

South Australian Perinatal Practice Guideline

Diabetes Mellitus and Gestational Diabetes

© Department for Health and Wellbeing, Government of South Australia. All rights reserved.

Note:

This guideline provides advice of a general nature. This statewide guideline has been prepared to promote and facilitate standardisation and consistency of practice, using a multidisciplinary approach. The guideline is based on a review of published evidence and expert opinion.

Information in this statewide guideline is current at the time of publication.

SA Health does not accept responsibility for the quality or accuracy of material on websites linked from this site and does not sponsor, approve or endorse materials on such links.

Health practitioners in the South Australian public health sector are expected to review specific details of each patient and professionally assess the applicability of the relevant guideline to that clinical situation.

If for good clinical reasons, a decision is made to depart from the guideline, the responsible clinician must document in the patient's medical record, the decision made, by whom, and detailed reasons for the departure from the guideline.

This statewide guideline does not address all the elements of clinical practice and assumes that the individual clinicians are responsible for discussing care with consumers in an environment that is culturally appropriate and which enables respectful confidential discussion. This includes:

- The use of interpreter services where necessary,
- Advising consumers of their choice and ensuring informed consent is obtained,
- Providing care within scope of practice, meeting all legislative requirements and maintaining standards of professional conduct, and
- Documenting all care in accordance with mandatory and local requirements

Explanation of the aboriginal artwork:

The aboriginal artwork used symbolises the connection to country and the circle shape shows the strong relationships amongst families and the aboriginal culture. The horse shoe shape design shown in front of the generic statement symbolises a woman and those enclosing a smaller horse shoe shape depicts a pregnant woman. The smaller horse shoe shape in this instance represents the unborn child. The artwork shown before the specific statements within the document symbolises a footprint and demonstrates the need to move forward together in unison.



Australian Aboriginal Culture is the oldest living culture in the world yet Aboriginal people continue to experience the poorest health outcomes when compared to non-Aboriginal Australians. In South Australia, Aboriginal women are 2-5 times more likely to die in childbirth and their babies are 2-3 times more likely to be of low birth weight. The accumulative effects of stress, low socio economic status, exposure to violence, historical trauma, culturally unsafe and discriminatory health services and health systems are all major contributors to the disparities in Aboriginal maternal and birthing outcomes. Despite these unacceptable statistics the birth of an Aboriginal baby is a celebration of life and an important cultural event bringing family together in celebration, obligation and responsibility. The diversity between Aboriginal cultures, language and practices differ greatly and so it is imperative that perinatal services prepare to respectively manage Aboriginal protocol and provide a culturally positive health care experience for Aboriginal people to ensure the best maternal, neonatal and child health outcomes.

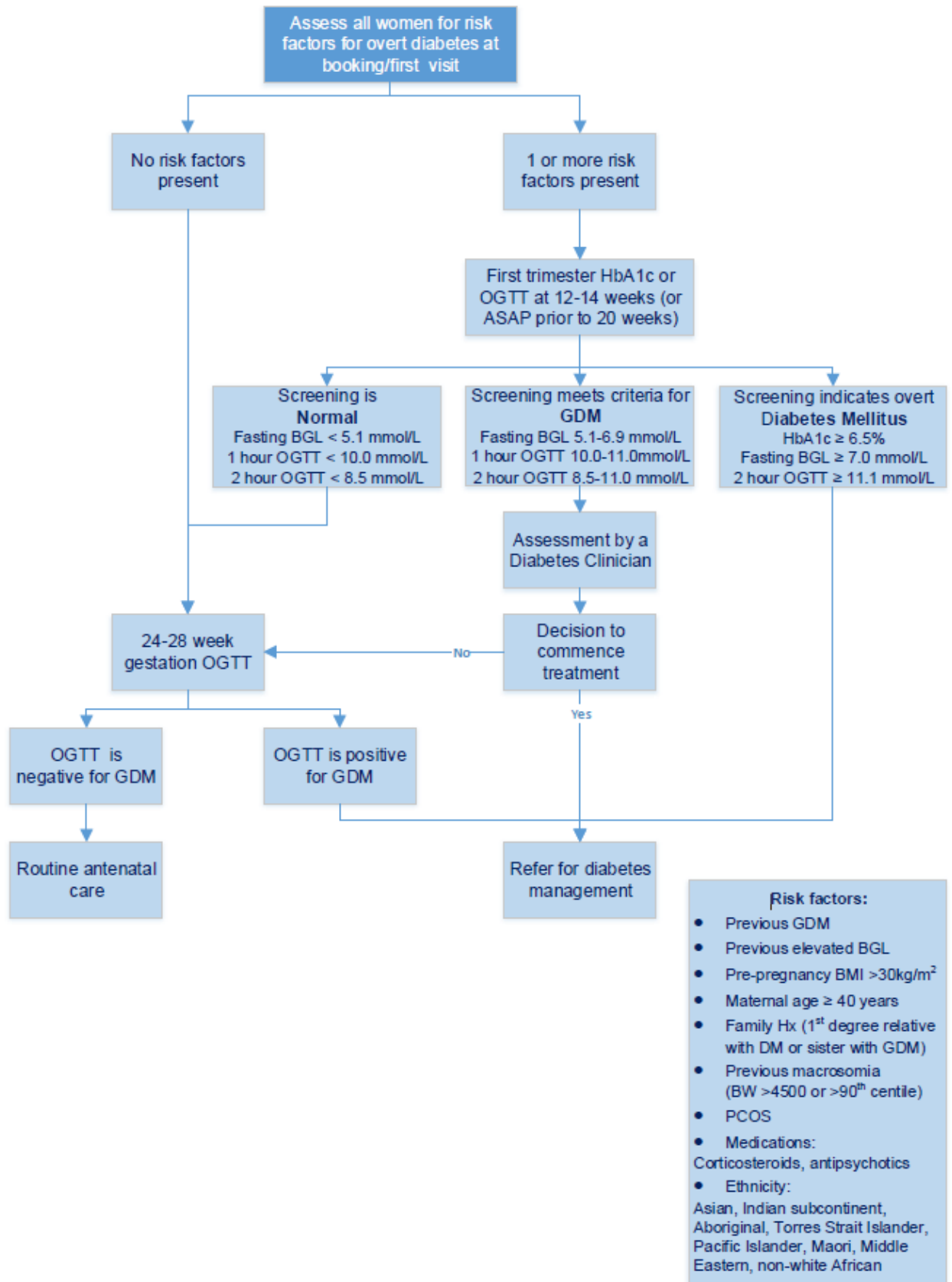
Purpose and Scope of Perinatal Practice Guideline

The purpose of this guideline is to provide clinicians with information on the management of diabetes mellitus type 1 and type 2 during the perinatal period along with diagnosis and management of gestational diabetes mellitus in pregnancy. Pre-conceptual care, antenatal care including specialist referral, blood glucose monitoring, treatment options, fetal surveillance intrapartum, postnatal care and follow-up, including the neonate and ongoing risk are detailed. The Insulin Infusion Regimen is included in this PPG.



Diabetes Mellitus and Gestational Diabetes

Flowchart 1: Screening and diagnosis of diabetes in pregnancy

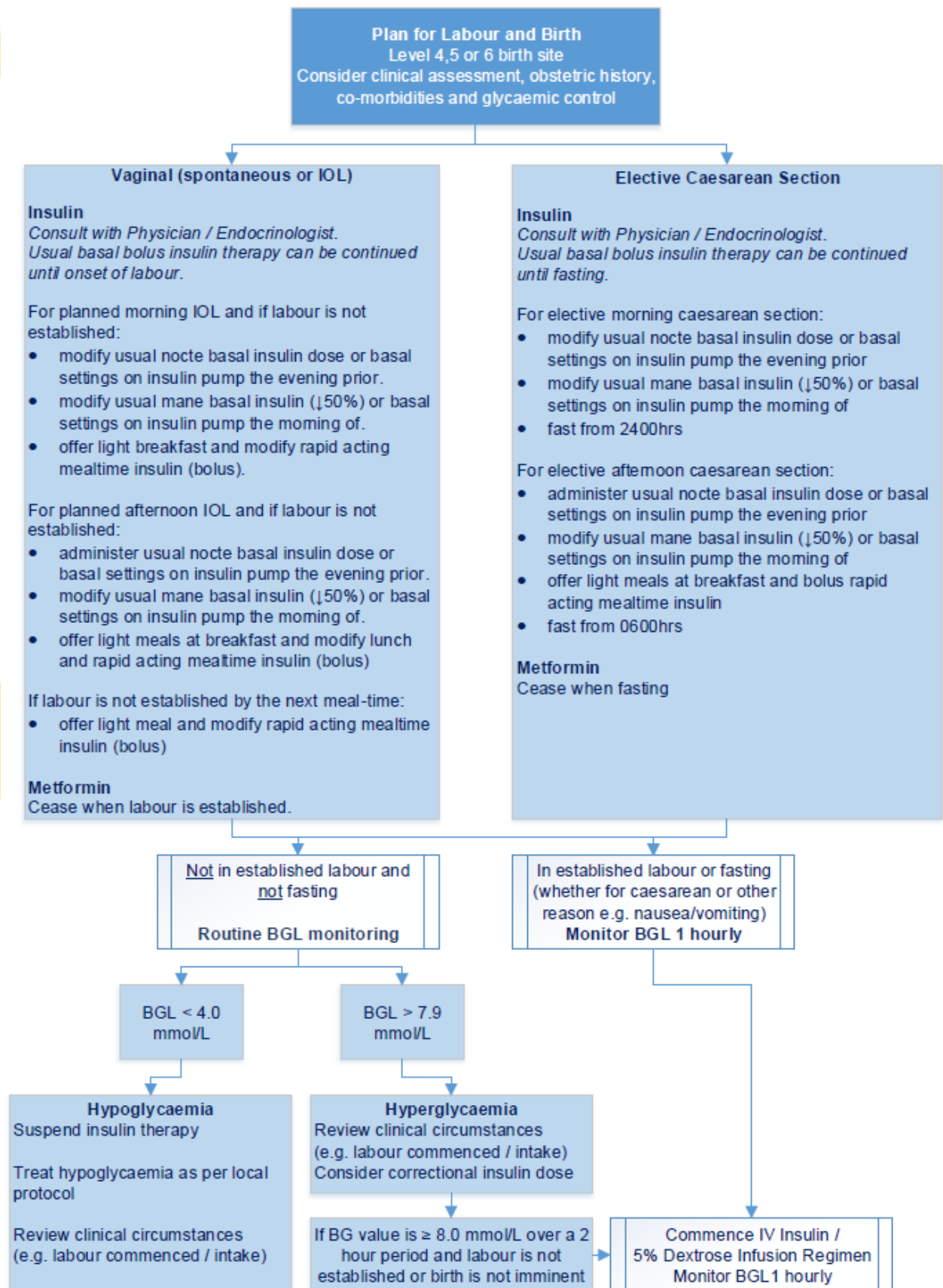


Diabetes Mellitus and Gestational Diabetes

Flowchart 2: Intrapartum management for women with type 1 diabetes

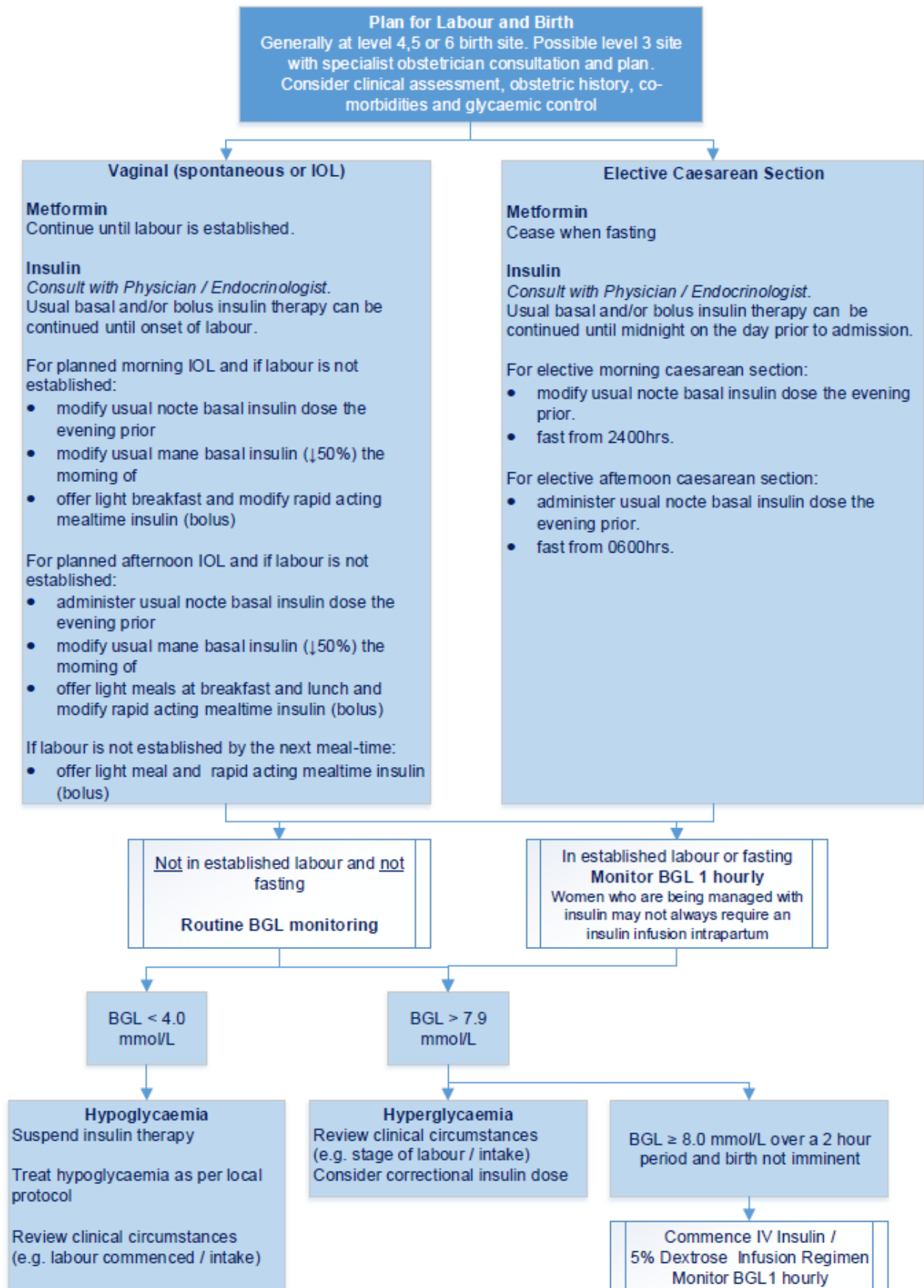


Diabetes Mellitus and Gestational Diabetes



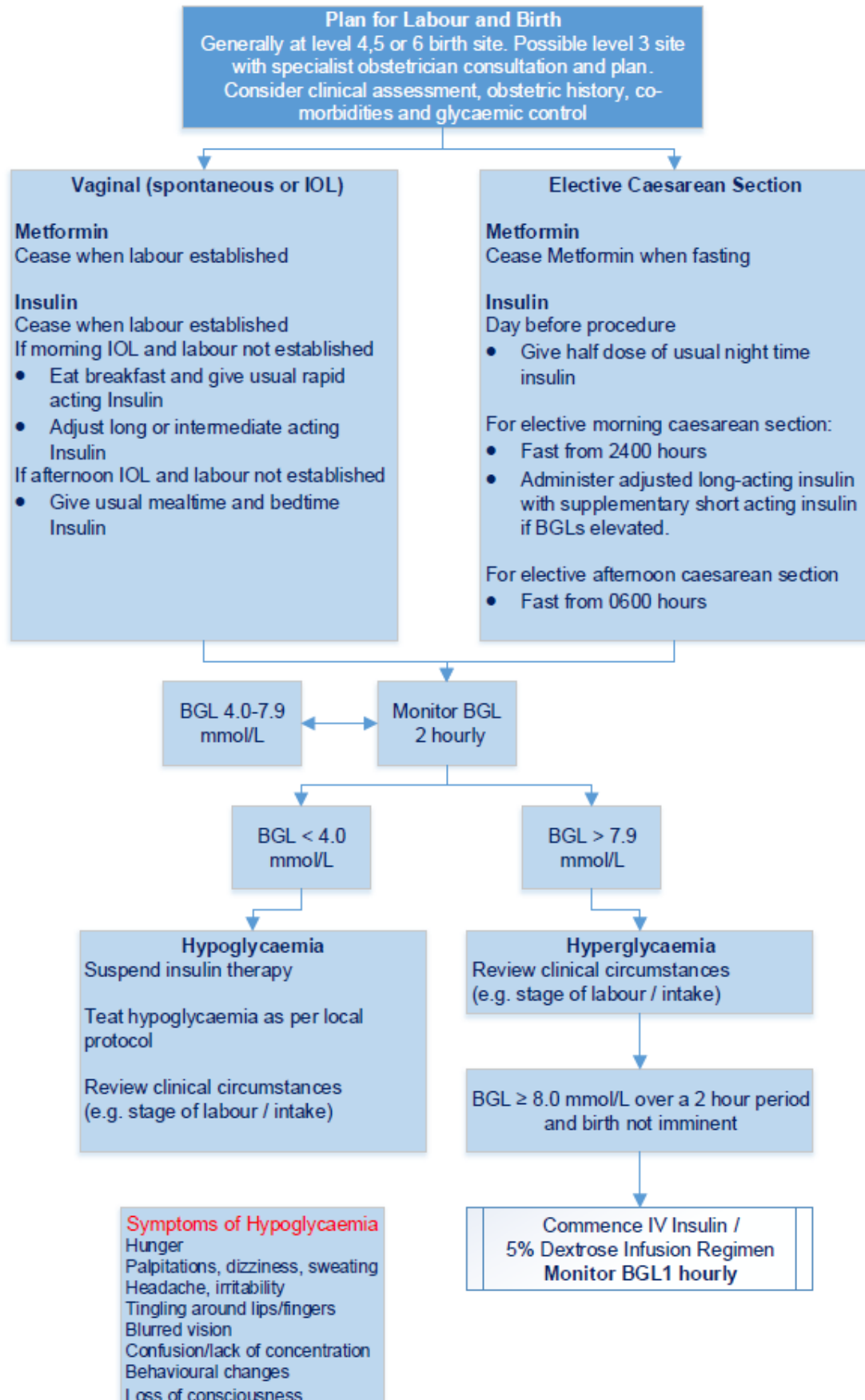
Diabetes Mellitus and Gestational Diabetes

Flowchart 3: Intrapartum management for women with type 2 diabetes requiring insulin and/or metformin in pregnancy



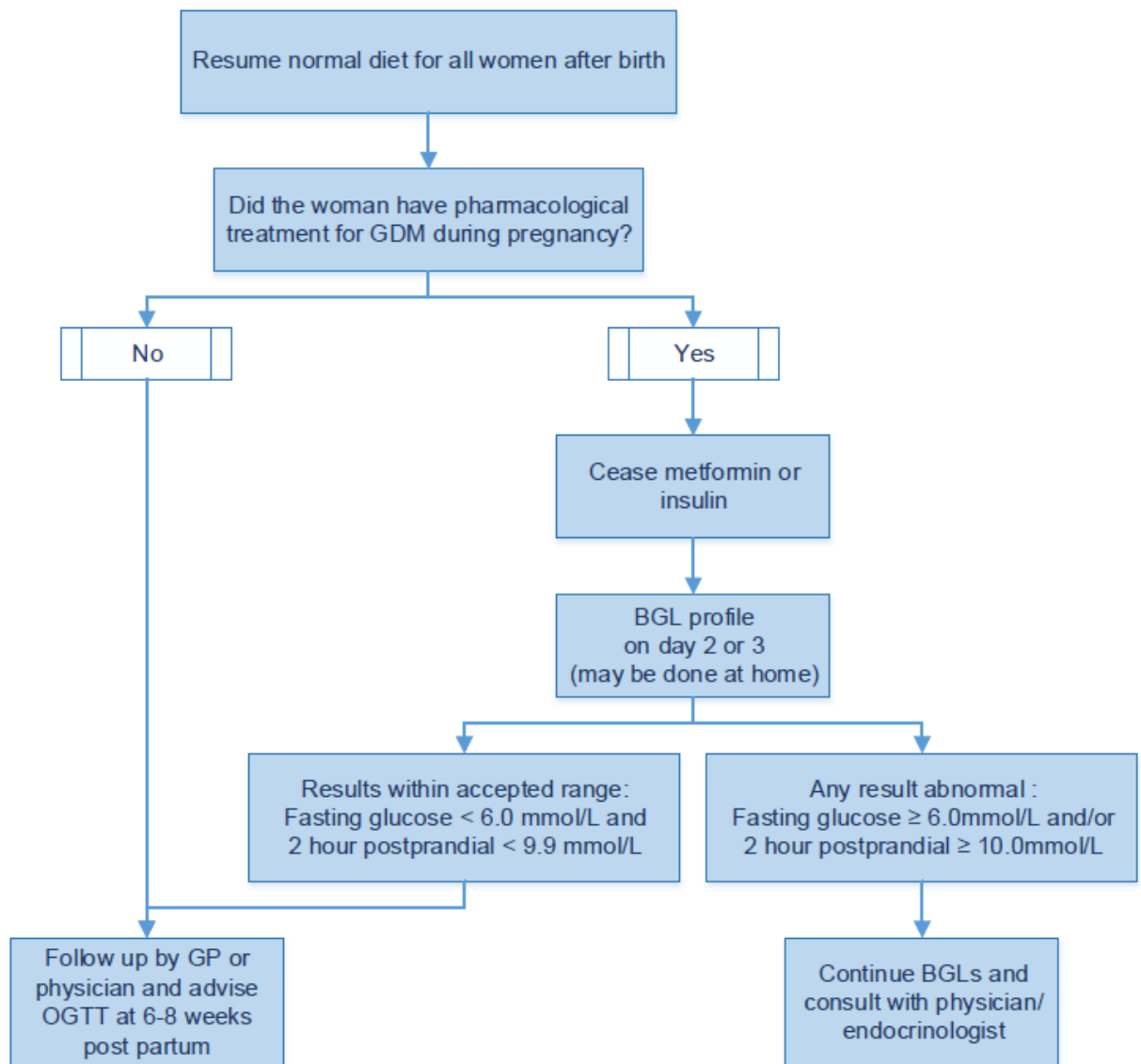
Diabetes Mellitus and Gestational Diabetes

Flowchart 4: Intrapartum management for women with GDM requiring insulin and/or metformin in pregnancy



Diabetes Mellitus and Gestational Diabetes

Flowchart 5: Postnatal management for women with GDM



Diabetes Mellitus and Gestational Diabetes

Table 1: Maternal Diabetes – Intrapartum monitoring and early neonatal Care

Maternal diabetes	Intrapartum maternal / fetal monitoring	Early neonatal care
Type 1 Diabetes mellitus	<p>Once labour is established:</p> <ul style="list-style-type: none"> > Commence hourly blood glucose measurements > Commence 5 % dextrose infusion at rate based on BGL > Commence insulin infusion at rate based on BGL > Continuous electronic fetal monitoring 	<ul style="list-style-type: none"> > A neonatologist or neonatal registrar should be informed of the birth > The baby's first blood glucose level should be obtained by 1 hour of age > The baby should be fed within the first hour after birth > Many babies will have hypoglycaemia, requiring transfer to the nursery and blood glucose monitoring (refer to <i>Neonatal Hypoglycaemia</i> in the A to Z index at www.sahealth.sa.gov.au/perinatal)
Type 2 Diabetes mellitus	<p>Once labour is established:</p> <ul style="list-style-type: none"> > Commence hourly blood glucose measurements > If the BGL is ≥ 8.0 mmol/L over a two hour period, and birth is not imminent, commence an insulin / dextrose infusion, adjusting insulin and dextrose dose to maintain BGL 4.1-7.9 mmol/L > Continuous electronic fetal monitoring 	
Gestational diabetes on insulin or metformin	<p>Once labour is established:</p> <ul style="list-style-type: none"> > Cease metformin and / or insulin > Commence 2 hourly blood glucose measurements > More frequent blood glucose monitoring is required if hyperglycaemia (BGL ≥ 8.0 mmol/L) is noted > If the BGL is ≥ 8.0 mmol/L over a two hour period, and birth is not imminent, commence an insulin / dextrose infusion with hourly blood glucose measurements, adjusting insulin and dextrose dose to maintain BGL 4.1-7.9 mmol/L > Continuous electronic fetal monitoring 	
Gestational diabetes (well controlled on diet)	<p>Once labour is established:</p> <ul style="list-style-type: none"> > Commence 4 hourly blood glucose monitoring, providing that the initial value is normal (BGL 4.1-7.9 mmol/L) > More frequent blood glucose monitoring is required if hyperglycaemia (BGL ≥ 8.0 mmol/L) is noted > If the BGL in labour is ≥ 8.0 mmol/L over a two hour period and birth is not imminent, commence an insulin / dextrose infusion with hourly blood glucose measurements, adjusting insulin and dextrose dose to maintain BGL 4.1-7.9 mmol/L > Continuous electronic fetal monitoring if diabetes was poorly controlled antenatally or there is confirmed fetal macrosomia or growth restriction or other clinical indication 	



Diabetes Mellitus and Gestational Diabetes

Table of Contents

Purpose and Scope of Perinatal Practice Guideline	1
Flowchart 1: Screening and diagnosis of diabetes in pregnancy.....	2
Flowchart 2: Intrapartum management for women with type 1 diabetes	3
Flowchart 3: Intrapartum management for women with type 2 diabetes requiring insulin and/or metformin in pregnancy.....	5
Flowchart 4: Intrapartum management for women with GDM requiring insulin and/or metformin in pregnancy.....	6
Flowchart 5: Postnatal management for women with GDM.....	7
Table 1: Maternal Diabetes – Intrapartum monitoring and early neonatal Care.....	8
Summary of Practice Recommendations.....	10
Abbreviations	11
Definitions.....	11
Introduction.....	11
DIABETES MELLITUS.....	12
Preconception counselling of women with established diabetes	12
Explain:.....	12
Antenatal care	13
First Visit.....	13
Subsequent Antenatal Visits	14
Antenatal admission.....	15
Timing of birth	15
Consider awaiting spontaneous labour if:	15
Plan induction of labour 38+6 weeks if:	15
If birth is likely to occur before 37+0 weeks:	16
Method of birth	16
Intrapartum care.....	16
Type 1 Diabetes	16
Type 2 diabetes.....	17
Neonatal management.....	17
Postpartum care.....	18
Maternal	18
Breastfeeding	18
GESTATIONAL DIABETES MELLITUS	20
Introduction.....	20
Diagnosis.....	20
Recommendations for early testing for hyperglycaemia in pregnancy for women with risk factors	20
Routine testing for hyperglycaemia in pregnancy	21
Women who decline OGTT or are unable to tolerate glucose drink.....	21
Management: Gestational Diabetes Mellitus	22
Blood glucose monitoring and indications for treatment	22
Insulin versus metformin	23
Antenatal Visits	23
Timing of birth	24
Await spontaneous labour if:.....	24
Plan elective birth at 38 to 39 weeks if:.....	24
If birth is planned before 37+0 weeks:	24
Method of birth	24
Intrapartum care.....	25
Induction of labour for women requiring treatment in pregnancy.....	25
Neonatal management.....	25
Postpartum	25
Glucose testing postpartum	25
Follow-up.....	26
Subsequent pregnancy	26
References	27
Appendix 1: Insulin Infusion Regimen (Part A & Part B).....	28
Acknowledgements	30

Diabetes Mellitus and Gestational Diabetes

Summary of Practice Recommendations

Women with established diabetes benefit from preconceptual counselling with referral to specialist services at this time

HbA1c \geq 8.0% increases the risk of birth defects and pregnancy should be deferred until an adequate HbA1c is achieved

The target HbA1c at conception is \leq 6.5%, whilst preventing severe hypoglycaemia

Commence folate 5 mg daily at least 6 weeks before conception

Consider addition of insulin if oral treatment is inadequate to maintain tight control of blood glucose

Some oral hypoglycaemic agents are contraindicated and should be ceased in pregnancy and breastfeeding

Women with established diabetes require early referral to endocrinologist / obstetric physician, obstetrician and Credentialed Diabetic Educator (CDE) in pregnancy

Consider tertiary level morphology ultrasound at 19-20 weeks as part of routine care

Women with markedly elevated (\geq 10 %) HbA1c should have a fetal echocardiogram at 20-22 weeks if their morphology ultrasound was not at a tertiary level facility

Women should be encouraged to adjust insulin based on post prandial glucose values rather than pre-prandial values and anticipated carbohydrate intake

Planned early birth to prevent stillbirth without significantly increasing the risk of neonatal morbidity can be considered dependent on clinical assessment, obstetric history, co-morbidities and glycaemic control

Women with type 1 diabetes require an insulin / dextrose infusion regimen when in established labour or fasting with modification of usual long-acting insulin dose

Women with type 2 diabetes and gestational diabetes (GDM) may not require an insulin / dextrose infusion regimen in labour but require close monitoring

All women with risk factors for overt diabetes should be screened with an early oral glucose tolerance test (OGTT). Women with a positive result require referral to a diabetes clinician

All women with a negative result on early OGTT or without risk factors should be screened for gestational diabetes with an OGTT between 24 and 28 weeks of pregnancy

Women who screen positive for GDM in second trimester require referral to a CDE +/- obstetric physician / endocrinologist +/- obstetric medical officer depending on glycaemic control, need for pharmacological therapy and presence of co-morbidities

Plan for labour and birth for women with GDM is dependent on clinical assessment, obstetric history, co-morbidities and glycaemic control

Women with GDM require postnatal follow-up with OGTT and their GP at 6-8 weeks

All infants of women with diabetes in pregnancy require a BGL by 1 hour of age

Encourage breastfeeding, with first feed within 1 hour of birth



Diabetes Mellitus and Gestational Diabetes

Abbreviations

ADIPS	Australasian Diabetes in Pregnancy Society
BG	Blood glucose
BGL	Blood glucose level
CDE	Registered Nurse/Midwife – Credentialed Diabetes Educator
EFM	Electronic fetal monitoring
g	Gram(s)
GDM	Gestational diabetes mellitus
GP	General Practitioner
HbA1c	Glycosylated haemoglobin
Hb	Haemoglobin
IOL	Induction of labour
L	Litre
LSCS	Lower segment caesarean section
mg	Milligram(s)
mL	Millilitre(s)
mmol	Millimole(s)
mmol/L	Millimole(s) per litre
OGTT	Oral glucose tolerance test
RDS	Respiratory distress syndrome
WHO	World Health Organisation

Definitions

Gestational diabetes mellitus	Carbohydrate intolerance of variable severity with onset or first recognition during pregnancy. This definition applies regardless of whether insulin is subsequently used for treatment and whether or not the condition persists after pregnancy ⁷
Pre / post prandial	Before / after a meal
Type 1 diabetes	The pancreas no longer makes sufficient insulin as the result of autoimmune damage and so the body cannot convert glucose into energy. Daily insulin via injection or a continuous subcutaneous insulin infusion pump is required. Diagnosis is usually made when non-pregnant
Type 2 diabetes	Hyperglycaemia resulting from resistance to the effects of insulin and subsequent insufficient production of insulin to maintain blood glucose in the normal range. Life style modification (diet, physical activity and weight control) is the cornerstone of management. Oral medication (such as metformin or various glucose lowering agents) may be required. Insulin may be necessary where such oral treatment is insufficient to control blood glucose. Diagnosis is made when non-pregnant

Introduction

Worsening diabetic control is associated with adverse pregnancy outcomes and tight control of blood glucose before and in the first weeks of pregnancy reduces the risk of fetal malformation¹. Continued tight control later in pregnancy facilitates normal fetal growth and minimises adverse pregnancy outcomes

Treatment of pregnant women with gestational diabetes (see below) with dietary and physical activity advice, blood glucose monitoring and medication as needed reduces serious perinatal morbidity and may also improve maternal quality of life².



DIABETES MELLITUS

Preconception counselling of women with established diabetes

Aim for review by the woman's endocrinologist / physician, Credentialed Diabetes Educator (CDE) and General Practitioner (GP)

Explain:

Control of blood glucose

Reasons for and benefits of optimal blood glucose and glycosylated haemoglobin concentrations prior to and during pregnancy.

Risks associated with poor control³

- > Congenital malformations
- > Pregnancy complications including macrosomia and / or growth restriction, polyhydramnios, preterm birth, pre-eclampsia, shoulder dystocia, intra-uterine fetal death
- > Operative delivery or caesarean section
- > Care of the newborn including risk of hypoglycaemia (and therefore need for monitoring blood glucose), jaundice, respiratory distress

Consider possible contraindications to pregnancy

The following disorders increase the likelihood of severe neonatal morbidity or mortality associated with preterm birth and also increase the likelihood of the woman suffering severe and potentially irreversible complications related to the pregnancy e.g. cerebrovascular accident, myocardial infarction, worsening renal function, blindness, death. Counselling should occur regarding the advisability of pregnancy if the woman has any:

- > Ischaemic heart disease
- > Severe renal disease
- > Advanced retinopathy
- > Severe Gastropathy
- > Uncontrolled hypertension

Outline preconception management plan

If poor control, advise delaying attempts for pregnancy and offer contraception advice for interim period until blood glucose control is optimised.

Aim for HbA1c < 7.0 % and ideally < 6.5 %⁴ adjusted within acceptable limits of risk of severe hypoglycaemia.

HbA1c ≥8.0% increases the risk of birth defects and pregnancy should be deferred until an adequate HbA1c is achieved. HbA1c ≥ 10.0% is associated with a very high risk of birth defects and adverse outcomes and pregnancy should be avoided.

Test HbA1c at least every 3 months to assess risk of birth defects and to guide blood glucose control.

Refer to a CDE and dietitian.

Consider addition of insulin if oral treatment is inadequate to maintain euglycaemic control. Insulin and metformin therapy can be continued up to and into pregnancy. There are very few data regarding safety of other hypoglycaemic agents in respect of fetal outcomes and these should be discontinued for pregnancy and changed to insulin and/or metformin.

In women with type 1 diabetes, where suitable, a change to continuous subcutaneous insulin infusion pump (CSII) therapy can be considered before conception to obtain satisfactory target blood glucose values and maintain these in pregnancy. Arrange for a referral to a Diabetes Endocrine Service who can assess the suitability for Insulin Pump Therapy. The change to CSII therapy during pregnancy may be associated with a period of worsened BGL control with potential adverse effect on the fetus. Specialist diabetes clinician advice and supervision should be obtained regarding this. The use of other technologies to improve BGL control such as Continuous Glucose Monitoring⁵ or Closed Loop Insulin delivery⁶ should be managed under the guidance of diabetes specialist.

Diabetes Mellitus and Gestational Diabetes

Assess for complications of diabetes, especially retinopathy and nephropathy, consider potential for ischaemic heart disease or cerebrovascular disease.

Consider need for consultation e.g. ophthalmologist and/or nephrologist review

Instruct on the use of a menstrual calendar to establish date of conception

Commence folate 5 mg daily ideally at least 6 weeks before conception. (Note level of evidence for 5 mg rather than 0.5 mg is inconclusive, unless there has been a previous pregnancy complicated by a fetal neural tube defect)

Consider need for iodine and vitamin D supplementation. For further information, refer to Vitamin and mineral supplementation in pregnancy in the A to Z index at www.sahealth.sa.gov.au/perinatal

Prepare for diabetes management after conception i.e.:

1. Recommend changes to diet as per current pregnancy guidelines
2. Test and record blood glucose measurements to include fasting and 2 hour postprandial readings. Women with pre-conception diabetes, who have been monitoring pre-prandial blood glucose for determination of insulin dose in relation to their proposed dose will need advice on the possibility of changing to or adding post prandial blood glucose monitoring, as adjusting treatment to these values has been shown to be associated with improved perinatal outcomes
3. Contact a Diabetes Clinician for advice on treatment (e.g. adjusting metformin and/or insulin dosing, changing to insulin). Note that preparation for these changes should preferably be made in anticipation of a planned pregnancy. Fertile women with diabetes should be made aware these changes are necessary, should pregnancy occur, as soon as possible after conception. Note: CDEs offer ambulatory glucose stabilisation services in both metropolitan and country areas.

Antenatal care

Refer early to high risk care with endocrinologist/obstetric physician, obstetrician and CDE.

Plan birth in a Level 4, 5 or 6 hospital (see *Standards for Maternal and Neonatal Services in South Australia* available at www.sahealth.sa.gov.au/perinatal)

First Visit

Bloods

- > Routine booking bloods
- > Glycosylated haemoglobin (HbA1c)
- > Thyroid function test (type 1 diabetes)
- > Electrolytes, liver and renal function tests, urate
- > Random glucose

Urine

- > Early morning spot urine for albumin / creatinine ratio and / or a random midstream urine for protein / creatinine ratio, together with microscopy, culture and sensitivity

Medications

- > Review medications
- > Some oral hypoglycaemic agents are contraindicated and should be ceased e.g. thiazolidinediones (glitazones), repaglinide, acarbose, dipeptidyl peptidase-4 inhibitors, glucagon-like peptide-1 antagonists, sodium-glucose co-transporter-2 inhibitors⁷.
- > Ongoing type 2 diabetes treatment with metformin is increasingly being used in pregnancy around the world although some Australian experts are still reluctant to advise this. Follow up of infants exposed to metformin in utero at 7 to 9 years of age show similar body fat percent and metabolic measures to those exposed to insulin in utero for GDM⁸. Metformin is excreted more rapidly in pregnancy and increased doses may be required. The alternative of glibenclamide as the preferred sulphonylurea is not recommended for first line treatment as it has been shown to increase the risk of neonatal hypoglycaemia and is suspected of causing in utero fetal hypoglycaemia⁹. Sulphonylurea use in pregnancy should be supervised by an endocrinologist / obstetric physician.

Diabetes Mellitus and Gestational Diabetes

- > Insulin may be needed in type 2 diabetes to improve glucose control
- > Ceasing oral agents and starting or switching to insulin should be done in collaboration with a physician / endocrinologist to minimise hyperglycaemia during critical stages of fetal growth and development
- > Commence low dose aspirin 100 mg / day orally especially if the woman has a high risk of vascular disease or has had previous pre-eclampsia

Education

- > Reinforce dietary advice and physical activity recommendations
- > Appropriate blood glucose monitoring (and blood ketone monitoring if type 1 diabetes)
- > Advise on the likely need for additional/increased insulin
- > Involve a CDE

Referral

- > Arrange CDE and obstetric physician or endocrinologist referral
- > Arrange ophthalmologist referral

Subsequent Antenatal Visits

Frequency of visits

- > All routine antenatal care should be provided by an obstetric medical officer
- > Obstetrician and endocrinologist/obstetric physician review should be performed 2, 4 or 6 weekly according to the stability of BGL control and risk of complications. CDE monitoring of diabetes control and supervision of diabetes management should occur at least weekly.

Maternal surveillance

- > Review maternal HbA1c, renal function and proteinuria results at first visit. Repeat every two to three months or as indicated. Blood pressure measurement and urine dipstick for protein every visit.

Fetal surveillance

- > Confirm gestational age *with a dating and viability ultrasound at an estimated 7 to 9 weeks gestation.*
- > At 12 weeks gestation offer nuchal translucency assessment and serum screening
- > Offer early morphology ultrasound at 16 weeks if appropriate
- > 19-20 week morphology ultrasound (document that the woman has type 1 or type 2 diabetes on the request form). Recommend tertiary level morphology ultrasound for all women with type 1 diabetes and women with type 2 diabetes who had suboptimal BGL control peri-conception.
- > In the absence of a tertiary perinatal ultrasound service, a fetal echocardiogram for women with markedly elevated ($\geq 10\%$) HbA1c at 20-22 weeks
- > Consider further scans for growth / liquor volume in the third trimester

Consider umbilical artery blood flow measurement in late pregnancy if:

- > Evidence of microvascular (nephropathy or proliferative retinopathy) or macro vascular disease
- > Hypertension (essential or gestational or pre-eclampsia)
- > Intrauterine growth restriction
- > Smoker

Blood glucose monitoring

- > Arrange for the woman to make regular contact with her diabetes clinician (preferably at least once a week), for adjustment/titration of insulin / diabetes treatment (may be via phone/email)
- > Minimum of four times a day: before breakfast (fasting) and two hours after the start of each meal
- > Aim for blood glucose:
 - > Less than or equal to 5.0 mmol/L before breakfast (fasting)
 - > Less than or equal to 6.7 mmol/L two hours after a meal



Diabetes Mellitus and Gestational Diabetes

- > The target blood glucose should remain above 4.0 mmol/L
- > **NOTE:** The treatment targets for blood glucose values in diabetes are controversial and are subject to ongoing review
- > Women with type 1 or type 2 diabetes, who have been adjusting their insulin dose on the basis of pre-prandial blood glucose values and anticipated carbohydrate intake, may continue to monitor in this way. It has been shown however, that perinatal outcome is better with control based on post prandial glucose values.

Ketone testing

- > Preferably by blood finger prick testing to be performed :
 - > If BGL > 15 mmol/L (note Diabetic Ketoacidosis may occur at lower BGLs in pregnancy and blood ketones may be performed for BGL > 12 mmol/L)
 - > If hyperemesis occurs, particularly if two meals are missed.
- > Pregnant women with type 1 diabetes should promptly present for emergency medical/diabetic management if blood ketones \geq 0.6 mmol/L.
- > During inpatient admission for diabetes stabilisation perform blood ketones twice daily.

Antenatal admission

- > Consider if complications arise
- > Consider if glycaemic targets are not being met (i.e. difficult to manage)
- > Consider in late pregnancy to optimise blood glucose values and antenatal monitoring as well as assessment of timing of delivery
- > Women who have difficulty maintaining blood glucose values within targets should have contact with a neonatologist, as neonatal morbidity can be anticipated

Timing of birth

The main goal of proposing early birth is to prevent stillbirth without significantly increasing the risk of neonatal morbidity.

However, the decision for elective birth should be made on an individual basis, taking into account a number of clinical factors including:

- > Gestational age
- > Estimated fetal weight (ultrasound and clinical)
- > Fetal growth patterns (e.g. asymmetry AC / HC ratio)
- > Type 1 or type 2 diabetes
- > Degree of glycaemic control
- > The woman's obstetric history (e.g. a history of stillbirth)
- > Parity
- > Cervical status (Bishop's score)
- > Existing medical co-morbidities such as hypertension, vasculopathy, obesity and advanced maternal age should also be considered

Consider awaiting spontaneous labour if:

- > Blood glucose values remain within target ranges
- > Normal fetal growth
- > There is no polyhydramnios or other complication of pregnancy (e.g. pre-eclampsia)
- > Birth should occur before 40⁺⁶ weeks of pregnancy

Plan induction of labour 38+6 weeks if:

- > Difficulty maintaining blood glucose values within optimal concentrations at 38⁺⁰ weeks
- > Polyhydramnios or oligohydramnios



Diabetes Mellitus and Gestational Diabetes

- > Macrosomia or growth restriction
- > Development of hypertension / pre-eclampsia (or plan birth earlier as indicated)

If birth is likely to occur before 37+0 weeks:

Consider administration of corticosteroids for fetal lung maturity.

There is insufficient evidence to dictate the particulars of the administration of antenatal corticosteroids to diabetic pregnant women. Each case should be assessed by the attending obstetrician and a decision made taking into account the type of diabetes, the gestational age, the planned mode of birth and the likelihood of fetal or maternal complications.

- > Admission for additional glucose monitoring and increased insulin dosing should be at the direction of the physician / endocrinologist.
- > If not in labour, an insulin infusion is not generally required but in labour an infusion may occasionally be considered if high doses of insulin have been required during pregnancy (see [insulin infusion regimen](#) in appendix) and refer to local hyperglycaemia management protocols

Method of birth

Vaginal birth if estimated fetal weight is < 4,000 grams as clinically indicated

One cohort study found that the use of a fetal weight threshold $\geq 4,250$ grams in diabetic women for elective caesarean section reduced the incidence of shoulder dystocia in this population³.

When discussing the mode of birth with the woman, the medical officer should also take into consideration that current estimations of fetal weight with ultrasonography are associated with a 95% likelihood of a greater than 20% error (above or below) the stated estimated fetal weight.

Discuss with the woman the potential risks and benefits of induction of labour.

Intrapartum care

Type 1 Diabetes

Labour and birth needs to be managed within a Level 4, 5 or 6 hospital (see *Standards for Maternal and Neonatal Services in South Australia* available at www.sahealth.sa.gov.au/perinatal)

Normal labour management.

Continuous electronic fetal monitoring ([refer to table 1](#))

Care of the woman with type 1 diabetes in labour should be in consultation with the obstetric physician / endocrinologist (see [flowchart 2](#))

The physician / endocrinologist should document a clear plan in the woman's casenotes when induction of labour (IOL) or elective caesarean section is planned.

If IOL is planned, modify usual long acting insulin the evening before in consultation with the physician / endocrinologist. Cessation of long acting insulin for labour and birth is not recommended. The woman's usual diabetes management can be continued until the onset of labour or until fasting for caesarean section. Insulin pump adjustments will need appropriate dose modifications.

On the morning of induction, if not already in labour, the woman can be given a light breakfast and, in consultation with the physician / endocrinologist, a dose of shorter acting insulin (e.g. Actrapid[®], NovoRapid[®] or Humalog[®]), and a reduced dose (e.g. half) of long acting insulin given (if usually given in the morning). Insulin pump adjustments will need similar dose modifications under diabetes clinician guidance.

If labour is not established by lunch time, a further light meal and rapid acting insulin may be considered, in consultation with the physician / endocrinologist, with a further 2 hours post prandial blood glucose reading.

Avoid prolonged labour and water overload – if ordered, oxytocin should be administered with 0.9 % sodium chloride to prevent hyponatraemia into a mainline of 0.9 % sodium chloride (Refer to *Oxytocin: augmentation and induction of labour infusion regimens* PPG available at www.sahealth.sa.gov.au/perinatal). Two intravenous access lines will be required to accommodate the dextrose / insulin infusions and mainline / oxytocin infusions.

Diabetes Mellitus and Gestational Diabetes

Be aware of the increased risk of shoulder dystocia.

Insulin regimen

- > Once in labour, a [5 % dextrose infusion](#) should be commenced at a rate based on the woman's BGL
- > At the same time a short-acting insulin infusion (Actrapid® or NovoRapid®) should be set up in accordance with [insulin infusion regimen](#) in the appendix.
- > Measure blood glucose every hour using blood glucose meter and/or laboratory determinations and adjust insulin infusion with the aim of keeping blood glucose between 4.1 and 7.9 mmol/L.
- > Continuation of patient self-managed insulin pump therapy is possible with a clear management and adjustment plan.

Type 2 diabetes

Labour and birth will generally need to be managed within a Level 4, 5 or 6 hospital (see *Standards for Maternal and Neonatal Services in South Australia* available www.sahealth.sa.gov.au/perinatal) Location of birth is dependent on glycaemic control, medication in pregnancy, presence of co-morbidities and access to specialised personnel. Plan for labour and birth should be made in consultation with a specialist obstetrician.

If induction of labour is planned, any pre-existing insulin regimen is continued until labour is established or no later than midnight on the day of admission. Further insulin management will be according to guidelines below (see [flowchart 3](#))

If metformin is being used, this can be continued until labour is established.

Routine blood glucose monitoring to continue until labour is established.

On the morning of induction, if not already in labour, the woman can be given a light breakfast with metformin if being used and, if insulin is being used, a dose of rapid acting insulin in consultation with the physician / endocrinologist.

If labour is not established by lunch time, a further light meal with metformin and/or rapid acting insulin may be considered, in consultation with the physician / endocrinologist.

Once labour is established, blood glucose levels should be taken every 1 hour ([refer to table 1](#))

If the blood glucose in labour is ≥ 8.0 mmol/L over a two hour period, and birth is not imminent, an insulin / dextrose infusion should be commenced - Refer to [insulin infusion regimen](#). Continue hourly blood glucose measurement using blood glucose meter and / or laboratory determinations and adjust insulin infusion with the aim of keeping blood glucose between 4.1 and 7.9 mmol/L.

If ordered, oxytocin should be administered with 0.9 % sodium chloride to prevent hyponatraemia into a mainline of 0.9 % sodium chloride (Refer to *Oxytocin: augmentation and induction of labour infusion regimens* PPG available at www.sahealth.sa.gov.au/perinatal). Two intravenous access lines will be required to accommodate the dextrose / insulin infusions and mainline / oxytocin infusions.

Normal labour management.

Continuous electronic fetal monitoring.

Be aware of the increased risk of shoulder dystocia.

Cease IV 5% dextrose immediately following birth.

Neonatal management

A neonatologist, neonatal registrar, paediatrician or credentialed GP should be informed of the birth.

The baby should be fed within the first hour after birth. Breastfeeding should be encouraged.

Many babies will have hypoglycaemia, requiring blood glucose monitoring, close observation and transfer to the nursery. Refer to *Neonatal Hypoglycaemia* in the A to Z index at www.sahealth.sa.gov.au/perinatal

The baby's first blood glucose measurement should be obtained by 1 hour of age.

Other morbidities e.g. polycythaemia, jaundice, hypocalcaemia, respiratory distress syndrome (RDS) may also occur, further emphasising the need for nursery observation and management.

Postpartum care

Maternal

Send placenta for histopathological examination.

Medication therapy will require review by duty medical staff, obstetrician or GP obstetrician in consultation with the endocrinologist / obstetric physician, as there is an immediate fall in maternal insulin resistance after delivery of the placenta.

Normal vaginal birth

After birth, insulin infusion can usually be ceased in all women with pre-existing diabetes.

For women with type 1 diabetes, continue long acting subcutaneous insulin at usual time and recommence rapid acting insulin with meals. Commencement depends on when birth occurs and as prescribed by the physician / endocrinologist. Note: If long acting insulin was ceased, do not cease IV insulin / dextrose infusion until long acting insulin has been administered at least 4 hours prior.

Women with type 2 diabetes who have required an intrapartum insulin / dextrose infusion, cease this after birth and recommence oral hypoglycaemic agents (if required pre-pregnancy).

For women with type 2 diabetes previously using insulin, consider need for a lower dose of long acting subcutaneous insulin at usual time and perhaps commencement of rapid acting insulin with meals in consultation with the physician / endocrinologist.

Recommence usual diabetes diet.

Recommence routine blood glucose monitoring once the insulin infusion is ceased.

Physician / endocrinologist / CDE follow up as indicated.

Caesarean section

Women with Type 1 diabetes should continue with an insulin / dextrose infusion until the woman is ready to resume oral intake.

At the time of ceasing the insulin / dextrose infusion, long acting insulin needs to have been recommenced, usually at a lower dose, and administered at least 4 hours before the cessation of the insulin infusion. Short acting mealtime insulin can then be reintroduced, using the pre-pregnancy regimen as a basis, depending on oral intake. Modified doses will need to be considered to reduce the risk of hypoglycaemia, particularly if breastfeeding, in consultation with the physician / endocrinologist.

Recommence routine blood glucose monitoring.

Women with type 1 diabetes who are breastfeeding and/or expressing should be encouraged to undertake more frequent BGL testing (i.e. prior to commencing breastfeed or expression).

Recommence usual diabetes diet.

Contraception

A history of diabetes does not preclude the usual methods of contraception, and family planning is very important for such women.

Consult contraceptive guidelines or SHineSA for advice – 1300 794 584

Breastfeeding

Encourage breastfeeding. Babies who have been breastfed for at least 2 months may lower their risk of diabetes in childhood.

The increased energy consumption of lactation may allow smaller doses of insulin than usual for a woman with pre-pregnancy insulin-requiring diabetes. Such women require insulin adjustment instructions to reduce the risk of hypoglycaemia

All forms of insulin may be used safely by a breastfeeding mother

Metformin is excreted in very low levels into breast milk¹⁰ and is compatible with breastfeeding. It has not been reported to cause adverse effects in breastfed infants.



Diabetes Mellitus and Gestational Diabetes

Glibenclamide and glipizide are excreted in low concentrations in breast milk and may be used in breastfeeding women¹⁰. There is a lack of human data regarding the use of gliclazide and glimepiride and caution should be exercised with their use with consideration being given to alternatives.

Thiazolidinediones (rosiglitazone, pioglitazone), acarbose, dipeptidyl peptidase-4 inhibitors (e.g. sitagliptin), glucagon-like peptide-1 antagonists and sodium glucose cotransporter-2 inhibitors are not recommended for use by breastfeeding women¹⁰ as there are no human data available on their transfer into breast milk. Alternative options should be considered.



GESTATIONAL DIABETES MELLITUS

Introduction

Gestational Diabetes (GDM) is associated with an increased risk of adverse perinatal outcomes¹¹ and screening for GDM is recommended for all women not otherwise diagnosed with diabetes.

Diagnosis

The standard test for the diagnosis of GDM recommended by the Australasian Diabetes in Pregnancy Society (ADIPS) is the 75 gram fasted Oral Glucose Tolerance Test (OGTT). The ACHOIS trial² demonstrates the benefit of treatment of GDM for mother and baby and the HAPO study¹¹ shows the progressive increased risks with worsening degrees of untreated hyperglycaemia at the end of the second trimester.

Recommendations for early testing for hyperglycaemia in pregnancy for women with risk factors

Women, not known to have pre-existing glucose abnormalities, but with risk factors (see below) for overt diabetes in pregnancy (and therefore potentially pre-existing diabetes) should be tested early in pregnancy with an OGTT. If the practitioner wishes to test earlier than 12 weeks, then HbA1c can be performed as described below under 'Alternative diagnostic tests'. Women not diagnosed at early screening with overt diabetes in pregnancy or with OGTT results that would be consistent with GDM diagnosed at the end of the second trimester require repeat testing between 24 and 28 weeks gestation.

NOTE: Treatment of overt Diabetes diagnosed early in pregnancy is indicated to minimise the risks associated with pre-existing diabetes in pregnancy (see above). Early detection of milder degrees of glucose intolerance, using the criteria to diagnose GDM at the end of the second trimester, and early treatment may *potentially* improve outcomes. However, there is also the potential for overtreatment and fetal compromise from nutritional deprivation, with long term risk on future metabolic disease associated with fetal programming, as well as the risk of medicalising some normal women. Studies are currently in progress in SA and elsewhere in Australia to determine the most appropriate means of establishing a diagnosis of gestational diabetes in early pregnancy and to explore the outcomes of early treatment interventions.

Risk factors for overt Diabetes in Pregnancy (fasting glucose ≥ 7.0 mmol/L and/or 2 hour glucose ≥ 11.1 mmol/L):

- > Previous hyperglycaemia in pregnancy
- > Previously elevated blood glucose
- > Maternal age ≥ 40 years
- > Ethnicity (Asian, Indian subcontinent, Aboriginal, Torres Strait Islanders, Pacific Islander, Maori, Middle Eastern, non-white African)
- > Family history of DM (i.e. 1st degree relative with diabetes or sister with hyperglycaemia in pregnancy)
- > Pre-pregnancy (where available) or booking BMI > 30 kg/m²
- > Previous macrosomic baby (birth weight $> 4,500$ g or $> 90^{\text{th}}$ centile)
- > Polycystic ovarian syndrome
- > Medications: corticosteroids or antipsychotics



Diabetes Mellitus and Gestational Diabetes

Routine testing for hyperglycaemia in pregnancy

Oral Glucose Tolerance Test (OGTT)

Women not known to have diabetes should have a 75 gram oral glucose tolerance test (OGTT) at 24 - 28 weeks gestation. There is no need for a 3 day high carbohydrate diet before the OGTT

After an eight (at least) hour fast from food (plain water is acceptable), venous blood is drawn, before a 75 gram glucose drink is given to the pregnant woman, to be drunk over 10-15 minutes.

Further venous blood is drawn at one hour and at two hours after the glucose drink has been given. The woman should remain seated and non-smoking for the duration of the test.

The test may be performed at any time after the first trimester if symptoms and signs of abnormal glucose tolerance are present e.g. excess thirst; polyuria, polyhydramnios, fetal macrosomia.

Diagnosis using OGTT

Timing of blood glucose measurement	Venous glucose result for diagnosis of overt Diabetes Mellitus	Venous glucose result for diagnosis of Gestational Diabetes Mellitus
Fasting	≥ 7.0 mmol/L	5.1-6.9 mmol/L
1 hour post 75gm glucose drink		≥ 10.0 mmol/L
2 hours post 75gm glucose drink	≥ 11.1 mmol/L	8.5-11.0 mmol/L

Once diagnosis is confirmed, refer woman for initial diabetes education, including a dietitian for nutritional therapy and a CDE for diabetes education and self-blood glucose monitoring.

Women who decline OGTT or are unable to tolerate glucose drink

OGTT is contraindicated for women who have had gastric bypass surgery. Women who have undergone gastric banding are generally able to tolerate the OGTT. If the woman is unsure which procedure she has had, please refer to a medical officer for further discussion prior to ordering OGTT.

Alternative diagnostic tests include HbA1c or home capillary (i.e. finger prick) blood glucose monitoring (fasting and postprandial – see below) over a number of days, particularly if there has been previous intolerance of glucose loading (i.e. vomiting at OGTT), or steroid loading.

HbA1c:

Although HbA1c is an alternative diagnostic test for Diabetes Mellitus, it is not an established test in pregnancy. HbA1c may give some indication only of BGL control if an OGTT is not possible or if pre-existing diabetes is suspected in early pregnancy. Practitioners should be aware that non-diabetic women are only subsidised for one HbA1c screening test performed by laboratory per year

- > The diagnosis of overt Diabetes Mellitus is made with a HbA1c result of ≥ 6.5%
- > If the HbA1c is 5.9-6.5% then further diagnostic evaluation is required by home BGL testing.
- > HbA1c ≤ 5.8% then overt Diabetes Mellitus is unlikely.

NOTE: The HbA1c result is affected by anaemia in which case the cut off will be affected requiring further interpretation

- > For women in rural and remote communities without access to OGTT, a HbA1c can be considered for screening for gestational diabetes

Home blood glucose monitoring:

Women who decline OGTT or HbA1c should be offered diagnosis by self-blood glucose testing supported by a CDE or GP over 1 to 2 weeks (please note this is a resource intensive method of diagnosis and likely to represent a cost to the woman for testing strips and hire or purchase of the meter). Review of blood glucose should be undertaken by an obstetric physician or GP where any values are raised.



Diabetes Mellitus and Gestational Diabetes

Random blood glucose measurement:

A random venous blood glucose measurement is not a sensitive method of screening for GDM, but a non-fasting value ≥ 6.7 mmol/L indicates the need for a 75 gram oral glucose tolerance test (OGTT) or for capillary blood glucose monitoring. A fasting venous blood glucose of 5.1 mmol/L or more is diagnostic of GDM in the latter part of pregnancy, but before 24 weeks gestation indicates the need for a formal 75 gram OGTT.

If this is declined, offer the woman dietary and physical activity advice and notify the obstetric team of the women's choice and associated risks.

Management: Gestational Diabetes Mellitus

Blood glucose monitoring and indications for treatment

Refer to CDE / Dietitian for:

- > Dietary and physical activity advice.
- > Self-blood glucose monitoring and management of gestational diabetes education.

Blood glucose monitoring

- > Four times daily: before breakfast (fasting) and two hours after the start of each meal (e.g. if the woman starts a meal at 1300 hours, the test should be taken at 1500 hours)
- > Aim for tight blood glucose control:

- > Less than or equal to 5.0 mmol/L before breakfast (fasting)
- > Less than or equal to 6.7 mmol/L two hours after a meal

- > The target blood glucose should remain above 4.0 mmol/L, although in the absence of symptoms, values between 3.0 and 4.0 mmol/L are not of concern

NOTE: The treatment targets for blood glucose values in diabetes are controversial and are subject to ongoing review.

- > If blood glucose is in target range as above, testing may be reduced to twice daily at varying times.
- > If values continue to be within target range, testing may be further reduced to once daily at varying times.

Indications for referral to an obstetric physician / endocrinologist:

- > Blood glucose values are not within target range with diet modification and recommended physical activity.
- > Commencement of treatment as indicated (see below).

NOTE: Women requiring treatment for GDM will also require referral to an obstetric medical officer (if not already under their care).

Occasionally, the woman may require admission for further assessment if blood glucose is over 11.0 mmol/L despite monitoring and treatment, or if poor compliance with management advice is an issue.

- > Pregnancy complications or another significant medical disorder.
- > If there are concerns regarding fetal growth, either clinically or from ultrasound assessment (even though blood glucose values are within target range).

Indications for more intensive treatment:

- > Fasting values ≥ 5.1 mmol/L twice or more per week
- > Two hour post prandial values ≥ 6.8 mmol/L twice or more per week when recorded in the absence of dietary non-compliance



Diabetes Mellitus and Gestational Diabetes

Insulin versus metformin

Insulin has been the preferred treatment for gestational diabetes not controlled by diet. High grade evidence supports the safety of metformin in pregnancy¹² and evidence also includes 7 to 9 years of follow up of exposed infants⁸. The NICE guidelines⁴ support the use of Metformin as first line pharmacological management of GDM not controlled by diet. Clinicians may choose metformin treatment, noting that is not recommended in cases of suspected fetal growth restriction.

Insulin treatment

- > Refer to physician / endocrinologist for individualised management or in consultation with a CDE.
- > Usually a combination of rapid acting (aspart [Novorapid[®]], lispro [Humalog[®]]), and intermediate acting insulins (isophane [Protophane[®]]), or a basal bolus regimen with a long acting insulin (glargine (Lantus[®]) or detemir (Levemir[®])) may be used.

Metformin treatment

As above, there is evidence to support the safety of metformin use in pregnancy but its use is not currently endorsed by Australian regulatory authorities or professional bodies. Metformin crosses the placenta and hence there is caution regarding recommendations of its use in pregnancy.

Metformin can be considered for use in women who have not achieved target blood glucose with diet and physical activity changes and who either decline or are unable to take insulin. The woman should be educated about the potential risks, benefits and areas of uncertainty so that an informed decision can be made.

Use of metformin should only be in consultation with a physician / endocrinologist with specialised knowledge of its use in pregnancy.

- > Refer to physician / endocrinologist for individualised management
- > Insulin may be added to metformin treatment where blood glucose targets have not been achieved with metformin

Metformin should not be used or should be withdrawn where there is evidence of progressive fetal growth restriction, as it affects insulin action and therefore may hypothetically impact on insulin's effect as a promotor of fetal growth

Antenatal Visits

The lead maternity carer is dependent on local maternity care options, BGL control and whether treatment is required. For example, women diagnosed with GDM who maintain adequate glycaemic control with diet/exercise alone can remain under the care of a midwife; whereas women requiring treatment with any form of medication will require care from an obstetric medical officer/GP.

Frequency of visits

- > All routine antenatal care should be provided.
- > 2, 4 or 6 weekly (+/- obstetric physician / endocrinologist) dependent on BGL control, pharmacological treatment and fetal growth.
- > Increase frequency if suboptimal BGL control or other clinical concerns.
- > Review at 36 weeks by an obstetric consultant/registrar to confirm plan for birth if there is suboptimal BGL control, pharmacological treatment or fetal growth concerns.

Fetal surveillance

- > There is no need for additional ultrasound assessment in the context of GDM that is well-managed by diet alone.
- > Consider ultrasound for growth / liquor volume between 32 weeks and 36 weeks if there is suboptimal BGL control, pharmacological treatment or fetal growth concerns.



Diabetes Mellitus and Gestational Diabetes

Timing of birth

The goals of early birth are to prevent birth complications, e.g. caesarean section and birth trauma and to minimise adverse pregnancy outcomes.

The decision on elective birth should be made on an individual basis, taking into account a number of clinical factors including:

- > Gestational age
- > Estimated fetal weight and fetal growth patterns (ultrasound and clinical)
- > Degree of glycaemic control
- > The woman's obstetric history (e.g. a history of stillbirth, previous caesarean section or difficult delivery)
- > Parity
- > Cervical status

Discuss with the woman the potential risks and benefits of elective birth.

Consider the woman's preference in the final decision.

Await spontaneous labour if:

- > Blood glucose values remain within target range with lifestyle modification only
- > Normal fetal growth
- > There is no polyhydramnios or other complication of pregnancy (e.g. pre-eclampsia)

Birth should occur before 40⁺¹⁰ weeks of pregnancy

Plan elective birth at 38 to 39 weeks if:

- > Poor glycaemic control at 38⁺⁰ weeks
- > Polyhydramnios or oligohydramnios
- > Macrosomia or growth restriction
- > Increased maternal BMI requiring high doses of insulin
- > Development of hypertension / pre-eclampsia (or earlier as indicated)

If birth is planned before 37+0 weeks:

- > Consider administration of corticosteroids for fetal lung maturity.
- > There is insufficient evidence to dictate the particulars of the administration of antenatal corticosteroids to diabetic pregnant women. Each case should be assessed by the attending obstetrician and a decision made taking into account the type of diabetes, the gestational age, the planned mode of birth and the likelihood of fetal or maternal complications.
- > Admission for additional blood glucose monitoring and intensification of insulin therapy should be at the direction of the physician / endocrinologist.
- > If not in labour, an insulin infusion is not generally required but in labour an infusion may occasionally be considered if high doses of insulin have been required during pregnancy (see [insulin infusion regimen](#) in appendix and refer to local hyperglycaemia management protocols)

Method of birth

Vaginal birth if estimated fetal weight is < 4,500 grams as clinically indicated

- > When discussing the mode of birth with the woman, the medical officer should also take into consideration that current estimations of fetal weight via ultrasonography are associated with a 95% likelihood of a greater than 20% error (above or below) the stated estimated fetal weight.



Diabetes Mellitus and Gestational Diabetes

Intrapartum care

Birth can be planned in a level 3 (or above) hospital or at home providing GDM has remained well-controlled with diet/exercise alone. Women who have required pharmacological treatment for GDM management during pregnancy should have a plan for labour and birth made in consultation with a specialist obstetrician. Labour and birth may need to be managed within a Level 4, 5 or 6 hospital (see *Standards for Maternal and Neonatal Services in South Australia* available www.sahealth.sa.gov.au/perinatal).

If GDM has been well managed with diet alone, blood glucose readings may be taken every 4 hours once labour is established, providing that the initial glucose value is between 4.1-7.9 mmol/L. Once labour is established, at least 2 hourly blood glucose measurements should be taken if the woman is taking insulin or metformin.

More frequent blood glucose monitoring is required if hyperglycaemia is noted ([refer to table 1](#)).

- > If the blood glucose in labour is ≥ 8.0 mmol/L over a two-hour period, and birth is not imminent, an insulin / dextrose infusion should be commenced with blood glucose monitoring increased to 1 hourly as per [table 1](#)

Other care provided as per routine labour management.

Continuous electronic fetal monitoring is indicated if maternal diabetes has required use of medication, either insulin or metformin, or there is suspected fetal macrosomia or growth restriction associated with the maternal diabetes, or other obstetric complication requiring continuous EFM.

EFM should also be commenced if an insulin / dextrose infusion is required in labour ([refer to table 1](#)).

Be aware of the increased risk of shoulder dystocia.

Induction of labour for women requiring treatment in pregnancy

If induction of labour is planned, the last dose of long acting insulin, if being used, should be given the night before. If metformin is being used, this can be continued until labour is established.

Routine blood glucose monitoring should continue until labour is established.

On the morning of induction, if not already in labour, the woman can be given a light breakfast and, if insulin is being used, a dose of rapid acting insulin administered in consultation with the physician / endocrinologist (see [flowchart 4](#)).

If labour is not established by lunch time, a further light meal with metformin and/or rapid acting insulin may be considered, in consultation with the physician / endocrinologist.

Note: If an oxytocin infusion is required as well as insulin / dextrose, 2 intravenous access lines will be required. Oxytocin should be administered with 0.9% sodium chloride to prevent hyponatraemia.

Neonatal management

A neonatologist, neonatal registrar, paediatrician or credentialed GP should be informed of the birth if the woman required treatment with medication either during pregnancy or labour.

The baby should be fed within the first hour after birth. Breastfeeding should be encouraged.

Babies are at risk of hypoglycaemia, requiring close observation, blood glucose monitoring and transfer to the nursery.

The baby's first blood glucose should be obtained by 1 hour of age.

Other morbidities e.g. polycythaemia, jaundice, hypocalcaemia, respiratory distress syndrome (RDS) may occur, further emphasising the need for nursery observation and management.

Postpartum

Send placenta for histopathological examination if the woman has gestational diabetes with other complications.

Glucose testing postpartum

See [flowchart 5](#).

Diabetes Mellitus and Gestational Diabetes

All women with gestational diabetes can resume a normal diet immediately postpartum.

Women with GDM who did not require pharmacological treatment in pregnancy do not necessarily require BGL testing postpartum, but should have a follow up OGTT as below.

Women who did require pharmacological treatment in pregnancy:

Cease metformin and/or insulin following birth and resume a normal diet as tolerated.

A blood glucose profile can be measured on day 2 or 3 (i.e. can be done at home.)

- > If the results show fasting glucose < 6.0 mmol/L and 2 hour postprandial glucose < 9.9 mmol/L, the woman may then be followed up by her General Practitioner for OGTT and advice at 6-8 weeks after birth
- > If any reading is abnormal (fasting glucose \geq 6.0 mmol/L; 2 hour postprandial glucose \geq 10.0 mmol/L), encourage a healthy diet, continue measuring blood glucose profiles and consult with physician / endocrinologist regarding ongoing diabetes management.

Follow-up

Women with GDM are recommended to have a 75 gram Oral Glucose Tolerance test 6 to 8 weeks postpartum, classified by the WHO diagnostic criteria¹³.

The Gestational Diabetes Recall Register, to which women with gestational diabetes will have been recruited when signing up to the NDSS, will facilitate long-term follow-up.

Women should be advised that the MAGDA trial¹⁴ demonstrates the benefits of healthy eating with regular physical activity, bringing weight into the normal range, as the established way of reducing the long-term risk of diabetes.

Exclusive breastfeeding should be encouraged. Low oestrogen levels in breastfeeding women may have a protective effect on glucose metabolism and subsequent reduce their risk of developing diabetes and babies who have been breastfed for at least 2 months lower their risk of diabetes in childhood.

Advise woman about the increased risk of type 2 diabetes (50 % in 20 years) and need for life-long screening for diabetes (every 2 years).

Offspring of women with diabetes, both pre-existing and gestational, are at increased risk of obesity and developing diabetes.

Contraception: A history of gestational diabetes does not preclude the usual methods of contraception, although there are data which suggest that use of progestogen based methods is associated with an increased rate of progression to established diabetes¹⁵. Consult contraceptive guidelines or SHineSA for advice – 1300 794 584

Subsequent pregnancy

Advise woman of high (30 - 70 %) risk of recurrent gestational diabetes in any future pregnancy and need for early glucose screening in subsequent pregnancies.

Pre-conception advice and assessment of glucose tolerance (via OGTT) should be offered before any further pregnancy is undertaken.



References

1. Nielsen GL, Møller M, Sørensen HT. HbA1c in early diabetic pregnancy and pregnancy outcomes: a Danish population-based cohort study of 573 pregnancies in women with type 1 diabetes. *Diabetes Care* 2006;29:2612–2616
2. Crowther CA, Hiller JE, Moss JR, McPhee AJ, Jeffries WS, Robinson JS: Effect of treatment of gestational diabetes mellitus on pregnancy outcomes. *N Engl J Med* 2005; 352:2477-86.
3. Confidential Enquiry into Maternal and Child Health: Pregnancy in Women with Type 1 and Type 2 Diabetes in 2002–03, England, Wales and Northern Ireland. London: CEMACH; 2005.
4. NICE guideline 63 (2015) Diabetes in pregnancy. Management of diabetes and its complications in pregnancy from the pre-conception to the postnatal period. Available from <https://www.nice.org.uk/guidance/ng3>.
5. Feig DS, Donovan LE, Corcoy R, et al. Continuous glucose monitoring in pregnant women with type 1 diabetes (CONCEPTT): a multicentre international randomised controlled trial. *Lancet* 2017;390:2347-59. 10.1016/S0140-6736(17)32400-5
6. Stewart ZA, Wilinska ME, Hartnell S, et al. Closed-loop insulin delivery during pregnancy in women with type 1 diabetes. *N Engl J Med* 2016; 375: 644–54.
7. Briggs GG, Freeman RK. *Drugs in Pregnancy and Lactation*. 10th ed. Philadelphia: Lippincott Williams and Wilkins; 2014.
8. Rowan JA, Rush EC, Plank LD, Lu J, Obolonkin V, Coat S, Hague WM. Metformin in gestational diabetes: the offspring follow-up (MiG TOFU): body composition and metabolic outcomes at 7–9 years of age. *BMJ Open Diabetes Res Care* 2018;6:e000456
9. Sénat M, Affres H, Letourneau A, et al. Effect of Glyburide vs Subcutaneous Insulin on Perinatal Complications Among Women With Gestational Diabetes A Randomized Clinical Trial. *JAMA*. 2018;319(17):1773–1780
10. Hale TW. *Hale's Medications and Mother's Milk* 2019, 2nd Edition, Springer Publishing 2018.
11. The HAPO Study Cooperative Research Group. Hyperglycemia and Adverse Pregnancy Outcomes. *NEJM* 2008;358:199102002.
12. Rowan JA, Rush EC, Obolonkin V, Battin M, Wouldes T, Hague WM. Metformin in Gestation Diabetes. *Diabetes Care* 2011;34:2279-84.
13. Nankervis A, McIntyre HD, Moses R, Ross GP, Callaway L, Porter C et al. Australian Diabetes In Pregnancy Society (ADIPS) Consensus guidelines for the testing and diagnosis of Gestational Diabetes Mellitus in Australia(modified November 2014).. Available from URL:http://www.adips.org/downloads/2014ADIPSGDMGuidelinesV18.11.2014_000.pdf
14. O'Reilly S, Dunbar JA, Versace V, Janus E, Best JD, Carter R, Oats JJN et al. Mothers after Gestational Diabetes in Australia (MAGDA): A randomised controlled trial of a postnatal diabetes prevention program. *PLOS Medicine* published 26 July 2016 <https://doi.org/10.1371/journal.pmed.1002092>
15. Kjos S. Postpartum care of the woman with diabetes. *Clin Obstet Gynecol* 2000 Mar;43:75-86

Useful web sites:

Australian Diabetes in Pregnancy Society

<https://www.adips.org/>

ADIPS: Information for women on Gestational Diabetes (including Insulin Therapy and Metformin booklets in other languages)

<https://www.adips.org/information-for-consumers-accepted.asp>

ADIPS: Australian Aboriginal Women Educational Resources

<https://www.adips.org/resources-australian-aboriginal-women.asp>



Diabetes Mellitus and Gestational Diabetes

Appendix 1: Insulin Infusion Regimen (Part A & Part B)

Part A: Intrapartum insulin infusion regimen

BGL in mmol/L	Infusion rate (units per hour)
< 4.0	0
4.0 - 6.0	0.5
6.1 – 8.0	1
8.1 – 10.0	2
> 10.0	4 AND discuss with physician / endocrinologist

Part B: 5% Dextrose infusion regimen (run concurrently with insulin infusion)

BGL in mmol/L	5% Dextrose Infusion (mL/hour)
≤ 4.0	100
4.1 – 10.0	80
> 10.0	Suspend dextrose infusion

Indications

- > Women with Type 1 diabetes in pregnancy who enter labour, have labour induced or are scheduled for caesarean section
- > Women with Type 2 diabetes or gestational diabetes who are being managed with insulin may not always require an insulin infusion intrapartum. If the blood glucose is ≥ 8.0 mmol/L, the physician should be informed and consideration given to an insulin / dextrose infusion. (This is not necessary if birth is imminent.)
- > An insulin infusion is not generally required for women after corticosteroid loading for fetal lung maturation. However, an infusion may occasionally be considered if high doses of insulin have been required during pregnancy. Also refer to local hyperglycaemia management protocols

Insulin preparation

- > In a 50 mL syringe for an infusion pump draw up 49.5 mL of sodium chloride 0.9 %
- > Add 0.5 mL of short-acting insulin (e.g. Actrapid[®]) (50 units) to make up a total of 50 mL
- > This results in one unit of insulin per mL

Management of infusion

- > Set up an infusion of 5 % dextrose and adjust the [infusion rate](#) based on hourly BGL
- > Insulin [infusion rate](#) to be commenced and adjusted based on hourly BGL
- > Check blood glucose hourly (BGL to be taken on opposite arm of the infusion)
- > Aim for blood glucose levels 4.1 – 7.9 mmol/L
- > Cease the insulin infusion if woman is hypoglycaemic (BGL < 4.0 mmol/L) and treat hypoglycaemia
- > Restart the infusion after a hypoglycaemic event when BGL is > 5.5 mmol/L
- > Cease dextrose infusion if BGL > 10.0 mmol/L and restart when BGL < 8.0 mmol/L
- > Only discontinue IV insulin infusion 4 hours post-administration of subcutaneous basal insulin



Diabetes Mellitus and Gestational Diabetes

Considerations

- > Consider maintenance of insulin pump therapy basal settings in type 1 and type 2 women previously using continuous subcutaneous insulin infusion.
- > Consider maintenance of long-acting insulin at the usual time in type 1 and type 2 women previously prescribed insulin.
- > Variations of the intrapartum insulin infusion regimen may be considered in consultation with the physician/endocrinologist (e.g. in women who are still eating and not requiring a glucose infusion)

Documentation

Adequate documentation of the insulin infusion regimen should include:

- > Dextrose infusion rate
- > Insulin infusion rate (units/hour)
- > All times of insulin infusion commencement and cessation
- > BGL readings
- > Ketones (if performed)

See below for an example chart (excerpt taken from NALHN Actrapid Infusion Protocol)

20..... Day/Month	Time																					
BGL Record (mmol/L)	20																					
	15																					
	10																					
	5																					
	4 3 2																					
BGL reading																						
Insulin infusion rate (Units/hr)																						
Nurse (s) initials																						
Ketones/ Hypo intervention (✓)																						
MO notified (✓)																						



Acknowledgements

The South Australian Perinatal Practice Guidelines gratefully acknowledge the contribution of clinicians and other stakeholders who participated throughout the guideline development process particularly:

Write Group

Dr Bill Jeffries
Professor Bill Hague
Dr Julie Chemmanam
Collette Hooper
Hazel Grigg
Jane Giles
Emma Merkel
Dr Lee Tan

Other Major Contributors

Rebecca Smith

SAPPG Management Group Members

Sonia Angus
Dr Kris Bascomb
Lyn Bastian
Elizabeth Bennett
Dr Feisal Chenia
John Coombas
A/Prof Rosalie Grivell
Dr Sue Kennedy-Andrews
Jackie Kitschke
Catherine Leggett
Dr Anupam Parange
Dr Andrew McPhee
Rebecca Smith
A/Prof John Svigos
Dr Laura Willington



Diabetes Mellitus and Gestational Diabetes

Document Ownership & History

Developed by: SA Maternal, Neonatal & Gynaecology Community of Practice
Contact: HealthCYWHSPerinatalProtocol@sa.gov.au
Endorsed by: SA Health Safety and Quality Strategic Governance Committee
Next review due: 08/04/2024
ISBN number: 978-1-76083-124-0
PDS reference: CG215
Policy history: Is this a new policy (V1)? **N**
Does this policy amend or update an existing policy? **Y**
If so, which version? V4
Does this policy replace another policy with a different title? **Y**
If so, which policy (title)? **Combines 2 guidelines: Diabetes Mellitus and Gestational Diabetes with Insulin Infusion Regimen**

Approval Date	Version	Who approved New/Revised Version	Reason for Change
08/04/2019	V5	SA Health Safety and Quality Strategic Governance Committee	Formally reviewed in line with 3 year scheduled timeline for review
3/06/2015	V4	SA Health Safety and Quality Strategic Governance Committee	Formally reviewed in line with 3 year scheduled timeline for review
4/10/2011	V3	SA Health Maternal & Neonatal Clinical Network	Formally Reviewed
18/10/2007	V2	SA Health Maternal & Neonatal Clinical Network	Formally reviewed
18/12/2006	V1	SA Health Maternal & Neonatal Clinical Network	Original Maternal & Neonatal Network approved version.

