

# Queensland Clinical Guidelines

*Translating evidence into best clinical practice*

Maternity and Neonatal **Clinical Guideline**

## Gestational diabetes mellitus

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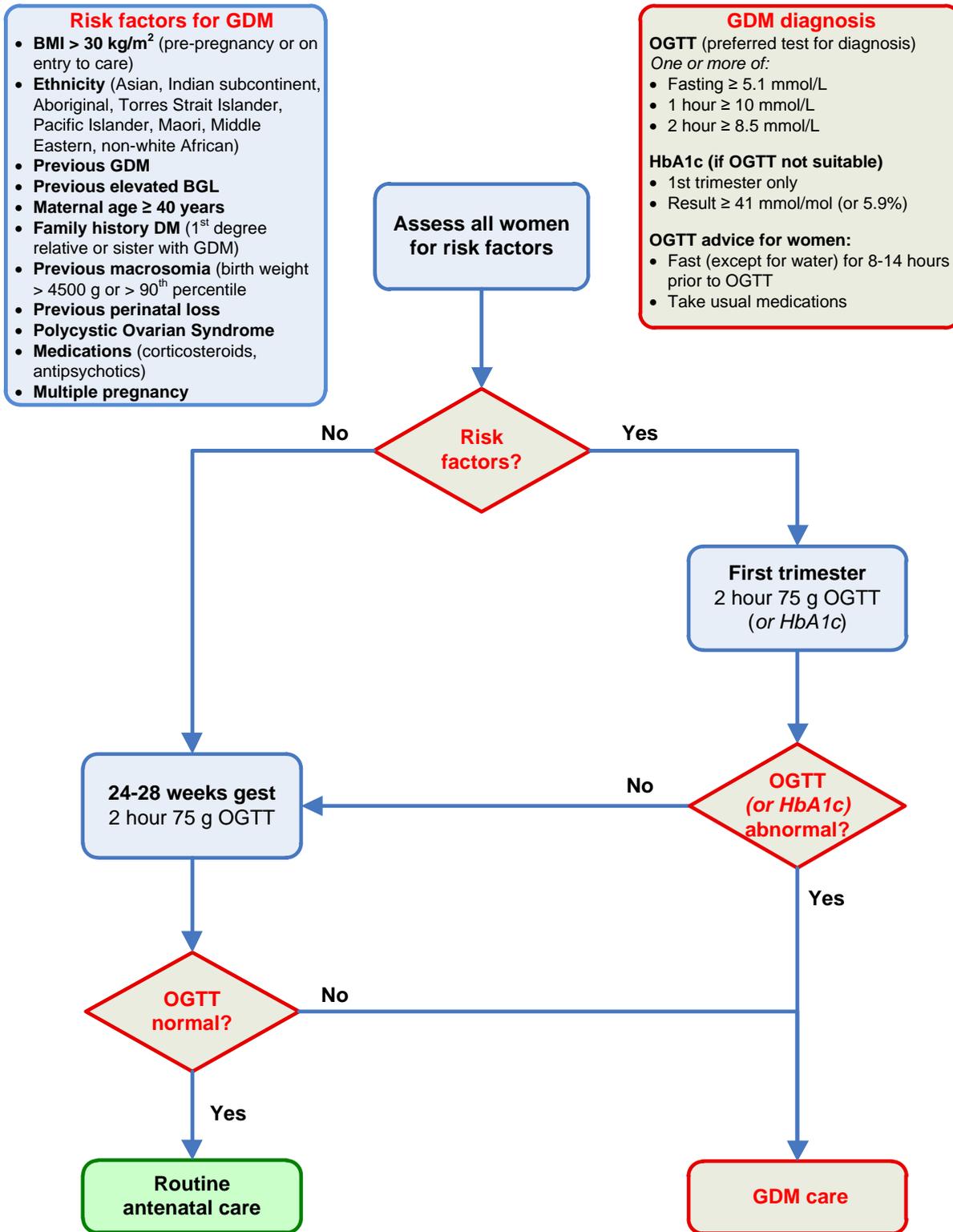
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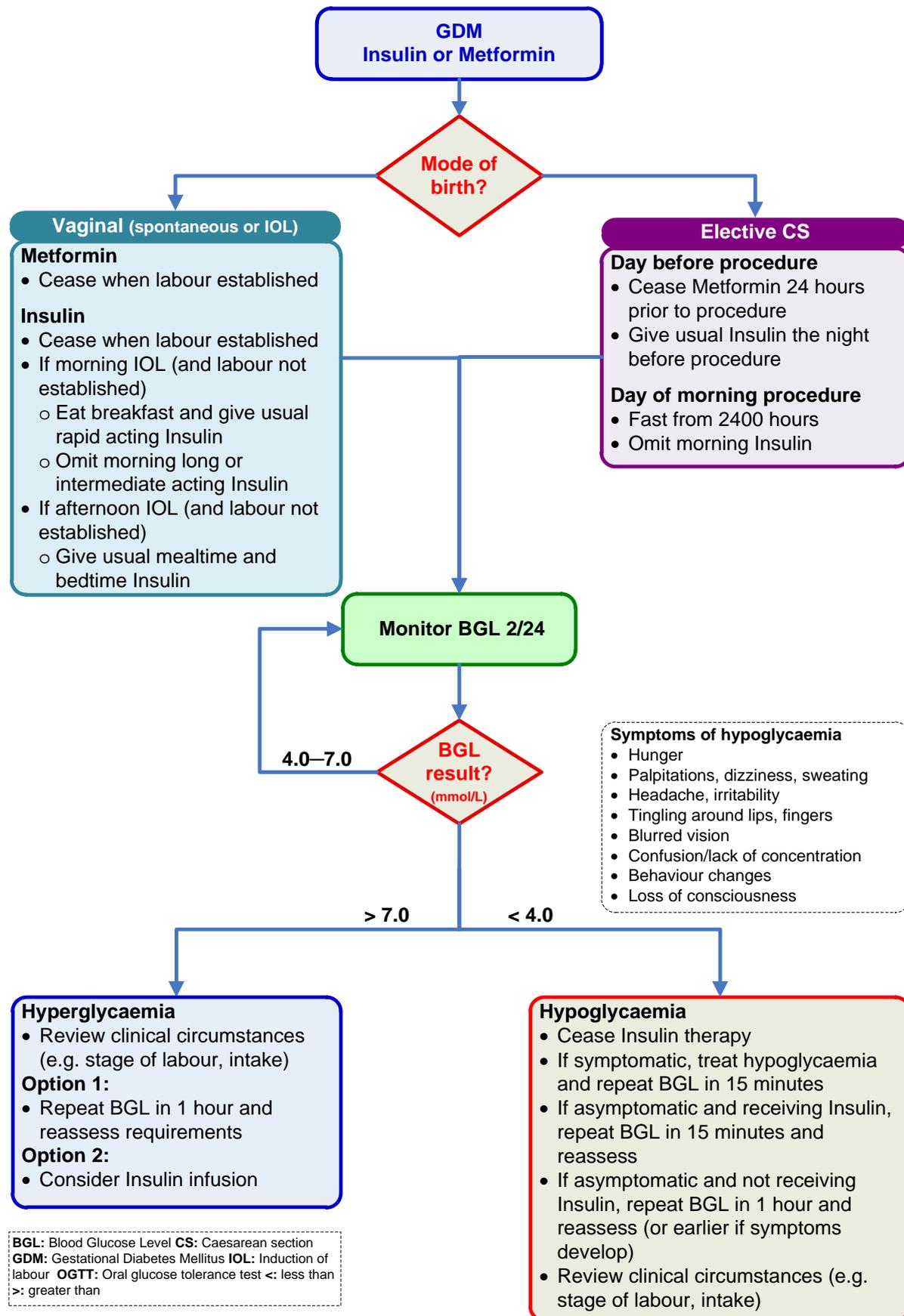
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**Flow Chart: Screening and diagnosis of GDM**

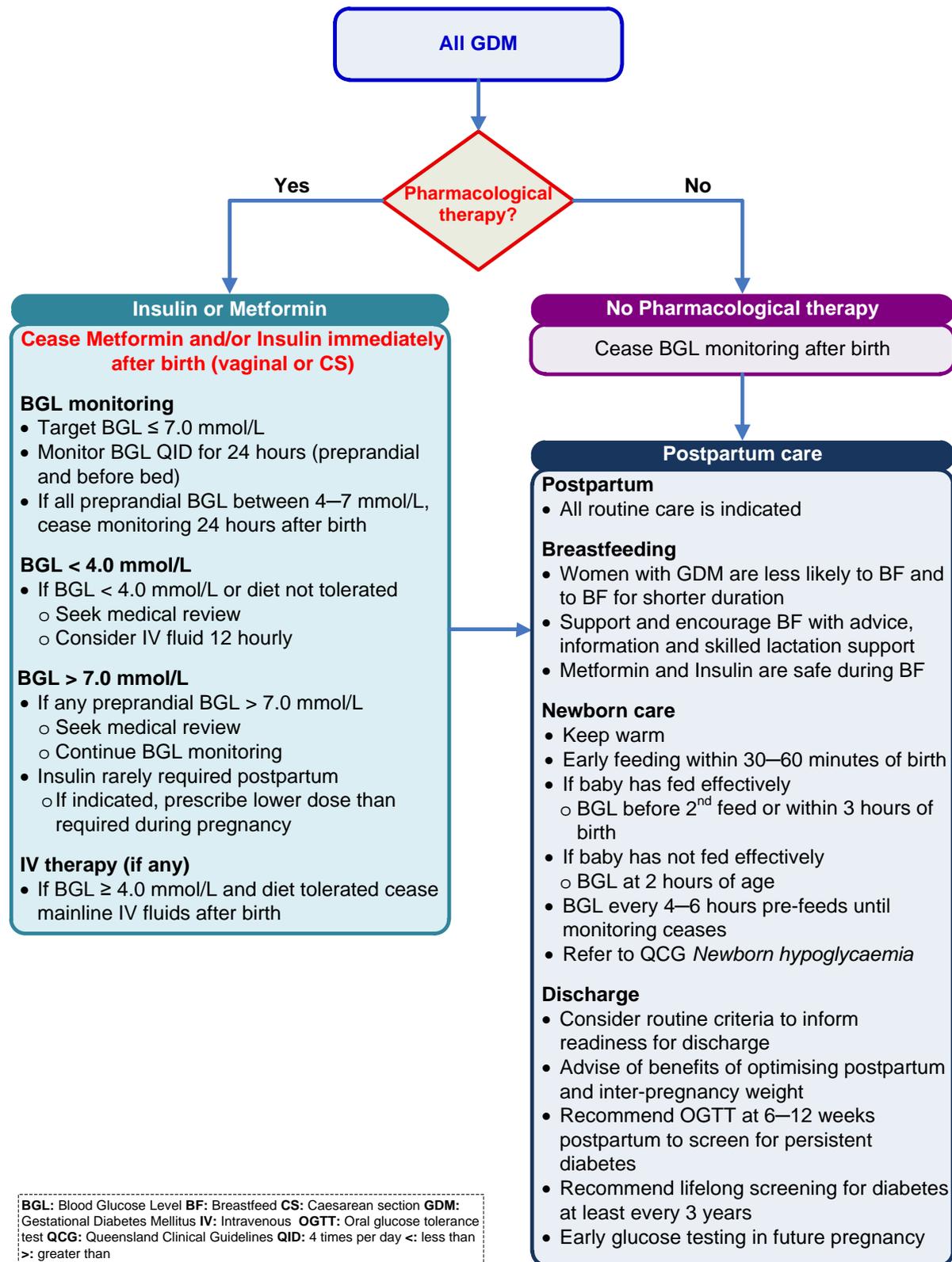


**BGL:** Blood glucose level **BMI:** Body Mass Index **DM:** Diabetes Mellitus **GDM:** Gestational Diabetes Mellitus  
**gest:** gestational age **HbA1c:** Glycated haemoglobin  
**OGTT:** Oral glucose tolerance test **≥:** greater than or equal to **<:** less than **>:** greater than

**Flowchart: Intrapartum management for GDM requiring Insulin and/or Metformin**



**Flowchart: Postpartum care for all GDM**



**Abbreviations**

AC	Abdominal circumference
ADIPS	Australasian Diabetes in Pregnancy Society
BGL	Blood glucose level
BMI	Body mass index
CI	Confidence interval
CS	Caesarean section
GDM	Gestational diabetes mellitus
GI	Glycaemic Index
GWG	Gestational weight gain
IOL	Induction of labour
IOM	Institute of Medicine
LGA	Large for gestational age
MNT	Medical nutrition therapy
NDSS	National Diabetes services scheme
OGTT	Oral glucose tolerance test – 75 gram glucose load
USS	Ultrasound scan

**Definition of terms**

Antenatal contact	In this guideline the term <i>antenatal contact</i> 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.
GDM	In this guideline the term 'GDM' is used to refer to women with diagnostic criteria for both GDM and <i>Diabetes in Pregnancy</i> unless otherwise specified. Refer to Table 1. Diabetes classification.
LGA	Fetal weight greater than the 90 <sup>th</sup> percentile for gestational age.
Macrosomia	Excessive fetal growth variously described as more than 4000 g or more than 4500 g. Thresholds may be influenced by ethnicity. <sup>1</sup>
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.
Pre/Postprandial	Before/after eating a meal.
Psychosocial Services	In this guideline, psychosocial services refers to 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.
Impaired fasting glucose (IFG)	Diagnosed when the fasting BGL is higher than 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'.

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## 1 Introduction

Gestational diabetes mellitus (GDM) is one of the most common medical complications of pregnancy<sup>2</sup> and is defined as any degree of glucose intolerance with the onset or first recognition during pregnancy. This includes undiagnosed diabetes mellitus detected for the first time during pregnancy.<sup>3</sup> Although GDM usually resolves following birth, it is associated with significant morbidities for the woman and her child both perinatal and in the long term.<sup>4</sup>

There is widespread 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), National Health and Medical Research Council, Australian College of Midwives, Australian Diabetes Educators Association, Royal Australian and New Zealand College of Obstetricians and Gynaecologists, World Health Organisation and the International Federation of Gynaecology and Obstetrics.

### 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.

- Queensland incidence rose from 4.9% to 8% between 2006–2013<sup>5</sup>
- Aboriginal and Torres Strait Islander women are twice as likely to have GDM as non-Indigenous women<sup>6</sup>
- In 2014, registrations with the National GDM register increased 16% from 2013<sup>7</sup>:
  - 24,703 women were registered
  - 68 newly diagnosed women everyday
  - 27% required Insulin therapy
  - 92% aged under 40 years
  - 8% aged over 40 years

## 1.2 Diabetes classification

Table 1. Diabetes classification

Classification	Description
<b>GDM<sup>2</sup></b>	<ul style="list-style-type: none"> <li>• Glucose intolerance of variable severity with onset or first recognition during pregnancy</li> <li>• Evidenced by elevated plasma glucose levels</li> <li>• Refer to Table 8. Plasma glucose values for diagnosis of GDM</li> </ul>
<b>Diabetes in Pregnancy<sup>2</sup></b>	<ul style="list-style-type: none"> <li>• Hyperglycaemia (onset or first recognition during pregnancy) where the plasma glucose levels exceed the threshold(s) for diagnosis of diabetes outside pregnancy</li> <li>• May indicate undiagnosed/pre-existing diabetes but a definitive diagnosis of non-gestational diabetes cannot be made until the postpartum period</li> <li>• Additional management (beyond that required for lower abnormal plasma glucose levels) is required</li> <li>• Refer to Table 8. Plasma glucose values for diagnosis of GDM</li> </ul>
<b>*Type 1<sup>8</sup></b>	<ul style="list-style-type: none"> <li>• The body no longer makes its own insulin and cannot convert glucose into energy</li> <li>• <math>\beta</math> cell destruction usually leads to near absolute insulin deficiency</li> <li>• Daily Insulin via injection or a continuous subcutaneous Insulin infusion (CSII) pump is required</li> <li>• Diagnosis is established outside of pregnancy (before or after)</li> </ul>
<b>*Type 2<sup>8</sup></b>	<ul style="list-style-type: none"> <li>• Hyperglycaemia resulting from resistance to the effects of insulin and/or insufficient production of insulin</li> <li>• Life style modification (diet and physical activity) is the cornerstone of management</li> <li>• Oral hypoglycaemic medication and/or Insulin therapy may be required</li> <li>• Diagnosis is established outside of pregnancy (before or after)</li> </ul>
<b>*Pre-diabetes</b>	<ul style="list-style-type: none"> <li>• A condition in which blood glucose levels are higher than normal but not high enough to be diagnostic of type 2 diabetes</li> <li>• Diagnosis is established outside of pregnancy (before or after)</li> <li>• Includes impaired fasting glucose (IFG) and/or impaired glucose tolerance (IGT)</li> </ul>

\*Management not discussed in this guideline

### 1.3 Clinical standards

Table 2. Clinical standards

Aspect	Consideration
<b>Clinical care</b>	<ul style="list-style-type: none"> <li>• Provide care in accordance with the Clinical Service Capability Framework<sup>9</sup></li> <li>• Undertake clinical observations in accordance with the National Consensus Framework<sup>10</sup></li> <li>• Consider use of maternity early warning tools to monitor for clinical deterioration</li> <li>• Develop locally agreed protocols to support management including:               <ul style="list-style-type: none"> <li>○ Consultation mechanisms or processes with higher service capabilities including the use of telehealth</li> <li>○ Standardised forms or communications that support care planning (e.g. peripartum Insulin management plan)</li> </ul> </li> <li>• Support clinical staff to develop communication skills that enable positive and non-judgemental discussions about obesity and weight gain with pregnant women<sup>11</sup></li> <li>• Consider access to local resources that are required to meet the increasing burden of non-communicable diseases (e.g. anaesthetic services, dietetic services, consulting rooms)</li> </ul>
<b>Low risk GDM</b>	<ul style="list-style-type: none"> <li>• Establish local criteria for low risk GDM model of care:               <ul style="list-style-type: none"> <li>○ 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</li> <li>○ Establish referral pathways and consultation mechanisms with higher level services as required</li> </ul> </li> <li>• The following groups of women are not suitable for care in a “low risk” model:               <ul style="list-style-type: none"> <li>○ Pre-existing diabetes (type 1 or type 2)</li> <li>○ Diabetes in Pregnancy</li> <li>○ GDM requiring pharmacological therapy</li> <li>○ Other medical or pregnancy complications</li> </ul> </li> </ul>
<b>Diabetes related products</b>	<ul style="list-style-type: none"> <li>• Establish access to free or subsidised blood glucose meter programs (e.g. via manufacturers)</li> <li>• Advise to register (requires approved clinician support) with National Diabetes Services Scheme (NDSS) to access diabetes related products at subsidised cost               <ul style="list-style-type: none"> <li>○ Free registration is open to all Australian citizens and others who are Medicare eligible<sup>7</sup></li> <li>○ 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 post natal OGTT</li> </ul> </li> </ul>

## 2 Risk assessment

Abnormalities of glucose tolerance have immediate, short-term, and long-term implications for the health of the woman and her baby<sup>6</sup> which may be prevented by adequate treatment.<sup>12-14</sup> Discuss with all women the benefits of achieving or maintaining a healthy lifestyle (e.g. nutrition, gestational weight gain and physical activity).<sup>13,15</sup>

### 2.1 Risk factors

Assess all women early in their pregnancy (e.g. at the first antenatal visit) for risk factors associated with gestational diabetes.<sup>3</sup>

Table 3. Risk factors for GDM

Aspect	Risk factors
<b>Context</b>	<ul style="list-style-type: none"> <li>It is not known if all risk factors are of equivalent predictive value<sup>3</sup></li> </ul>
<b>Risk factors</b> <sup>3,16</sup>	<ul style="list-style-type: none"> <li>Ethnicity: <ul style="list-style-type: none"> <li>Asian</li> <li>Indian subcontinent</li> <li>Aboriginal/Torres Strait Islander</li> <li>Pacific Islander</li> <li>Maori</li> <li>Middle Eastern</li> <li>Non-white African</li> </ul> </li> <li>Maternal age greater than or equal to 40 years</li> <li>Previously elevated blood glucose level</li> <li>Previous GDM</li> <li>Family history of Diabetes Mellitus (first degree relative with diabetes or sister with GDM)</li> <li>BMI greater than 30 kg/m<sup>2</sup></li> <li>Previous large for gestational age (LGA) (birth weight greater than 4500 g or greater than 90<sup>th</sup> centile)</li> <li>Previous perinatal loss</li> <li>Polycystic ovarian syndrome</li> <li>Medications: corticosteroids, antipsychotics</li> <li>Multiple pregnancies<sup>17</sup></li> </ul>

## 2.2 Risks of GDM

Table 4. Risks of GDM

Aspect	Increased risk
<b>Context</b>	<ul style="list-style-type: none"> <li>• There is a clear relationship between increased plasma glucose levels during pregnancy and adverse fetal and maternal outcomes independent of other known factors for these outcomes<sup>18</sup></li> <li>• There is a continuum of risk for adverse pregnancy outcomes across the maternal glucose levels which includes levels below diagnostic values for GDM<sup>2,18,19</sup></li> <li>• There is variable quality and conflicting evidence about the degree of risk conferred by maternal hyperglycaemia on maternal and fetal outcomes<sup>20</sup></li> </ul>
<b>Maternal short term</b>	<ul style="list-style-type: none"> <li>• Preeclampsia<sup>4,15,18,21</sup></li> <li>• Induced labour<sup>6</sup></li> <li>• Operative birth<sup>4,6</sup></li> <li>• Hydramnios<sup>22</sup></li> <li>• Post-partum haemorrhage<sup>22</sup></li> <li>• Infection<sup>22</sup></li> </ul>
<b>Maternal long term</b>	<ul style="list-style-type: none"> <li>• Recurrent GDM in subsequent pregnancies<sup>23</sup></li> <li>• Progression to type 2 diabetes<sup>24</sup> <ul style="list-style-type: none"> <li>○ About 5% develop type 2 diabetes within 6 months of birth<sup>25</sup></li> <li>○ About 60% develop type 2 diabetes within 10 years<sup>25</sup></li> </ul> </li> <li>• Development of cardiovascular disease<sup>26</sup></li> </ul>
<b>Newborn/Fetal short term</b>	<ul style="list-style-type: none"> <li>• Respiratory distress syndrome<sup>22</sup></li> <li>• Jaundice<sup>18,27</sup></li> <li>• Hypoglycaemia<sup>18,22</sup></li> <li>• Premature birth<sup>18</sup></li> <li>• Hypocalcaemia<sup>27</sup></li> <li>• Polycythaemia</li> <li>• Increased newborn weight<sup>18</sup> and adiposity<sup>28</sup></li> <li>• Macrosomia<sup>15,18</sup> <ul style="list-style-type: none"> <li>○ Shoulder dystocia - risk increases as fetal weight increases</li> <li>○ Bone fracture</li> <li>○ Nerve palsy</li> <li>○ Caesarean section birth</li> <li>○ Hypoxic-ischaemic encephalopathy (HIE)</li> <li>○ Death</li> </ul> </li> </ul>
<b>Newborn long term</b>	<ul style="list-style-type: none"> <li>• Impaired glucose tolerance<sup>29</sup></li> <li>• Development of type 2 diabetes<sup>4</sup></li> <li>• Obesity<sup>4</sup></li> <li>• There is no evidence that current treatment reduces long term risks in the newborn<sup>14</sup></li> </ul>

## 2.3 Risk reduction

Table 5. Risk reduction

Aspect	Consideration
<b>Context</b>	<ul style="list-style-type: none"> <li>• Dietary counselling has been shown to reduce the incidence of GDM when compared to standard care<sup>30</sup> but the quality of the evidence is low</li> <li>• Probiotics combined with dietary counselling improves glucose metabolism and insulin sensitivity in healthy women<sup>31</sup></li> <li>• Low Vitamin D levels have been associated with increased risk of developing GDM and sub optimal BGLs in GDM in 3<sup>rd</sup> trimester<sup>32</sup></li> <li>• It is unclear if physical activity interventions during pregnancy prevent GDM but they do limit excessive weight gain, reduce the risk of caesarean birth and of having a high birth weight newborn<sup>33-36</sup></li> </ul>
<b>Recommendation</b>	<ul style="list-style-type: none"> <li>• Advise women that regular physical activity and healthy eating before and during pregnancy help to limit excessive weight gain<sup>35-37</sup></li> </ul>

## 2.4 Diagnostic tests

Table 6. Diagnostic tests

Aspect	Consideration
<b>Context</b>	<ul style="list-style-type: none"> <li>Some professional bodies recommend the use of non-pregnancy glucose reference ranges in the early stages of pregnancy (e.g. first trimester), but this approach has not been endorsed by ADIPS</li> <li>This guideline recommends the use of a single set of diagnostic criteria for GDM and Diabetes in Pregnancy [refer to Table 8. Plasma glucose values for diagnosis of GDM]</li> <li>Not all women with mild elevations of glucose (particularly fasting glucose) in early pregnancy will progress to severe glucose abnormalities               <ul style="list-style-type: none"> <li>Individualised management is required</li> </ul> </li> </ul>
<b>OGTT</b>	<ul style="list-style-type: none"> <li>Principal value is identifying women with any degree of hyperglycaemia</li> <li>Suitable for use in the first trimester and at 24–28 weeks gestation</li> </ul>
<b>HbA1c</b>	<ul style="list-style-type: none"> <li>HbA1c is only suitable for diagnostic testing in the first trimester before erythrocyte formation starts to increase and basal glucose levels fall</li> <li>Principal value is in identifying women likely to have pre-existing glucose abnormalities (e.g. type 2 diabetes)</li> <li>It is unlikely to identify milder degrees of hyperglycaemia</li> <li>Consider known Haemoglobinopathies and the effects on HbA1c results<sup>38</sup></li> </ul>
<b>Test type recommendation</b>	<ul style="list-style-type: none"> <li>OGTT is the preferred diagnostic test for pregnant women with or without risk factors</li> <li>There may be circumstances where HbA1c is appropriate <b>in the first trimester</b> including:               <ul style="list-style-type: none"> <li>If the woman is unable to tolerate the OGTT (e.g. due to morning sickness, hyperemesis)</li> <li>Opportunistic care is appropriate</li> <li>OGTT is not practical due to clinical, geographical or logistical circumstances</li> </ul> </li> </ul>

## 2.5 Testing for GDM

In line with the ADIPS guideline, it is recommended that all women be offered testing for GDM during pregnancy as outlined in Table 7. Testing for GDM.

Table 7. Testing for GDM

Aspect	Recommendation
<b>With risk factor(s)</b>	<ul style="list-style-type: none"> <li>Perform an early OGTT (or HbA1c) with first antenatal bloods or at the first antenatal visit (in the first trimester)<sup>3</sup></li> <li>If the early OGTT (or HbA1c) is normal, repeat OGTT at 24–28 weeks as for women with no risk factors</li> </ul>
<b>No risk factor(s)</b>	<ul style="list-style-type: none"> <li>Routinely recommend an OGTT to all pregnant women, who are not known to have GDM, at 24–28 weeks gestational age<sup>3</sup></li> <li>Advise the woman:               <ul style="list-style-type: none"> <li>To maintain a normal diet and then to fast for 8–14 hours before the OGTT</li> <li>During fasting, to drink water to prevent dehydration and to continue any usual medications</li> </ul> </li> <li>The Oral Glucose Challenge Test is no longer recommended</li> <li>The three day high carbohydrate diet is not required prior to the OGTT</li> </ul>
<b>Maternal medications</b>	<ul style="list-style-type: none"> <li>Do not perform an OGTT within one week of maternal steroids (betamethasone/dexamethasone) administration</li> <li>If receiving steroids monitor BGLs</li> <li>If taking Metformin for Polycystic Ovarian Syndrome, OGTT results may be misleading</li> </ul>
<b>If testing declined</b>	<ul style="list-style-type: none"> <li>Fasting glucose test may be an alternative although this will only give partial information on glucose metabolism</li> </ul>

## 2.6 Diagnosis of GDM

GDM diagnosis is based on the results of the fasting 75 g oral glucose tolerance test (OGTT) performed during pregnancy. One or more elevated level is sufficient for a diagnosis of GDM. If a fasting glucose test has been performed for other reasons and shows an elevated value, this may be accepted as diagnostic of GDM.<sup>2,39</sup>

## 2.7 Diabetes in Pregnancy

Women with **elevated values** that would be diagnostic of diabetes outside of pregnancy may be classified as having *Diabetes in Pregnancy*<sup>2</sup> [refer to Table 8. Plasma glucose values for diagnosis of GDM]. These women:

- Require management in a centre/clinic with experience in the management of pre-existing diabetes in pregnancy (not suitable for a low risk model of care)
- May have complications such as retinopathy and nephropathy associated with undiagnosed diabetes. Offer appropriate screening tests
- Are at higher risk of pregnancy complications
- Require postpartum testing to confirm or exclude non-gestational diabetes

Table 8. Plasma glucose values for diagnosis of GDM

Diagnosis	Time	Plasma glucose level (one or more)
<b>GDM<sup>2</sup></b>	<b>Fasting</b>	5.1–6.9 mmol/L
	<b>1 hour</b>	Greater than or equal to 10.0 mmol/L
	<b>2 hour</b>	8.5–11.0 mmol/L
	<b>HbA1c</b>	There is limited evidence to suggest that an HbA1c greater than or equal to 41 mmol/mol and less than 48 mmol/mol (5.9%/6.5%) in early pregnancy may be sufficient to diagnose GDM <sup>40</sup> Lower values do not exclude GDM <sup>41,42</sup>
<b>Diabetes in Pregnancy<sup>2</sup></b>	<b>Fasting</b>	Greater than or equal to 7.0 mmol/L
	<b>1 hour</b>	<i>A one hour level is not used</i>
	<b>2 hour</b>	Greater than or equal to 11.1 mmol/L
	<b>Random</b>	Greater than or equal to 11.1 mmol/L Confirm with additional standardised testing
	<b>HbA1c</b>	Greater than or equal to 48 mmol/mol or 6.5% in early pregnancy

### 2.7.1 Standardisation of HbA1c measurement

Worldwide (including Australia), HbA1c measurement and reporting has been standardised using Systeme International (SI) units.<sup>43</sup> If HbA1c is used for testing refer to Section 2.4 Diagnostic tests.

Table 9. Conversion table for HbA1c values

HbA1c as percentage (old units)	HbA1c in mmol/mol (new units–SI)
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

### 3 Antenatal care

There are three interrelated objectives for antenatal care of women diagnosed with GDM: Effective management of the diabetes, monitoring for maternal complications and preventing fetal/neonatal complications.<sup>44</sup> All routine antenatal care is indicated.

Table 10. Antenatal care

Aspect	Considerations
<b>Models of care</b>	<ul style="list-style-type: none"> <li>• A multidisciplinary team approach is ideal [Refer to definition of terms]</li> <li>• Women without other risk factors and with well managed diet-treated GDM may be suitable for low risk models of care although closer surveillance/more frequent antenatal contact is still required</li> </ul>
<b>Antenatal contacts</b>	<ul style="list-style-type: none"> <li>• Individualise the antenatal schedule of contact according to clinical circumstances</li> <li>• More frequent antenatal contact is required if BGLs are suboptimal or there are complicating factors (e.g. hypertension, preeclampsia, macrosomia, intrauterine growth restriction)</li> <li>• GDM diagnosed before 16 weeks gestational age requires increased surveillance and monitoring</li> <li>• Refer to Appendix A: Schedule of antenatal contact</li> </ul>
<b>Antenatal expression of breast milk</b>	<ul style="list-style-type: none"> <li>• There is weak and conflicting evidence about the risks and benefits of routine antenatal expression of breast milk<sup>45,46</sup> <ul style="list-style-type: none"> <li>○ Antenatal expression may potentially benefit neonates<sup>46</sup></li> <li>○ Onset of preterm labour/birth and increased admission to special care nursery may be associated with antenatal expression<sup>47</sup></li> <li>○ If utilised, consider recommending commencement after 37 weeks of gestation</li> </ul> </li> </ul>
<b>Initial clinical assessment all GDM</b>	<ul style="list-style-type: none"> <li>• All routine antenatal assessments are indicated throughout pregnancy</li> <li>• Develop an individualised plan of care with women whose pregnancy is complicated with diabetes <ul style="list-style-type: none"> <li>○ Review and update the plan at frequent intervals</li> </ul> </li> <li>• Consider an ultrasound scan (USS) at 28–30 weeks gestation to establish a baseline for future evaluation of fetal growth</li> <li>• Order laboratory evaluation of serum creatinine</li> </ul>
<b>Additional if Diabetes in Pregnancy</b>	<ul style="list-style-type: none"> <li>• Review and/or recommend morphology USS as there may be an increased risk of fetal congenital anomaly</li> <li>• Test for retinopathy and/or nephropathy as these substantially increase the risk of developing preeclampsia <ul style="list-style-type: none"> <li>○ Recommend optometrist or ophthalmologist review</li> <li>○ Test for microalbuminuria</li> </ul> </li> </ul>

### 3.1 Maternal surveillance

Table 11. Maternal surveillance

Aspect	Recommendation
<b>Monitoring</b>	<ul style="list-style-type: none"> <li>Women with GDM require increased surveillance throughout pregnancy               <ul style="list-style-type: none"> <li>Maintain a high index of suspicion for associated conditions (e.g. preeclampsia)</li> </ul> </li> <li>Reassess the requirement for increased antenatal contact with multidisciplinary team members at each contact</li> <li>Review BGL self-monitoring records at each contact</li> <li>Assess psychosocial needs and offer support or referral as appropriate to the circumstances</li> <li>Women participating in Ramadan fasting will require a practical approach and close consultation with the health care team<sup>48</sup></li> <li>Refer to Appendix A Schedule of care</li> </ul>
<b>Weight</b>	<ul style="list-style-type: none"> <li>Pre-pregnancy obesity and excessive gestational weight gain (GWG) are independent risk factors for fetal macrosomia in women with GDM<sup>49</sup></li> <li>Compared to normal weight women without GDM<sup>49</sup>:               <ul style="list-style-type: none"> <li>Normal weight women with GDM are 1.94 times as likely (95%CI 1.43–2.68) to have a LGA infant</li> <li>Obese women with GDM are 5.47 times as likely (95% CI 4.34–6.90) to have a LGA infant</li> </ul> </li> <li>Calculate pre-pregnancy BMI at the first opportunity</li> <li>Discuss GWG in a sensitive and non-judgemental manner that minimises maternal anxiety<sup>11</sup></li> <li>Recommend and discuss desirable GWG and rate of GWG               <ul style="list-style-type: none"> <li>Refer to Table 12. Target weight gains<sup>50</sup></li> </ul> </li> <li>Optimal GWG for twin pregnancy is uncertain. Institute of Medicine (IOM) recommend GWG<sup>50</sup> <ul style="list-style-type: none"> <li>Normal weight: 17–25 kg</li> <li>Overweight: 14–23 kg</li> <li>Obese: 11–19 kg</li> </ul> </li> <li>Weigh at each visit               <ul style="list-style-type: none"> <li>Rapid GWG may indicate polyhydramnios</li> <li>Inadequate GWG or weight loss may reflect inappropriate restriction of dietary intake and/or improved diet quality</li> </ul> </li> <li>Consider referral to a dietitian if not already under dietetic care</li> <li>Refer to the Queensland Clinical Guideline <i>Obesity</i><sup>51</sup></li> <li>Refer to Australian Dietary Guidelines<sup>52</sup></li> </ul>
<b>Urine testing</b>	<ul style="list-style-type: none"> <li>Test urine at each antenatal visit               <ul style="list-style-type: none"> <li>Ketonuria is a sign of fat metabolism and may indicate carbohydrate restriction and inadequate nutrition. Consider individual circumstances (e.g. time since last meal and degree of ketonuria) when determining if intervention is required</li> <li>Protein may indicate other complications (e.g. preeclampsia or renal impairment or nephropathy)</li> <li>Glucose in the urine is not a reliable indicator of inadequate glycaemic management<sup>53</sup></li> </ul> </li> </ul>

Table 12. Target weight gains as recommended by IOM

Pre-pregnancy BMI (kg/m <sup>2</sup> )	Rate of gain 2 <sup>nd</sup> and 3 <sup>rd</sup> trimester (kg/week)*	Recommended range of total gain (kg)
Less than 18.5	0.45	12.5 to 18
18.5 to 24.9	0.45	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

\*Calculations assume 0.5–2 kg weight gain in the first trimester

### 3.2 Fetal surveillance

Table 13. Fetal surveillance

Aspect	Considerations
<b>Context</b>	<ul style="list-style-type: none"> <li>• There is limited evidence or consensus regarding specific antepartum tests or their frequency<sup>54</sup></li> <li>• Monitoring type and frequency is influenced by the presence of other pregnancy complications (e.g. antepartum haemorrhage, preeclampsia, fetal growth restriction) as well as severity of maternal hyperglycaemia<sup>24</sup></li> <li>• Fetal abdominal circumference (AC) greater than or equal to 75% for gestational age, measured at 29 to 33 weeks gestation, correlates with an increased risk for birth of an LGA infant<sup>55</sup></li> </ul>
<b>Fetal growth and wellbeing</b>	<ul style="list-style-type: none"> <li>• Perform clinical assessment of fetal size and amniotic fluid volume</li> <li>• Assess the fetal response to maternal GDM by USS measurement of fetal AC commencing at 28–30 weeks</li> <li>• Longitudinal growth assessment is superior to a single measurement late in pregnancy</li> <li>• Consider 2–4 weekly USS for women with unstable diabetes or who require pharmacological therapy</li> <li>• If excessive fetal growth or AC (above 75<sup>th</sup> centile) is detected consider more intensive management<sup>24</sup> which <i>may</i> include: <ul style="list-style-type: none"> <li>○ Lower targets for glycaemic management</li> <li>○ Addition of pharmacologic therapy</li> </ul> </li> </ul>

### 3.3 Psychosocial support

Table 14. Psychosocial support

Aspect	Consideration
<b>Context</b>	<ul style="list-style-type: none"> <li>• Emotional well-being is an important part of diabetes care and self-management<sup>8</sup></li> <li>• Rapport between the woman and the health care provider can enhance compliance<sup>56</sup></li> <li>• Barriers to effective treatment response in women with GDM include depression, eating disorders, stress and anxiety<sup>57</sup></li> </ul>
<b>Information and education</b>	<ul style="list-style-type: none"> <li>• Individualise the approach to management. Take into account<sup>56</sup>: <ul style="list-style-type: none"> <li>○ Cultural/language background</li> <li>○ Learning ability and style of learning (e.g. written information, visual)</li> <li>○ Family and social circumstances</li> </ul> </li> <li>• Provide women and their families comprehensive information about GDM to aid in self-management including: <ul style="list-style-type: none"> <li>○ Implications of GDM for the woman and her baby</li> <li>○ Dietary and physical activity recommendations</li> <li>○ Self-monitoring of blood glucose procedures and targets</li> <li>○ Importance of long term follow-up</li> </ul> </li> </ul>
<b>Psychosocial support</b>	<ul style="list-style-type: none"> <li>• Support women to make positive lifestyle changes <ul style="list-style-type: none"> <li>○ 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<sup>58</sup></li> </ul> </li> <li>• Perform a psychosocial assessment and refer women as required to mental health services for support</li> <li>• Utilise strategies to support behaviour change including self-monitoring, goal setting, problem solving and motivational interviewing<sup>59</sup></li> </ul>

### 3.4 Self-monitoring

Results from BGL self-monitoring form only part of the clinical decision regarding the need for pharmacological treatment in 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 Section 3.2, 3.5, and 3.6.

Table 15. Self-monitoring

Aspect	Considerations
<b>Context</b>	<ul style="list-style-type: none"> <li>• Self-monitoring of BGLs before and after meals is a key part of the management of GDM</li> <li>• Self-monitoring of BGLs can improve glycaemic management by providing a baseline from which to evaluate the effectiveness of interventions</li> <li>• There is limited evidence about optimal treatment targets for self-monitoring capillary BGL<sup>3</sup> <ul style="list-style-type: none"> <li>○ The two major studies in this area<sup>15,44</sup> used different targets and a recent systematic review<sup>60</sup> suggested the targets used were higher than the levels found in normal pregnancy</li> </ul> </li> <li>• Targets currently recommended by ADIPS are not backed by strong evidence and are noted as an area for future research</li> </ul>
<b>BGL self-monitoring</b>	<ul style="list-style-type: none"> <li>• Recommend BGL self-monitoring to women diagnosed with GDM</li> <li>• Provide individual or group teaching about self-monitoring of blood glucose by a clinician experienced in diabetes education including: <ul style="list-style-type: none"> <li>○ Importance of hand washing</li> <li>○ Use of blood glucose meter</li> <li>○ Use of lancet device and safe disposal of sharps</li> <li>○ Recording of BGL results (e.g. BGL diary)</li> <li>○ Potential causes of errors in monitoring techniques and results</li> <li>○ Registration with the NDSS for accessing diabetes related self-monitoring products (Medicare eligible only)</li> <li>○ Understanding results and the impact of exercise, dietary intake, stress and illness</li> </ul> </li> <li>• Initially, recommend BGL self-monitoring four times per day, either: <ul style="list-style-type: none"> <li>○ Before breakfast and 1 hour postprandial <b>or</b></li> <li>○ Before breakfast and 2 hours postprandial</li> </ul> </li> <li>• Reduce or increase BGL self-monitoring frequency depending on glycaemic targets achieved and progress of pregnancy</li> <li>• Advise women to bring blood glucose meter and diary to each appointment for review and download of data</li> <li>• Blood glucose meter is for their individual use only</li> </ul>
<b>BGL targets</b>	<ul style="list-style-type: none"> <li>• Trend patterns and mean values of BGL are more important than individual results (which may reflect dietary or lifestyle related factors)</li> <li>• Suggested capillary BGLs (not supported by strong evidence) are<sup>3</sup>: <ul style="list-style-type: none"> <li>○ Fasting: less than or equal to 5.0 mmol/L</li> <li>○ 1 hour after commencing meal: less than or equal to 7.4 mmol/L</li> <li>○ 2 hours after commencing meal: less than or equal to 6.7 mmol/L</li> </ul> </li> <li>• If BGL is elevated on 2 occasions at the same test point within 1 week review recent dietary modifications, physical activity interventions and pharmacologic interventions</li> <li>• If average BGL over 1 week is elevated (BGL at the same time each day) consider pharmacological therapy<sup>55,60</sup></li> </ul>

### 3.5 Medical nutrition therapy

The primary intervention for women diagnosed with GDM is to modify diet and physical activity<sup>25</sup> with the aim of improving BGLs, maintaining weight gain within recommended parameters and promoting a healthy and balanced lifestyle beyond pregnancy<sup>36</sup> that delays or avoids the subsequent development of type 2 diabetes.

Table 16. Non-pharmacological management

Aspect	Considerations
<b>Context</b>	<ul style="list-style-type: none"> <li>• Medical Nutrition Therapy (MNT) focuses on food choices for achieving optimal nutrition for maternal and fetal health, promoting appropriate GWG, achieving BGLs within target range and absence of ketones<sup>61</sup></li> <li>• There is limited evidence about which types of dietary advice are most suitable for women with GDM<sup>62-64</sup></li> <li>• MNT involves individualised advice based on nutritional assessment, but include as a minimum 175 g of carbohydrate per day<sup>61</sup>, and a low glycaemic index diet<sup>63,65</sup></li> </ul>
<b>Medical nutrition therapy (MNT)</b>	<ul style="list-style-type: none"> <li>• Refer women diagnosed with GDM to an accredited practising dietitian within 1 week of diagnosis               <ul style="list-style-type: none"> <li>○ Consider telehealth consultation if necessary</li> </ul> </li> <li>• Provide dietary advice that is culturally appropriate and individualised</li> <li>• Provide written information about:               <ul style="list-style-type: none"> <li>○ Healthy eating</li> <li>○ Meeting the nutritional requirements of pregnancy (five food groups)</li> <li>○ Carbohydrate foods and influence on BGLs</li> <li>○ Portion size and distribution throughout the day</li> <li>○ Glycaemic index (GI)</li> <li>○ Weight gain during pregnancy</li> <li>○ Weight loss as a result of dietary restriction not recommended</li> <li>○ Safe foods for pregnancy</li> <li>○ Label reading</li> <li>○ Maintenance of a food diary</li> </ul> </li> </ul>
<b>Schedule of dietetic visits</b>	<ul style="list-style-type: none"> <li>• Minimum schedule of dietetic appointments recommended by American Dietetic Association Nutrition Practice Guidelines<sup>66</sup> <ul style="list-style-type: none"> <li>○ 1 hour initial counselling session</li> <li>○ 2 review appointments (minimum)</li> <li>○ 1 postnatal follow up</li> <li>○ Review scheduled 2–4 weekly based on clinical need</li> <li>○ Further review is recommended if pharmacological treatment is initiated</li> </ul> </li> </ul>

### 3.6 Physical activity

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

Table 17. Physical activity

Aspect	Consideration
<b>Context</b>	<ul style="list-style-type: none"> <li>Physical activity is recognised as a helpful adjunctive therapy for GDM<sup>8,37,54</sup></li> <li>Women with GDM may experience greater blood glucose uptake through increased insulin sensitivity from both aerobic and resistance training<sup>67</sup></li> </ul>
<b>Intensity</b>	<ul style="list-style-type: none"> <li>Assess levels of current physical activity<sup>67</sup>:               <ul style="list-style-type: none"> <li>If minimal, increase duration of moderate physical activity slowly</li> <li>If already more active, maintain or lower intensity during pregnancy rather than attempting to progress to higher levels</li> <li>Refer to Appendix B for a guide to target heart rate ranges by age and BMI</li> </ul> </li> <li>Intensity can be assessed using rating of perceived exertion scales<sup>67</sup> <ul style="list-style-type: none"> <li>Refer to Appendix B: Physical activity for Borg's rating of Perceived Exertion Scale<sup>68</sup></li> </ul> </li> <li>Physical activity of moderate intensity enables the woman to talk but not sing whilst exercising<sup>67</sup></li> </ul>
<b>Duration</b>	<ul style="list-style-type: none"> <li>Recommend 30 minutes of physical activity on most days of the week<sup>69</sup></li> <li>Physical activity may be broken into shorter periods of at least 10 minute periods of moderate effort<sup>70</sup></li> </ul>
<b>Type</b>	<ul style="list-style-type: none"> <li>Physical activity can include aerobic exercise (such as walking, stationary cycle, swimming, aquatic activities, conditioning machines, prenatal exercise classes) and light or moderate resistance exercises<sup>67,69</sup></li> <li>Discuss modifications to the physical activity program as pregnancy progresses (particularly in the third trimester as the body's centre of gravity is altered)</li> <li>Avoid activities that<sup>67,70</sup>:               <ul style="list-style-type: none"> <li>Involve lying flat on the back</li> <li>Increase the risk of falling or abdominal trauma (e.g. contact sports, most racquet sports, horseback riding, water skiing)</li> <li>Are at extreme altitudes (e.g. scuba diving, mountain climbing)</li> </ul> </li> </ul>
<b>Recommendation</b>	<ul style="list-style-type: none"> <li>Advise women that moderate physical activity is associated with a range of health benefits, improves BGLs and is not associated with adverse outcomes<sup>67,69</sup></li> <li>Advise women to:               <ul style="list-style-type: none"> <li>Drink plenty of water during and after physical activity</li> <li>Wear loose light clothing to avoid over heating</li> <li>Not to exercise when hungry, unwell or with an elevated temperature</li> <li>Record daily activity and duration</li> </ul> </li> <li>Discuss contraindications and indications to stop physical activity               <ul style="list-style-type: none"> <li>Refer to Table 18. Cautions and contraindications for physical activity</li> </ul> </li> </ul>

### 3.6.1 Cautions and contraindications for physical activity

Consider individual circumstances when advising women about physical activity.

Table 18. Cautions and contraindications for physical activity

Aspect	Condition
<b>Contra-indications<sup>69</sup></b>	<ul style="list-style-type: none"> <li>• Contraindications for physical activity include (but are not necessarily limited to) the following conditions:               <ul style="list-style-type: none"> <li>○ Hemodynamically significant heart conditions</li> <li>○ Restrictive lung conditions</li> <li>○ Incompetent cervix/cerclage</li> <li>○ Multiple gestation at risk for premature labour</li> <li>○ Persistent second or third trimester bleeding</li> <li>○ Placenta praevia after 26 weeks of gestation</li> <li>○ Premature labour during the current pregnancy</li> <li>○ Ruptured membranes</li> <li>○ Preeclampsia</li> <li>○ Intrauterine growth restriction</li> </ul> </li> </ul>
<b>Cease physical activity and seek advice from care provider<sup>69</sup></b>	<ul style="list-style-type: none"> <li>• Advise women to stop physical activity and contact their health care provider if they are concerned and/or experience any of the following:               <ul style="list-style-type: none"> <li>○ High heart rate</li> <li>○ Dyspnoea prior to or during exertion</li> <li>○ Dizziness, faintness, nausea</li> <li>○ Headache</li> <li>○ Decreased fetal movements</li> <li>○ Uterine contractions, vaginal bleeding, amniotic fluid leakage</li> <li>○ Back or pelvic pain</li> <li>○ Chest pain</li> <li>○ Muscle weakness</li> <li>○ Calf pain or swelling or sudden swelling of ankles, hands and/or face</li> </ul> </li> <li>• Refer to Appendix B for a guide to target heart rate ranges by age and BMI</li> </ul>

## 4 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 BGL markedly elevated in early pregnancy requiring intensive management to achieve euglycaemia)
- Degree and pattern of hyperglycaemia (i.e. fasting or postprandial) to inform most appropriate type of pharmacological therapy
- Fetal growth (macrosomia or small for gestational age) and AC
- Maternal preference

### 4.1 Metformin

Table 19. Metformin

Aspect	Considerations
<b>Context</b>	<ul style="list-style-type: none"> <li>• Women who do not achieve optimal BGLs with lifestyle modification (MNT and physical activity) have traditionally been started on Insulin<sup>25,71,72</sup></li> <li>• There is adequate evidence to consider the use of Metformin as a treatment option in GDM<sup>71,73-75</sup></li> <li>• Metformin does cross the placenta but there appear to have been no teratogenic problems<sup>71,74</sup></li> <li>• Metformin when compared to Insulin is effective at lowering blood glucose and is safe for pregnant women and their fetuses<sup>25,72,74</sup></li> <li>• Up to 50% of women with GDM treated with Metformin will require supplemental Insulin to achieve glycaemic targets<sup>72</sup></li> <li>• Higher rates of severe hypoglycaemia were found in the newborns of women who used Insulin than in women using Metformin<sup>25,72,74</sup></li> <li>• Women prefer Metformin to Insulin<sup>74</sup></li> <li>• There is reassuring short term data on safety of use in pregnancy and development of the offspring<sup>75</sup></li> </ul>
<b>Indications</b>	<ul style="list-style-type: none"> <li>• Average BGL over 1 week is elevated (BGL at the same monitoring time each day) after consideration of dietary and physical activity factors</li> <li>• USS shows incipient fetal macrosomia (AC above the 75<sup>th</sup> percentile) at diagnosis</li> <li>• Mild overall elevated BGL or elevated fasting BGL</li> </ul>
<b>Potential side effects</b>	<ul style="list-style-type: none"> <li>• Nausea, loss of appetite</li> <li>• Diarrhoea</li> <li>• Vomiting</li> <li>• Lowering of serum Vitamin B12 levels (generally if longer term therapy)</li> <li>• May be associated with preterm birth prior to 37 weeks<sup>74</sup></li> </ul>
<b>Education</b>	<ul style="list-style-type: none"> <li>• Advise women to take Metformin after a meal</li> <li>• Cease if significant gastro intestinal side effects occur and are persistent</li> <li>• Add Insulin if glycaemic targets are not achieved or Metformin not tolerated</li> </ul>
<b>Contraindications</b>	<ul style="list-style-type: none"> <li>• Conditions that may alter renal function<sup>76</sup></li> <li>• Severe hepatic impairment<sup>76</sup></li> </ul>
<b>Administration</b>	<ul style="list-style-type: none"> <li>• Discuss with women about Metformin crossing the placenta and being a category C drug in Australia</li> <li>• Commencement dose: 500 mg oral daily with food</li> <li>• Standard (SR) or slow release (XR) Metformin may be used</li> <li>• Maximum dose: 2000 mg oral daily<sup>74</sup></li> <li>• Titrate dose according to BGLs</li> <li>• Review BGLs within 3 days of commencement</li> </ul>

\*Refer to an Australian pharmacopoeia for complete drug information

## 4.2 Insulin therapy

Table 20. Insulin use

Aspect	Consideration
<b>Context</b>	<ul style="list-style-type: none"> <li>Insulin is safe to use in pregnancy<sup>64</sup></li> <li>There is no evidence for superiority of a specific Insulin or Insulin regimen for GDM<sup>24</sup></li> <li>Approximately 27% of women diagnosed with GDM will require Insulin therapy<sup>77</sup></li> </ul>
<b>Indications</b>	<ul style="list-style-type: none"> <li>Hyperglycaemia in excess of targets despite optimisation of non-pharmacological therapies</li> <li>Suboptimal BGL with other therapies</li> <li>Maternal preference</li> </ul>
<b>Potential side effects</b>	<ul style="list-style-type: none"> <li>Hypoglycaemia</li> <li>Local (injection site) allergic reactions</li> <li>Systemic reaction (skin eruptions, oedema)</li> </ul>
<b>Combination therapy</b>	<ul style="list-style-type: none"> <li>Insulin added to Metformin can improve BGLs<sup>74</sup></li> </ul>
<b>Commencement</b>	<ul style="list-style-type: none"> <li>Consult with expert clinician for calculating and ordering appropriate Insulin therapy</li> <li>Individualise dose for each woman as requirements vary</li> <li>Provide details on how to seek advice if any concerns with Insulin therapy</li> <li>Review BGLs (e.g. by phone or email) within 3 days post Insulin commencement</li> <li>Refer to Table 21. Insulin type by glycaemic abnormality for type of Insulin</li> <li>Consider dietitian review to ensure appropriate carbohydrate intake</li> </ul>
<b>Titration</b>	<ul style="list-style-type: none"> <li>Insulin requirements may be anticipated to rise throughout the third trimester as a result of increasing maternal insulin resistance. Tends to plateau at 36–38 weeks<sup>78</sup></li> <li>The 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<sup>78</sup></li> </ul>

\*Refer to an Australian pharmacopoeia for complete drug information

### 4.2.1 Insulin type by glycaemic abnormality

Table 21. Insulin type by glycaemic abnormality

Abnormality	Suggested Insulin type	Action profile
<b>Elevated fasting glucose</b>	<ul style="list-style-type: none"> <li>Single bedtime injection of intermediate-acting Insulin will often suffice</li> </ul>	Onset: 1.5 hours Peak: 4–12 hours Duration: Up to 24 hours
<b>Postprandial hyperglycaemia</b>	<ul style="list-style-type: none"> <li>Meal time rapid acting</li> </ul>	Onset: 10–20 mins Peak: 1–3 hours Duration: 3–5 hours
<b>Fasting and postprandial hyperglycaemia</b>	<ul style="list-style-type: none"> <li>Basal-bolus Insulin regimen               <ul style="list-style-type: none"> <li>Mealtime rapid-acting Insulin and bedtime intermediate-acting <i>or</i></li> <li>Twice daily mixed Insulin (if woman is reluctant to inject four times per day)</li> </ul> </li> </ul>	As for elevated fasting glucose and postprandial hyperglycaemia  Onset: 30 minutes Peak: 2–12 hours Duration: 24 hours

\*Refer to an Australian pharmacopoeia for complete drug information

### 4.3 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 if not receiving pharmacological therapy. In the absence of symptoms of hypoglycaemia, confirm the accuracy of results prior to initiating treatment.

Table 22. Hypoglycaemia in women receiving glucose lowering medication

Aspect	Considerations
<b>Definitions</b>	<ul style="list-style-type: none"> <li>• <b>Mild hypoglycaemia:</b> BGL less than 4.0 mmol/L and may or may not be associated with symptoms of a low blood glucose level</li> <li>• <b>Severe hypoglycaemia:</b> BGL is very low, generally less than 3.0 mmol/L and is associated with confusion and potentially loss of consciousness. The woman requires third party assistance to manage the episode</li> </ul>
<b>Causes</b>	<ul style="list-style-type: none"> <li>• Too much physical activity</li> <li>• Too much Insulin</li> <li>• Missed, delayed or inadequate carbohydrate with meal</li> <li>• Alcohol intake (decreases blood glucose)<sup>76</sup></li> </ul>
<b>Symptoms</b>	<ul style="list-style-type: none"> <li>• Hunger</li> <li>• Light headedness/headache</li> <li>• Sweating/shaking/weakness</li> <li>• Tingling around the lips</li> <li>• Irritability</li> <li>• Blurred vision</li> <li>• Severe hypoglycaemia (when unable to self-treat) can lead to confusion and loss of consciousness and requires urgent medical treatment</li> </ul>
<b>Treatment</b>	<ul style="list-style-type: none"> <li>• Consume <b>one 15 g serve</b> of fast acting carbohydrates (one of the following) <ul style="list-style-type: none"> <li>○ 5–7 glucose jelly beans or</li> <li>○ Glass of soft drink (not diet) or</li> <li>○ Lucozade 100 mL or</li> <li>○ 3 heaped teaspoons of sugar or honey dissolved in water</li> </ul> </li> <li>• If after 15 minutes symptoms persist or BGL less than 4.0 mmol/L repeat one serve of fast acting carbohydrates</li> <li>• <b>Do not over-treat</b> with fast acting carbohydrates as this may lead to rebound hyperglycaemia</li> <li>• When BGL is 4.0 mmol/L or above eat longer lasting carbohydrate <ul style="list-style-type: none"> <li>○ Eat a snack (e.g. sandwich or crackers, glass of milk) or usual meal if within 30 minutes</li> <li>○ Avoid over treatment of hypoglycaemia resulting in hyperglycaemia</li> <li>○ Document BGL and time of hypoglycaemic episode</li> </ul> </li> </ul>
<b>Hypoglycaemia prevention</b>	<ul style="list-style-type: none"> <li>• Plan to eat regular meals with adequate carbohydrate serves</li> <li>• Be prepared and carry a food snack at all times (including while exercising)</li> <li>• Aim to take long or intermediate acting Insulin at the same time each day</li> <li>• Identify causal factors of the hypoglycaemic episode and avoid/mitigate for the future</li> <li>• Carry blood glucose meter at all times so BGL can be checked if symptoms present</li> </ul>

#### 4.4 Education for safe self-administration of Insulin therapy

Table 23. Education for safe self-administration of Insulin

Aspect	Consideration
<b>Safety</b>	<ul style="list-style-type: none"> <li>• Ideally provided by a qualified diabetes educator or clinician trained in teaching self-administration of Insulin<sup>79</sup></li> <li>• Individual sessions (rather than group sessions) are preferable</li> <li>• Confirm type of Insulin and dose ordered</li> </ul>
<b>Demonstrate</b>	<ul style="list-style-type: none"> <li>• Insulin delivery device</li> <li>• Applying needle to device</li> <li>• Priming device and dialling dose</li> <li>• Injection sites and rotation</li> <li>• Self-injection technique</li> <li>• Needle size</li> <li>• Degree of injection angle (if required)</li> <li>• Use of skin fold (if required)</li> </ul>
<b>Discussion points</b>	<ul style="list-style-type: none"> <li>• Hand washing</li> <li>• Insulin action and profile</li> <li>• Timing of injection</li> <li>• Recognition of hypoglycaemia symptoms and treatment               <ul style="list-style-type: none"> <li>◦ Refer to Table 22. Hypoglycaemia in women receiving glucose lowering medication</li> </ul> </li> <li>• Potential side effects</li> <li>• Safe disposal of sharps</li> <li>• Safe driving<sup>80</sup></li> <li>• Storage and handling of Insulin</li> <li>• Expiry of Insulin (opened and unopened)</li> <li>• Travelling: letter authorising to carry Insulin and needles in hand luggage</li> <li>• Update NDSS registration to enable access to free Insulin needles</li> </ul>

## 5 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.<sup>81</sup>

Table 24. Planning for birth

Aspect	Considerations
<b>Context</b>	<ul style="list-style-type: none"> <li>• There is consistent evidence that maternal hyperglycaemia is related to the risk of excessive fetal growth<sup>81</sup></li> <li>• Macrosomia increases the risk of birth injuries including shoulder dystocia and brachial plexus injuries<sup>44,82</sup></li> <li>• There is little quality evidence to inform management between induction of labour (IOL) at term, expectant management or elective caesarean section (CS)<sup>83,84</sup> <ul style="list-style-type: none"> <li>◦ In one single centre study<sup>85</sup> (n=200) IOL at 38 weeks reduced birth weight (3,672 g versus 3,446 g; p &lt; 0.01) and rates of macrosomia (27% v 15%; p=0.05) when compared to expectant management, with no concomitant increase in the rate of CS (25% in the IOL group v 31% in the expectant management group; p=0.43)</li> </ul> </li> </ul>
<b>Fetal weight</b>	<ul style="list-style-type: none"> <li>• Estimation of fetal weight by clinical assessment or USS can have significant margins of error<sup>24,81,86</sup></li> </ul>
<b>Antenatal corticosteroids</b>	<ul style="list-style-type: none"> <li>• If steroids are required for fetal lung maturity, monitor BGLs and consider admission and intensified Insulin therapy</li> </ul>
<b>Timing of birth</b>	<ul style="list-style-type: none"> <li>• Well managed with MNT and no fetal macrosomia or other complications, wait for spontaneous labour (unless there are other indications for IOL)<sup>54</sup></li> <li>• With suspected fetal macrosomia or other complications, consider birth from 38–39 weeks gestation<sup>87,88</sup></li> <li>• Pharmacological therapy alone is not an indication for birth before term</li> <li>• In most cases, women with optimal BGLs who are receiving pharmacotherapy do not require expedited birth before 39 weeks gestation<sup>54</sup></li> </ul>
<b>Induction of labour</b>	<ul style="list-style-type: none"> <li>• There is no clear evidence that women with GDM and a normally grown fetus should have different indications for IOL than women without GDM<sup>81</sup></li> <li>• Consider concomitant complications (e.g. preeclampsia, growth restriction, obesity) that influence the risk of stillbirth when counselling women about expectant management versus IOL</li> </ul>
<b>Mode of birth</b>	<ul style="list-style-type: none"> <li>• If fetal weight is estimated at: <ul style="list-style-type: none"> <li>◦ Less than 4000 g, vaginal birth is usually appropriate</li> <li>◦ 4500 g or more, recommend CS<sup>54,76,82</sup></li> <li>◦ 4000–4500 g, consider other individual factors (e.g. maternal stature, obstetric history, previous birth history, previous macrosomia with or without shoulder dystocia, limitations of estimating fetal weight)</li> </ul> </li> <li>• Instrumental extraction at birth increases the risk of shoulder dystocia compared to spontaneous vaginal birth<sup>82</sup></li> <li>• X-ray pelvimetry is not recommended<sup>82</sup></li> </ul>
<b>Communication</b>	<ul style="list-style-type: none"> <li>• Counsel each woman about the implications of GDM on birthing, specific to her circumstances so as to support informed decision making <ul style="list-style-type: none"> <li>◦ Document all discussions about the plan for birth in the health record</li> </ul> </li> <li>• Review the plan at frequent intervals and update in accordance with clinical circumstances</li> <li>• Involve all members of multidisciplinary team in communications about the plan for birth (including the anaesthetist if indicated)</li> <li>• Document intrapartum management recommendations (if required) unambiguously in the health record</li> <li>• Advise women about the requirements for administration of pharmacological therapy (if any) when birth approaches/labour commences <ul style="list-style-type: none"> <li>◦ Refer to Section 5.1 Pharmacotherapy as birth approaches</li> </ul> </li> </ul>

## 5.1 Pharmacotherapy as birth approaches

Develop and document an individual pharmacotherapy plan taking into account individual circumstances.

Table 25. Pharmacotherapy as birth approaches

Labour/birth	Metformin	Insulin
<b>Spontaneous onset</b>	<ul style="list-style-type: none"> <li>• Cease Metformin when in established labour</li> </ul>	<ul style="list-style-type: none"> <li>• Titrate Insulin requirements according to BGL during labour</li> </ul>
<b>IOL</b>	<ul style="list-style-type: none"> <li>• Cease Metformin when in established labour</li> </ul>	<p>Morning IOL commencement</p> <ul style="list-style-type: none"> <li>• Eat early morning breakfast</li> <li>• Administer usual dose of rapid acting Insulin with breakfast</li> <li>• Omit long or intermediate acting Insulin in the morning</li> <li>• Cease Insulin when in established labour</li> </ul> <p>Afternoon/Evening IOL commencement</p> <ul style="list-style-type: none"> <li>• Administer usual dose of rapid acting Insulin with evening meal</li> <li>• If not in established labour, administer long or intermediate acting Insulin before bedtime</li> <li>• Cease Insulin when in established labour</li> </ul>
<b>Caesarean section</b>	<ul style="list-style-type: none"> <li>• Cease Metformin 24 hours prior to elective procedure</li> </ul>	<ul style="list-style-type: none"> <li>• Administer usual rapid and intermediate/long acting Insulin the night before</li> <li>• Fast from midnight</li> <li>• Omit all Insulin on the morning of the CS</li> </ul>

## 5.2 Intrapartum monitoring

Refer to the Queensland Clinical Guideline *Intrapartum fetal surveillance*<sup>89</sup>

Table 26. Intrapartum monitoring

Aspect	Monitoring
<b>All women</b>	<ul style="list-style-type: none"> <li>• Aim for BGL between 4.0 and 7.0 mmol/L irrespective of GDM therapy during pregnancy<sup>12</sup></li> <li>• Ensure adequate glucose during labour to meet high energy requirements</li> <li>• Continuous CTG during labour is required for women with GDM if during pregnancy<sup>90</sup>: <ul style="list-style-type: none"> <li>○ Insulin or Metformin required or</li> <li>○ Suboptimal BGLs or</li> <li>○ Fetal macrosomia</li> </ul> </li> </ul>
<b>Non pharmacological therapy during pregnancy</b>	<ul style="list-style-type: none"> <li>• BGL on arrival then 4 hourly monitoring <ul style="list-style-type: none"> <li>○ Increase frequency according to BGLs</li> <li>○ Refer to Section 5.3 Intrapartum BGL management</li> </ul> </li> <li>• It is uncommon to experience hypoglycaemia or to require Insulin</li> </ul>
<b>Pharmacological therapy during pregnancy</b>	<ul style="list-style-type: none"> <li>• BGL on arrival, then 2 hourly monitoring <ul style="list-style-type: none"> <li>○ Increase frequency according to BGLs</li> <li>○ Refer to Section 5.3 Intrapartum BGL management</li> </ul> </li> <li>• If required, Insulin requirements are commonly lower during labour (usually no Insulin necessary)</li> </ul>

### 5.3 Intrapartum BGL management

The aim of intrapartum BGL management is to maintain optimal BGLs while avoiding hypoglycaemia.

Table 27. Intrapartum BGL management

Aspect	Considerations
<b>BGL more than 7.0 mmol/L</b>	<ul style="list-style-type: none"> <li>• If BGL greater than 7.0 mmol/L seek medical review</li> <li>• Consider clinical circumstances (e.g. stage of labour, imminency of birth, intake, effects of increased stress levels) when determining management</li> <li>• Management may include:               <ul style="list-style-type: none"> <li>◦ Repeat BGL in 1 hour and reassess <b>or</b></li> <li>◦ Consider Insulin infusion</li> </ul> </li> </ul>
<b>BGL less than 4.0 mmol/L or symptomatic</b>	<ul style="list-style-type: none"> <li>• Cease Insulin therapy</li> <li>• If symptomatic, treat hypoglycaemia, repeat BGL in 15 minutes</li> <li>• If asymptomatic and receiving Insulin, repeat BGL in 15 minutes and reassess</li> <li>• If asymptomatic and not receiving Insulin, repeat BGL in 1 hour and reassess (or earlier if becomes symptomatic)</li> <li>• Refer to Table 22. Hypoglycaemia management</li> </ul>

#### 5.3.1 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 28. Insulin infusion (example only)

Aspect	Recommendation	
<b>IV Infusion</b>	<ul style="list-style-type: none"> <li>• Administer via infusion pump</li> </ul>	
Mainline	<ul style="list-style-type: none"> <li>• Commence 1 litre Dextrose containing fluid (e.g. 4% Dextrose/0.18% Sodium Chloride or Hartmann's with 5% Dextrose) at 80 mL/hour</li> </ul>	
Sideline	<ul style="list-style-type: none"> <li>• Add 50 units Neutral Insulin (Actrapid, Humulin R) to 49.5 mL of 0.9% Sodium Chloride to give a concentration of 1 unit/mL</li> <li>• Flush line with Insulin admixture down to connection port</li> </ul>	
<b>BGL monitoring</b>	<ul style="list-style-type: none"> <li>• Monitor BGL hourly while Insulin infusion being administered</li> <li>• Commence and adjust Insulin infusion according to BGL</li> <li>• Medical review two hours after commencement to assess individual requirements</li> </ul>	
<b>Insulin infusion starting doses and BGL targets</b>	<b>BGL (mmol/L)</b>	<b>Insulin infusion</b>
	4.0 mmol/L or less	<ul style="list-style-type: none"> <li>• Discontinue infusion</li> <li>• Notify and review by Medical Officer</li> </ul>
	4.1–6.0 mmol/L	<ul style="list-style-type: none"> <li>• 1 mL/hour</li> </ul>
	6.1–8.0 mmol/L	<ul style="list-style-type: none"> <li>• 2 mL/hour</li> </ul>
	8.1–10.0 mmol/L	<ul style="list-style-type: none"> <li>• 3 mL/hour</li> </ul>
10.1 mmol/L or more	<ul style="list-style-type: none"> <li>• Continue infusion</li> <li>• Notify and review by Medical Officer</li> </ul>	

## 6 Postpartum care

Provide routine maternal postpartum care appropriate to the clinical circumstances.

Table 29. Postpartum BGL monitoring

GDM	Considerations
<b>Context</b>	<ul style="list-style-type: none"> <li>There is limited evidence/consensus regarding the frequency and type of postpartum BGL monitoring for women with GDM who have been well managed with non-pharmacological therapy</li> <li>Postpartum target BGL for all women with GDM is less than or equal to 7.0 mmol/L (preprandial)</li> </ul>
<b>Non-pharmacological therapy</b>	<ul style="list-style-type: none"> <li>Cease BGL monitoring after birth</li> </ul>
<b>Pharmacological therapy</b>	<ul style="list-style-type: none"> <li>Cease pharmacological therapy (Metformin and Insulin) immediately after birth (vaginal or CS)</li> <li>Continue BGL monitoring QID for 24 hours (preprandial and before bed)</li> <li>If all preprandial BGL are between 4.0 mmol/L and 7.0 mmol/L discontinue monitoring 24 hours after birth</li> <li>If BGL greater than or equal to 4.0 mmol/L and diet tolerated, cease mainline IV fluids</li> <li>If diet not tolerated or BGL less than 4.0 mmol/L seek medical review               <ul style="list-style-type: none"> <li>Consider 4% Dextrose/0.18% Sodium Chloride or Hartmann's/Dextrose IL IV 12 hourly</li> </ul> </li> </ul>
<b>If BGL elevated</b>	<ul style="list-style-type: none"> <li>If any preprandial BGL greater than 7.0 mmol/L               <ul style="list-style-type: none"> <li>Seek medical review</li> <li>Continue BGL monitoring</li> </ul> </li> <li>Insulin is rarely required postpartum               <ul style="list-style-type: none"> <li>If indicated, prescribe lower dose than required during pregnancy</li> </ul> </li> </ul>

### 6.1 Newborn care

Table 30. Newborn care

Aspect	Considerations
<b>Context</b>	<ul style="list-style-type: none"> <li>Refer to Table 4. Risks of GDM</li> <li>Risk of neonatal hypoglycaemia correlates with quality of glycaemic management more than type of diabetes<sup>55</sup></li> <li>Risk of newborn hypoglycaemia is increased if Insulin required during labour<sup>55</sup></li> </ul>
<b>Newborn care<sup>91</sup></b>	<ul style="list-style-type: none"> <li>Keep newborn warm (36.5–37.2 °C)               <ul style="list-style-type: none"> <li>Dry after birth</li> <li>Early skin-to-skin contact</li> </ul> </li> <li>Initiate early feeds within 30–60 minutes of birth</li> <li>Encourage feeding at least 3 hourly or more frequently</li> <li>Perform BGL               <ul style="list-style-type: none"> <li>Prior to second feed or within 3 hours of birth if baby has fed effectively</li> <li>At 2 hours of age if the baby has not fed effectively</li> <li>Every 4–6 hours pre-feeds until monitoring ceases</li> </ul> </li> <li>If feeding is unsuccessful, recheck BGL Observe for signs of neonatal hypoglycaemia and initiate additional BGL monitoring if detected</li> <li>For ongoing management refer to Queensland Clinical Guideline: <i>Newborn hypoglycaemia</i><sup>91</sup></li> </ul>

## 6.2 Breastfeeding

Table 31. Breastfeeding

Aspect	Considerations
<b>Context</b>	<ul style="list-style-type: none"> <li>Women with GDM are less likely to breastfeed (75% v 86%) and to continue for a shorter duration (9 v 17 weeks) compared with women without GDM<sup>92</sup> <ul style="list-style-type: none"> <li>These values are even lower in women with GDM who require Insulin therapy or who are obese<sup>92,93</sup></li> </ul> </li> <li>There is growing evidence that breastfeeding has short and long term benefits for mothers with GDM<sup>92,94-96</sup> <ul style="list-style-type: none"> <li>One study found breastfeeding duration of 3 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<sup>97</sup></li> </ul> </li> <li>Metformin and Insulin are both safe for breastfeeding women</li> </ul>
<b>Recommendation</b>	<ul style="list-style-type: none"> <li>Support and encourage women to breastfeed</li> <li>Provide advice and information to the woman on the importance of breastfeeding for both mother and newborn</li> <li>Offer early additional skilled lactation support and assistance with breastfeeding to women with GDM<sup>93</sup></li> <li>Refer to the Queensland Clinical Guideline: <i>Breast feeding initiation</i><sup>98</sup></li> </ul>

## 6.3 Discharge planning

Consider routine criteria to inform readiness for discharge.

Table 32. Discharge planning

Aspect	Considerations
<b>Optimise postpartum and inter-pregnancy weight</b>	<ul style="list-style-type: none"> <li>The risk of developing type 2 diabetes is greatly affected by body weight</li> <li>There is a significant increase in the odds of GDM occurring in subsequent pregnancies with each unit of BMI gained <i>between</i> pregnancies<sup>95</sup> <ul style="list-style-type: none"> <li>Gain of 1–1.9 kg/m<sup>2</sup> — 1.7 increased odds of future GDM</li> <li>Gain of 2.0–2.9 kg/m<sup>2</sup> — 2.5 increased odds of future GDM</li> <li>Gain of over 3 kg/m<sup>2</sup> — 3.4 increased odds of future GDM</li> </ul> </li> <li>Women who are overweight or obese at their index pregnancy, but who lose weight (approximately 2.0 kg/m<sup>2</sup>) lower their future risk of GDM by almost 80%<sup>95</sup></li> <li>After birth support women to maintain a healthy lifestyle that includes physical activity and maintenance of a healthy weight range and BMI<sup>99</sup></li> </ul>
<b>Referral and follow-up</b>	<ul style="list-style-type: none"> <li>Provide written advice to the woman's primary health carer(s) (e.g. GP, midwife, diabetes educator) about maternal and/or neonatal outcomes</li> <li>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<sup>8,54</sup> <ul style="list-style-type: none"> <li>The National Gestational Diabetes Register sends reminders to women and her GP to have diabetes checks postpartum</li> </ul> </li> <li>Women with a history of GDM require lifelong screening for the development of diabetes or pre-diabetes at least every 3 years<sup>8</sup> <ul style="list-style-type: none"> <li>If contemplating another pregnancy recommend OGTT or HbA1c annually<sup>8</sup></li> </ul> </li> <li>Women with a history of GDM found to have pre-diabetes require lifestyle intervention counselling to assist in preventing progression to type 2 diabetes<sup>8</sup></li> <li>Perform early glucose testing in a future pregnancy</li> </ul>

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## Appendix A: Antenatal schedule of care

### Testing (if risk factors)

Early OGTT or HbA1c (at entry to care)	24–28 week OGTT
Date ordered____/____/____ <input type="checkbox"/> Not ordered <input type="checkbox"/> Declined <input type="checkbox"/> Other_____	Date ordered____/____/____ <input type="checkbox"/> Not ordered <input type="checkbox"/> Declined <input type="checkbox"/> Other_____
<b>OGTT Result</b> (mmol/L) Fasting_____ 1 hour_____ 2 hour_____	<b>OGTT Result</b> (mmol/L) Fasting_____ 1 hour_____ 2 hour_____
<b>HbA1c Result</b> (mmol/mol)_____	
<b>Plan</b> <input type="checkbox"/> OGTT at 24–28 weeks gestation <input type="checkbox"/> Commence GDM care (24–28 week OGTT not required)	<b>Plan</b> <input type="checkbox"/> Routine antenatal care <input type="checkbox"/> Commence GDM care

### At Initial GDM Diagnosis

Discuss/Review/Refer	Considerations
<input type="checkbox"/> Review history	Previous GDM, medications
<input type="checkbox"/> Diabetes Educator consult	For GDM education within 1 week of diagnosis
<input type="checkbox"/> Dietitian review	Within 1 week of diagnosis
<input type="checkbox"/> Psychosocial assessment/support	Refer as required
<input type="checkbox"/> BGL self-monitoring	Commence self-monitoring
<input type="checkbox"/> BMI (pre-pregnancy)	Discuss healthy weight gain targets
<input type="checkbox"/> Physical activity, lifestyle advice	Include smoking cessation
<input type="checkbox"/> Baseline ultrasound scan (USS)	At 28–30 weeks
<input type="checkbox"/> Initial laboratory investigations	<input type="checkbox"/> Serum creatinine
<input type="checkbox"/> If <i>Diabetes in Pregnancy</i> :	<input type="checkbox"/> Optometrist/ophthalmologist review for diabetic retinopathy <input type="checkbox"/> Microalbuminuria for diabetic nephropathy

### Each Visit

Discuss/Review/Refer	Considerations
<input type="checkbox"/> Clinical surveillance	Review for complications (e.g. preeclampsia)
<input type="checkbox"/> Weigh	Review weight gain trends, diet, exercise
<input type="checkbox"/> Test urine	Investigate ketonuria, proteinuria
<input type="checkbox"/> Review BGL self-monitoring record	Review patterns, trends and mean BGL
<input type="checkbox"/> Psychosocial assessment/support	Refer as required
<input type="checkbox"/> Fetal growth and wellbeing (including AC)	USS 2–4 weekly as indicated
<input type="checkbox"/> If pharmacological therapy commenced	<input type="checkbox"/> Follow-up contact within 3 days: <input type="checkbox"/> Weekly diabetes educator review <input type="checkbox"/> Dietitian review
<input type="checkbox"/> Review suitability of model of care (Low risk not suitable if Insulin or Metformin required)	<input type="checkbox"/> Low risk GDM <input type="checkbox"/> Diabetic Clinic <input type="checkbox"/> Obstetric <input type="checkbox"/> Other_____
<input type="checkbox"/> Review next contact requirements (increase frequency if: suboptimal BGL, early diagnosis, diabetes in pregnancy, pharmacological therapy commenced)	<input type="checkbox"/> Fortnightly until 38 weeks <input type="checkbox"/> Fortnightly until 36 weeks <input type="checkbox"/> Weekly until birth <input type="checkbox"/> Other_____

## Appendix B: Physical activity

### 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		
7	Very, very light	
8		Can talk normally
9	Very light	
10		
11	Fairly light	
12		<b>Target in pregnancy:</b>
13	Somewhat hard	How you should feel with physical activity
14		Can talk but not sing
15	Hard	
16		Hard to talk
17	Very hard	
18		
19	Very very hard	
20	Maximum exertion	Don't work this hard

### 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 <sup>2</sup>	103–124
30–39	Low	128–144
	Active	130–145
	Fit	140–156
	BMI > 25 kg/m <sup>2</sup>	101–120
40+		125–140

Adapted from: Sports Medicine Australia. Pregnancy and exercise. Fact sheet. n.d. [cited 2014 December 11]. Available from: [www.sma.org.au](http://www.sma.org.au).

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