy[72]</td></tr>
</table>

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Appendix A: Conversion table for HbA1c measurement

Worldwide (including Australia), HbA1c measurement and reporting has been standardised using Systeme International (SI) units.

HbA1c as percentage	HbA1c in mmol/mol
5.0	31
6.0	42
6.5	48
7.0	53
8.0	64
9.0	75
10.0	86
11.0	97
12.0	108

Appendix B: Gestational weight gain

The National Academy of Medicine (formerly the Institute of Medicine) have recommended weight gain for women with singleton and twin pregnancies.

Pre-pregnancy BMI (kg/m^2)	Mean rate of gain 2nd and 3rd trimester (kg/week)	Recommended range of total gain (kg)
Singleton pregnancy		
Less than 18.5	0.51	12.5 to 18
18.5 to 24.9	0.42	11.5 to 16
25.0 to 29.9	0.28	7 to 11.5
Greater than or equal to 30	0.22	5 to 9
Twin pregnancy		
Less than 18.5	N/A	N/A
18.5 to 24.9	N/A	17-25
25.0 to 29.9	N/A	14-23
Greater than or equal to 30	N/A	11-19

Source: National Academy of Medicine. Weight gain during pregnancy. 2009 [cited 2020 May 11]. Available from: https://www.nap.edu

Appendix C: Antenatal schedule of care

Testing

Consideration	Result	Plan
Risk factors for GDM: ❑ 1st trimester: OGTT or HbA1c ❑ If after 1st trimester: OGTT	**OGTT** (mmol/L) Fasting: _____ 1 hour: _____ 2 hour: _____ **HbA1c** (mmol/mol) _____	**If normal:** OGTT at 24–28 weeks gestation ***or*** **If indicated:** Commence GDM care
Previous bariatric surgery and diabetes history/other risk factors: ❑ 1st trimester: HbA1c ❑ If after 1st trimester: fasting BGL	**HbA1c** (mmol/mol) _____ **BGL (**mmol/L) _____	**If normal:** Self-monitoring at 24–28 weeks gestation ***or*** **If indicated:** Commence GDM care
No risk factors or history: ❑ 24–28 weeks OGTT	**OGTT** (mmol/L) Fasting: _____ 1 hour: _____ 2 hour: _____	**If indicated:** Commence GDM care

At initial GDM diagnosis

Discuss/Review/Refer	Considerations
❑ Review history	Previous GDM, medications
❑ Diabetes educator consult	Within 1 week of diagnosis for GDM education
❑ Dietitian review	Within 1 week of diagnosis
❑ Psychosocial assessment/support	Refer as required
❑ BGL self-monitoring	Commence self-monitoring
❑ BMI (pre-pregnancy)	Discuss healthy weight gain targets
❑ Lifestyle advice	Physical activity, healthy eating, smoking cessation
❑ Baseline ultrasound scan (USS)	At 28–30 weeks gestation
❑ Initial laboratory investigations	❑ Serum creatinine
❑ If *Diabetes in Pregnancy*	❑ Optometrist/ophthalmologist review for diabetic retinopathy ❑ Microalbuminuria for diabetic nephropathy

Each Visit

Discuss/Review/Refer	Considerations
❑ Clinical surveillance	Complications (e.g. pre-eclampsia)
❑ Weigh	Weight gain trends, diet, exercise
❑ Test urine	Investigate ketonuria, proteinuria
❑ Review BGL self-monitoring record	Patterns, trends and mean BGL
❑ Psychosocial assessment/support	Refer as required
❑ Fetal growth and wellbeing (including AC)	USS 2–4 weekly as indicated (after 28–30 weeks)
❑ If pharmacological therapy commenced	❑ Follow-up contact within 3 days ❑ Diabetes educator (weekly) ❑ Dietitian review
❑ Review suitability of model of care	❑ Low risk GDM ❑ Diabetic clinic ❑ Obstetric ❑ Other _____
❑ Review next contact requirements (increase frequency if: suboptimal BGL, early diagnosis, diabetes in pregnancy, pharmacological therapy commenced)	❑ Fortnightly until 38 weeks ❑ Fortnightly until 36 weeks ❑ Weekly until birth ❑ Other_____

Appendix D: Exercise and exertion

Target heart rate ranges for pregnant women

Consider individual clinical circumstances when prescribing physical activity. Use the following heart rate ranges as a guide only.

Maternal age (years)	Fitness level or BMI	Heart rate range (beats/minute)
< 20		140–155
20–29	Low	129–144
	Active	135–150
	Fit	145–160
	BMI > 25 kg/m^2	103–124
30–39	Low	128–144
	Active	130–145
	Fit	140–156
	BMI > 25 kg/m^2	101–120
40+		125–140

< less than; **>** greater than

Adapted from: Sports Medicine Australia. Pregnancy and exercise. Fact sheet. n.d. [cited 2020 May 11]. Available from: www.sma.org.au.

Rating of perceived exertion

Rating of perceived exertion (RPE) is a widely used and reliable indicator to monitor and guide exercise intensity. The scale allows individuals to subjectively rate their level of exertion during exercise or exercise testing.

Rating of perceived exertion			Talk test
6		**How you feel when lying in bed or sitting relaxed in a chair. Little or no effort**	**Can talk normally**
7	Very, very light		
8			
9	Very light		
10			
11	Fairly light		
12		**Target in pregnancy: How you should feel with physical activity**	
13	**Somewhat hard**		**Can talk but not sing**
14			
15	Hard	**How you felt with the hardest work ever done**	**Hard to talk**
16			
17	Very hard		
18			
19	Very very hard		
20	**Maximum exertion**	**Don't work this hard**	

Adapted from: Sports Medicine Australia. Pregnancy and exercise. Fact sheet. n.d. [cited 2020 May 11]. Available from: www.sma.org.au.

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