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Health Service Executive

Guidelines for the Management of Pre-gestational and Gestational Diabetes Mellitus from Pre-conception to the Postnatal period

Changing practice to support service delivery

Office of the
Nursing & Midwifery
Services Director

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Foreword

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The impact of diabetes in pregnancy for both mother and baby can be far reaching, thus it is essential that every effort is made to achieve optimum obstetric outcomes and prevent long term disease.

The development of HSE national guidelines for the management of pre-gestational and gestational diabetes mellitus from pre-conception to the postnatal period is designed to support standardisation of care and encourage best clinical practice.

As part of the HSE efforts to improve healthcare, it is hoped that these national guidelines will assist all clinicians in the decision making process and help to standardise the management of diabetes and pregnancy at primary, secondary and tertiary levels.

These guidelines are based upon up to date scientific evidence and expert consensus and will provide support for consistency of treatment and improved pregnancy outcomes. The availability of national guidelines will also provide guidance to policy makers.

Healthcare is an ever changing science and advances and new developments in diabetes and pregnancy care will continue to take place. Revision of these guidelines will be necessary as new knowledge is gained.

The Health Service Executive wish to express their sincere gratitude to the Steering Group and the Guideline Development Team, as most of this work was performed on an honorary basis and in addition to their usual work commitments. The Health Service Executive also wish to thank the National Council for the Professional Development of Nursing & Midwifery for providing funding towards the development of the guidelines.

These guidelines constitute a general guide to be followed, subject to the medical practitioner's judgement in each individual case.

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Executive Summary

Diabetes mellitus is a significant health problem in Ireland. The number of people affected by diabetes in Ireland is increasing. It is estimated that at least 141,000 adults in the Republic of Ireland (4.7%) have diabetes (diagnosed or undiagnosed) and this is expected to rise to 194,000 or 5.6 % of the population by 2015 – a 37% increase[1]. The increasing incidence of diabetes will have significant economic consequences. It is estimated that in excess of 10% of healthcare spending in Ireland is diabetes related and the costs of caring for the growing number of people with diabetes will increase by up to 25% by 2040[1].

Pre-Gestational Diabetes Mellitus (Type 1 and Type 2)

The incidence of pre-gestational (Type 1 and Type 2) diabetes and pregnancy is increasing. The incidence of type 2 diabetes mellitus is increasing in younger people, including women of child bearing years. Women with type 2 diabetes mellitus are more likely to have additional risk factors for adverse pregnancy outcomes, such as obesity, increased parity and age and are more likely to present late in pregnancy[2]. Offspring of diabetic pregnancies may have an increased risk of diabetes in later life, thus optimal management and care of diabetes pre-conceptually and during pregnancy has far reaching implications for the mother, baby and society. It is therefore crucial that women with pre-gestational diabetes are informed as to the importance of pregnancy planning to ensure optimal blood glucose control and diabetes management at conception and throughout pregnancy. Optimal management of diabetes mellitus at conception and throughout pregnancy has been shown to avoid major maternal and fetal complications[3].

Maternal morbidities associated with pre-gestational diabetes mellitus in pregnancy include pregnancy induced hypertension, pre-eclampsia, obstructed labour and shoulder dystocia. Pre-existing complications of diabetes such as diabetic retinopathy and diabetic nephropathy can worsen in pregnancy[4].

Fetal morbidity and mortality is increased in babies born to women with pre-existing diabetes due to increased risk of birth injury and stillbirth. Macrosomia (increased birth weight) is increased 6-10 fold compared to the non-diabetes population[5].

Gestational Diabetes Mellitus

Gestational diabetes may be defined as any form of diabetes or glucose intolerance with onset or first recognition during pregnancy[6]. Gestational diabetes is associated with fetal macrosomia, thereby increasing the risk of birth injury to mother and fetus. Clinical risk factors attributable to gestational diabetes include: overweight/obesity, increased age, family history of diabetes and ethnicity. In terms of number of cases seen, gestational diabetes mellitus is more common than pre-gestational diabetes mellitus.

While there is universal agreement that pre-gestational diabetes increases the risk of adverse pregnancy outcomes; the level of glucose intolerance associated with a significantly increased risk of adverse outcomes has yet to be established[7]. Recently a number of large international clinical trials have demonstrated that diagnosis and intensive management of gestational diabetes are associated with decreased maternal and fetal morbidity and mortality.

Screening for gestational diabetes remains controversial. To date, the American Diabetes Association[8], the International Diabetes Federation[9] and the National Institute for Health and Clinical Excellence[10] recommend selective screening for gestational diabetes. These guidelines currently advocate selective screening for gestational diabetes mellitus.

Women with diabetes in pregnancy should be cared for by a multidisciplinary team consisting of a consultant endocrinologist or a physician with an interest and experience in diabetes and pregnancy, a consultant obstetrician with experience in the management of diabetes in pregnancy, a dietician and a diabetes midwife/nurse specialist[8, 10, 11].

Women with gestational diabetes mellitus are at high risk of developing type 2 diabetes mellitus later in life[12]. This risk may reach 50% in the decade following pregnancy. Therefore, follow up of women with a history of gestational diabetes mellitus provides an opportunity for screening and possibly preventing type 2 diabetes mellitus and its long-term complications[13].

Key Contents of Guidelines

Protocols for the management of type 1 diabetes (Section 3) and type 2 diabetes (Section 4) in pregnancy in the critical areas of preconception, antenatal and postnatal care are provided in the guidelines below. Similar management protocols for the management of gestational diabetes are provided at the start Section 5.

Key recommendations for care are highlighted in text boxes throughout the guidelines. These recommendations form the basis of an audit tool provided in Appendix 4.

A table formatted guide providing guidance of care per trimester is provided in both the management of type 1 diabetes (Section 3) and type 2 diabetes (Section 4) in pregnancy.

Desk top guides for the management of pre-existing diabetes in pregnancy and the management of gestational diabetes are provided in Appendix 3.

A glossary of terms and definitions can be found in Appendix 1.

Acknowledgments

The Guideline Development Team would like to acknowledge the work of the National Collaborating Centre for Women's and Children's' Health (UK), who compiled evidence tables under commission from the National Institute for Health and Clinical Excellence (NICE), which were used in part, in the production of these guidelines.

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SECTION ONE

Background

1.1 Policy Statement

These guidelines were developed to support the Health Service Executive's (HSE) commitment to delivering better services for the individual through the provision of evidence based practice[14].

The development of HSE evidence based guidelines for the management of type 1 and type 2 diabetes mellitus and gestational diabetes mellitus from pre-conception to the post-natal period are designed to encourage best clinical practice, improve clinical decision making and standardise care at primary, secondary and tertiary service levels.

The clinical guidelines were developed by a Guideline Development Group. They have been approved; following review and critical evaluation, by a Steering Group consisting of a diverse range of clinical healthcare professionals (see Section 1.6).

These evidence based clinical guidelines aim to support all healthcare professionals in the management of women with diabetes mellitus and their families and to advocate women centred care.

1.2 Purpose of Guidelines

When compared to the background population, women with pre-existing diabetes have an increased risk of miscarriage, fetal anomalies and pre-term labour[15]. Stillbirth, birth injury, perinatal morbidity and mortality are all more common to babies born to women with pre-existing diabetes.

Pre-gestational diabetes is associated with an increased risk of maternal morbidities such as pregnancy induced hypertension, pre-eclampsia, obstructed labour and shoulder dystocia. Subsequently to avoid these complications the rates of induction of labour and caesarean section are increased[16]. Women with type 2 diabetes are more likely to present late in pregnancy and have additional risk factors for adverse outcomes, such as obesity, increased parity and age[2].

It is suggested that the increased prevalence of gestational diabetes mellitus (GDM) may be credited to the pregnancy population becoming older and more obese[17]. Obesity in the young woman is of further concern and equally attributable to the escalating rates of GDM[6].

GDM may be the initial warning signs of intrinsic insulin resistance and beta cell dysfunction[12]; therefore it provides an opportunity for screening, and possible prevention of diabetes and its long-term complications[13]. Furthermore the diagnosis and intensive management of GDM are associated with decreased maternal and fetal morbidity and mortality[18, 19].

A hyperglycaemic intra-uterine environment is associated with an increased risk of obesity and abnormal glucose metabolism during childhood and adult life in the off-spring[7]. Thus, the correct management and care of the woman with diabetes pre-conceptually and during pregnancy have far reaching implications for the mother and baby and society as a whole.

Women who achieve tight glycaemic control prior to and during pregnancy have a perinatal mortality risk close to that of women without diabetes; however the risks of maternal and fetal morbidity in women with diabetes still remains higher than in non-diabetic pregnancies[20].

Specialised evidence-based management is vital for all women with diabetes in pregnancy so that an optimum maternal and perinatal outcome may be achieved.

1.3 Scope of Guidelines

These guidelines are applicable to all healthcare professionals in primary, secondary and tertiary healthcare services, involved in the care of all women of child-bearing years with diabetes and gestational diabetes.

The guidelines outline the management of women with pre-existing diabetes and gestational diabetes from pre-conception to the post-natal period. The management of diabetes complications during the pre-conception and antenatal period will be outlined.

The term 'women' incorporates all females of childbearing age, including young women who are cared for within the paediatric services[10].

1.4 Statement of Intent

These guidelines constitute a general guide to be followed, subject to the medical practitioner's judgement, in each individual woman's case.

1.5 Project Team

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1.6 Layout of Document

This document has been divided in to six sections, with each section colour coded.

Section One describes the administrative and corporate issues related to the guidelines' development and their intended use.

Section Two outlines the search strategies used by the Guideline Development Team and the levels of evidence associated with guideline statements.

Section Three presents the Guidelines for Type 1 diabetes mellitus from pre-conception to the post-natal period. This section is divided into: Pre-conception Care, Ante-natal Care and Post-natal Care.

Section Four presents the Guidelines for Type 2 diabetes mellitus from pre-conception to the post-natal period. This section is divided into: Pre-conception Care, Ante-natal Care and Post-natal Care.

Section Five presents the Guidelines for gestational diabetes mellitus from pre-conception to the post-natal period. This section is divided into: Screening and diagnosis of gestational diabetes, Diabetes management of gestational diabetes, Obstetric management of gestational diabetes and Post-natal Care.

Section Six contains references and appendices relevant to the document, including a glossary of terms and a list of abbreviations used within the document.

SECTION TWO

Methodology

2.1 Guideline Development Process

The need to standardise national evidence based management guidelines for the prevention, detection and treatment of women with pre-existing diabetes mellitus in pregnancy and gestational diabetes mellitus, was guided by a number of factors. These included the rapid increase in the incidence of diabetes mellitus both nationally and globally and requirements identified by the HSE regarding the management and treatment of women with diabetes in pregnancy in generic health services.

A Guideline Development Group was formed by the NMPDU to develop evidence based guidelines for the management of diabetes in pregnancy in Ireland. This group included representatives from professional bodies, representatives of National Hospitals Office, Primary Community and Continuing Care (PCCC), voluntary hospitals and private healthcare providers (see Section 1.5).

A Steering Group, consisting of a diverse range of health professionals was set up to lend their knowledge and expertise to ensure the validity and legitimacy of the guidelines produced. The composition of the Steering Group ensured that opinions from representatives from all stakeholder organisations could be heard (see Section 1.5).

It was agreed by both groups that the guidelines would be multi-disciplinary in nature, and applicable to all healthcare professionals involved in the management of women with pre-existing diabetes mellitus in pregnancy and gestational diabetes mellitus.

Furthermore, it was agreed that these guidelines would be derived guidelines; thereby allowing the Guideline Development Group to draw from other national and international guidelines.

The production of the guidelines involved numerous drafts, endorsement by the Steering Group and endorsement by national and international professional groups and organisations.

2.2 Search Strategy

Following a literature search to guide the process of guideline development, the framework as set out by The Scottish Intercollegiate Guidelines Network (SIGN) (www.sign.ac.uk) was deemed the most appropriate to meet the purpose of these guidelines.

SIGN[21] recommends identifying the need for guidelines and then conducting an extensive search of relevant databases for any pre-existing guidelines; therefore all guidelines related to diabetes and pregnancy published in the years 2001-2008 were identified.

The search was restricted to the English language and to guidelines which were compiled by multidisciplinary groups which were independent of any 'for-profit' organisations. Local, national and international guidelines, together with the Cochrane database of systematic reviews, PubMed, National Guidelines Clearing House, NICE, SIGN, CREST, MEDLINE, EMBASE and CINAHL were searched[22].

When national and international guidelines were sourced that met the search criteria, they were appraised by the Guideline Development Group using the Appraisal of Guidelines for Research and Evaluation tool (AGREE) (www.agreecollaboration.org). This tool assesses both the quality of the reporting and the quality of some aspects of recommendations. It provides an assessment of the likelihood that the guidelines will achieve their intended outcome[23].

Once guidelines were identified and appraised, and deemed appropriate for use in the Irish context, they informed the development of these derived guidelines. Permission was sought and granted from NICE (www.nice.org) and SIGN (www.sign.ac.uk) to use data from a number of their graded research evidence tables in these guidelines.

2.3 Levels of Evidence and Grades of Recommendation

- The grading systems[21] detailing the strength of evidence and levels of recommendation as used by the Guideline Development Group are presented in Tables 1 and 2 below.
- When gaps were identified in the literature, when evidence was conflicting or when following rigorous debate within the Guideline Development Group opinions remained incompatible, the clinical wisdom and consensus of the Steering Group was sought.

Table 1: SIGN (2008) Levels of Evidence

Evidence level and Quality Rating	Description
1++	High quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias
1+	Well-conducted meta-analyses, systematic reviews, or RCTs with a low risk of bias
1-	Meta-analyses, systematic reviews, or RCTs with a high risk of bias
2++	High quality systematic reviews of case control or cohort or studies High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal
2+	Well-conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal
2-	Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal
3	Non-analytic studies, e.g. case reports, case series
4	Expert opinion

Source: Scottish Intercollegiate Guidelines Network SIGN 50 A Guideline Developers Handbook 2008 Edinburgh: Scottish Intercollegiate Guidelines Network

Table 2: SIGN (2008) Grades of Recommendations

Grade of Recommendation	Level of Evidence
A	At least one meta-analysis, systematic review, or RCT rated as 1++, and directly applicable to the target population; ***or*** A body of evidence consisting principally of studies rated as 1+, directly applicable to the target population, and demonstrating overall consistency of results
B	A body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 1++ or 1+
C	A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results; ***or*** Extrapolated evidence from studies rated as 2++
D	Evidence level 3 or 4; ***or*** Extrapolated evidence from studies rated as 2+
Good practice point (√)	Recommended best practice based on the clinical experience of the Guideline Development Group

Source: Scottish Intercollegiate Guidelines Network SIGN 50 A Guideline Developers Handbook 2008 Edinburgh: Scottish Intercollegiate Guidelines Network

The Guideline Development Group used the SIGN grading system throughout the document. In some places evidence is used from the American Diabetes Association (ADA). When this occurs please note that ADA grades of recommendation are used.

Table 3: ADA evidence grading system for clinical practice recommendations

Level of Evidence	Description
A	Clear evidence from well-conducted, generalizable, randomized controlled trials that are adequately powered, including: ● Evidence from a well-conducted multicenter trial ● Evidence from a meta-analysis that incorporated quality ratings in the analysis Compelling nonexperimental evidence, i.e., "all or none" rule developed by the Centre for Evidence-Based Medicine at Oxford Supportive evidence from well-conducted randomized controlled trials that are adequately powered, including: ● Evidence from a well-conducted trial at one or more institutions ● Evidence from a meta-analysis that incorporated quality ratings in the analysis
B	Supportive evidence from well-conducted cohort studies, including: ● Evidence from a well-conducted prospective cohort study or registry ● Evidence from a well-conducted meta-analysis of cohort studies Supportive evidence from a well-conducted case-control study
C	Supportive evidence from poorly controlled or uncontrolled studies ● Evidence from randomized clinical trials with one or more major or three or more minor methodological flaws that could invalidate the results ● Evidence from observational studies with high potential for bias (such as case series with comparison to historical controls) ● Evidence from case series or case reports Conflicting evidence with the weight of evidence supporting the recommendation
E	Expert consensus or clinical experience

Source: American Diabetes Association 'Standards of Medical Care in Diabetes - 2009 Diabetes Care, Volume 32, Supplement 1, January 2009

SECTION 3

Guidelines for the Management of Type 1 Diabetes Mellitus from the Pre-conception to the Postnatal period

3.1 Pre-conception Care

3.1.1 Key messages

- The possibility of pregnancy should be identified, by direct questioning, at each diabetes consultation, in all women of child-bearing age with diabetes (C)[24].
- Women with diabetes who wish to conceive should be informed of the need to establish tight glycaemic control prior to conception (E)[24].
- All women planning pregnancy should be screened for complications of diabetes (E)[24].
- Medications with known teratogenic effects should be substituted with appropriate medication prior to conception (E)[24].
- High dose folic acid (5mgs) should be prescribed as part of pre-pregnancy care[11].
- Women with diabetes who are planning to become pregnant should be offered individualised dietary advice by a dietitian (B)[24].
- Assessment of self care ability should be undertaken and any shortcomings addressed (√).

The possibility of pregnancy should be identified, by direct questioning, at each consultation, in all women of child-bearing age with diabetes

3.1.2 Contraception

- The choice of contraceptive method is generally the same as that in the general population. In the presence of vascular complications of diabetes or other contraindications, the combined oestrogen-progestogen pill should be avoided and other methods discussed[11].
- Contraception should be continued until optimal glycaemic control is achieved (E)[24].

3.1.3 Education in the pre-conception period

For all women with diabetes, information on the following should be offered in the pre-conception period:

- Achieving and maintaining a healthy body weight.
- Diet and physical activity and the importance of an appropriate healthy eating meal plan[25].
- The need for assessment and treatment of any complications of diabetes prior to conception and during pregnancy[25].
- The increased risk of congenital defects, neonatal morbidity and perinatal mortality associated with diabetes and pregnancy[26, 25].
- The risk of possible transient exacerbation of pre-existing retinopathy (B)[24] or nephropathy.
- The risk of hypoglycaemia and of hypoglycaemia unawareness in pregnancy (√).

- Hypoglycaemia poses a risk to maternal safety and well-being[27]. These risks should be explained and education provided regarding the prevention and treatment of hypoglycaemia in the pre-pregnancy period (E)[24].

Women with pre-existing diabetes who are contemplating pregnancy, should be offered advice on the possible teratogenic effect of diabetes on pregnancy

3.1.4 Blood glucose targets in the pre-conception period

- Expected glycaemic targets should be discussed with the woman and realistic individualised goals should be agreed[10].
- The following capillary glucose targets are recommended in the pre-conception period:
  Fasting 3.5 – 5.0mmols/L
  1 hr post prandial < 7.0mmols/L (√).
- HbA_{1c} levels should be as low as possible, without excessive hypoglycaemia, before conception is attempted (B)[24].
- Frequent assessment by the healthcare team is required as hypoglycaemia can occur and should be avoided.
- HbA_{1c} levels should be measured monthly during the pre-conception period[10].
- Woman with an HbA1c level above the target level should be strongly advised to avoid conception (√).

Women with diabetes should be educated on the need for tight glycaemic control prior to conception

3.1.5 Blood glucose and ketone testing in the pre-conception period

- Frequency of self monitored blood glucose (SMBG) should include fasting, pre and post-prandial and bedtime recordings (A)[12], (E)[24].
- Women with type 1 diabetes should be encouraged to monitor blood glucose at bedtime as nocturnal hypoglycaemia may occur when trying to achieve tight glycaemic control (E)[24].
- Advice should be offered regarding blood or urinary ketone testing during periods of illness or hyperglycaemia[10, 24].
- Management of hypoglycaemia should be comprehensively discussed. The woman and her family must be advised of the role of glucagon and should be given clear instructions on its administration (E)[24].

3.1.6 Safety of diabetes medications in the pre-conception period

- Medications with known teratogenic effects should be substituted with medication appropriate to pregnancy prior to conception (E)[24].

3.1.7 Health promotion in the pre-conception period

- Women attending pre-pregnancy care must be encouraged to stop smoking and to avoid alcohol consumption.
- Body mass index (BMI) should be assessed and if necessary, weight loss encouraged prior to conception, as obesity is a proven independent risk factor for fetal anomalies and adverse pregnancy outcomes (B)[28].
- Appropriate physical activity should be advocated[24].
- High dose folic acid supplementation (5mg daily) is advised for at least three months before conception, to be continued until 12 weeks gestational age[11].

3.1.8 Dietary advice in the pre-conception period

- Dietary advice should be sensitive to the personal needs, willingness to change, and ability to make changes of the individual with diabetes (E)[24].
- Monitoring carbohydrate intake remains the key strategy in achieving glycaemic control (A)[24].
- A diet that includes carbohydrates from fruit, vegetables, whole grain, legumes* and low fat milk is encouraged for good health (B)[24].
- Dietary advice should be culturally appropriate (E)[24].

3.1.9 Physical activity in the pre-conception period

- Physical activity has beneficial effects on insulin resistance, thus regular physical activity is regarded as potentially advantageous to the majority of people with diabetes (E)[24].
- For women on insulin therapy, the management of hypoglycaemic events resulting from physical activity should be discussed (E)[24].

3.1.10 Diabetes complications: review and management in the pre-conception period

- A complete medical and obstetric history should be obtained at the preconception consultation[25].
- Pre-existing complications of diabetes need to be evaluated as complications may accelerate and may alter the outcome of pregnancy (A)[25].
- In the presence of advanced complications of diabetes, specialist advice should be sought from an endocrinologist specialising in diabetes in pregnancy, to evaluate the individualised risk of pregnancy in that patient (√).

3.1.10.1 Retinal assessment in the pre-conception period

- Retinal assessment by an ophthalmologist should be conducted prior to pregnancy[11].
- The risk of advancement of retinopathy during pregnancy should be discussed (B)[24].
- The risk of advancement of diabetic retinopathy can be reduced through gradual improvement of metabolic control[25].

**legumes: Well-known legumes include alfalfa, clover, peas, beans, lentils, mesquite, carob and soy.*

3.1.10.2 Renal assessment in the pre-conception period

- Women with a diagnosis of established nephropathy should be referred to and managed by a nephrologist[10].
- A baseline assessment of renal function through measurement of serum creatinine should be carried out prior to conception (E)[24].
- In the presence of overt diabetic nephropathy there is an increased risk of permanent deterioration in maternal renal function and poor obstetric outcomes[29, 30].
- Women with less severe nephropathy may have a transient deterioration of renal function during pregnancy (A)[25].
- When diabetic nephropathy occurs outcomes are worst in patients who are hypertensive at the onset of pregnancy[31].

3.1.10.3 Assessment of autonomic neuropathy in the pre-conception period

- Gastroparesis, urinary retention, hypoglycaemia unawareness or orthostatic hypotension may seriously complicate the management of diabetes in pregnancy[32]. If present, these conditions should be treated prior to conception.

3.1.10.4 Cardiovascular assessment in the pre-conception period

- Regular blood pressure monitoring should form part of the on-going assessment in the pre-conception period (C)[24].
- Blood pressure should be measured at the initial physical examination and anti-hypertensive medications appropriate to pregnancy prescribed as required (A)[24].
- Hypertensive women with diabetes who are contemplating pregnancy or who are at risk of becoming pregnant should be prescribed anti-hypertensive medications appropriate to pregnancy. Specifically, ACE inhibitors should be avoided, where possible, in this group (A)[24].
- Pre-existing or suspected coronary artery disease (CAD) warrants cardiology review before conception[25].
- Untreated CAD is associated with a high maternal mortality rate during pregnancy[25].

3.1.10.5 Thyroid assessment in the pre-conception period

- Thyroid function should be measured at initial physical assessment as both hypothyroidism and hyperthyroidism can adversely affect pregnancy outcomes if left untreated (B)[24].
- Repeat thyroid function tests should be carried out in the pre-conception period as necessary (√).

3.2 Antenatal Care

3.2.1 Key messages

- Pregnancy should be confirmed as early as possible and ideally, care commenced with a multi-disciplinary team that includes a consultant endocrinologist or a physician experienced in diabetes care in pregnancy, consultant obstetrician, diabetes nurse/midwife specialist and senior dietitian in a dedicated combined Obstetric-Endocrine clinic (A)[25].
- If not already commenced, folic acid 5mg daily should be initiated and any teratogenic medication discontinued, where the specialist team, in consultation with the woman, deems it appropriate to do so (√).
- Frequency of visits to vary according to the stage of pregnancy and glycaemic control[9], but usually occur every 2-3 weeks (√).
- Blood pressure, body weight and urinalysis should be measured at each visit as the risk of hypertensive disorders increases when pregnancy is complicated by diabetes[33].
- Severe, unexplained or frequent episodes of hypoglycaemia can occur as a result of many factors which include; defective counter-regulation, hypoglycaemia unawareness, as well as administration errors in insulin dose, dietary intake or physical activity expenditure[34, 35].
- As pregnancy progresses, women should be advised to monitor fetal movement and report any concerns immediately to the healthcare team (C)[36].
- Delivery should take place in a hospital with full obstetric, anaesthetic and neonatal intensive care facilities and with an experienced paediatrician available for delivery (C)[37].

Women with diabetes in pregnancy should be offered care by a specialised diabetes-obstetric multi-disciplinary team

3.2.2 Diabetes Management during Pregnancy

3.2.2.1 Blood glucose targets during pregnancy

- The following capillary glucose levels are recommended for pregnancy:
- Pre-prandial and pre-bed: 3.5-5.0mmol/L
- 1 hour post prandial: <7.0mmol/L[38, 39].
- HbA_{1c} levels should be as low as possible during pregnancy, without excessive hypoglycaemia (B)[24].

Target capillary blood glucose levels and HbA_{1c} targets should be explained
Pre prandial and pre-bed <5.0mmol/L 1hour post prandial <7.0mmol/L
HbA_{1c} as near to normal as possible

3.2.2.2 Blood glucose and ketone testing during pregnancy

- SMBG should be performed 7 times a day – pre-meals plus one hour post all meals plus once before bed (A)[12] (E)[10, 24].
- SMBG readings should be frequently reviewed by the endocrinologist and insulin dose adjusted as required (√).

- HbA_{1c} together with SMBG levels should be used to determine glycaemic control; however caution must be employed when haemoglobin variants exist (A)[24].
  - HbA_{1c} should be measured frequently during pregnancy (A)[40].
  - Measurement of fructosamine (corrected for albumin) may be employed when HbA_{1c} is altered (A)[41].
  - Ketone test strips should be prescribed and explained for use in the event of illness, hyperemesis or hyperglycaemia[10, 24].

3.2.2.3 Hypoglycaemia during pregnancy

- Women should be educated about the increased risk of hypoglycaemia and hypoglycaemia unawareness in pregnancy, especially in the first trimester[10].
- The management of hypoglycaemia should be individualised and discussed with the woman and her partner[11].
- Patterns of hypoglycaemia should be examined and preventative measures explained[42].
- Women who experience hypoglycaemia unawareness or altered hypoglycaemia awareness require specific advice, particularly in relation to driving and operating machinery (√).
- Women with diabetes should be encouraged to carry identification and rapid acting glucose with them at all times (E)[24].

The risk of hypoglycaemia and hypoglycaemic unawareness in pregnancy should be explained to all women on insulin treatment

3.2.2.4 Poor glycaemic control during pregnancy

- In the event of sub-optimal glycaemic control, precipitating factors such as diet, intercurrent illness, stress and lifestyle must be examined. Insulin therapy, diet and lifestyle will need to be adjusted[32].
- In some cases, hospitalisation may be the only way to achieve optimal glycaemic control may achieve control[32].

3.2.2.5 Insulin requirements and regimens during pregnancy

- Insulin requirements may alter rapidly in pregnancy and regimens and doses vary with the type of diabetes and with individual requirements[4].
- As pregnancy progresses, insulin requirements increase in the second trimester, while most women experience a reduction in insulin requirements in the latter part of the third trimester[32].
- Optimum glycaemic control needs to be balanced against the risk of hypoglycaemia[24].
- The flexibility of a basal bolus regime allows for easier adjustment of insulin doses and has been proven to improve glycaemic control and pregnancy outcomes (A)[43].
- If food intake is altered through excess hunger or nausea, insulin requirements will increase or decrease accordingly[33].
- CSII (continuous subcutaneous insulin infusion) pump may be offered to women with difficulties achieving optimum glycaemic control or who are at increased risk of hypoglycaemia in pregnancy[44].

3.2.2.6 Diabetes medications during pregnancy

- If not already discontinued prior to pregnancy, medications with known teratogenic effects should be substituted with medication appropriate for the antenatal period where the specialist team, in consultation with the patient, deems it appropriate to do so (√).

3.2.2.7 Health promotion during pregnancy

- Women should be encouraged, supported and provided with appropriate information from the multidisciplinary team to make positive lifestyle changes e.g. cessation of smoking and alcohol consumption (√).

3.2.2.8 Dietary advice during pregnancy

- Women with type 1 diabetes should be offered individualised dietary advice from a dietitian, familiar with components of diabetes in pregnancy, regularly throughout the antenatal period (E)[24].
- Advice should be appropriate to glycaemic control and gestational age (√).
- A diet that includes carbohydrates from fruit, vegetables, whole grain, legumes and low fat milk is encouraged for good health (B)[24].
- Dietary advice should be culturally appropriate (E)[24].

3.2.2.9 Physical activity during pregnancy

- Physical activity has beneficial effects on insulin resistance, thus regular physical activity is regarded as potentially advantageous to the majority of people with diabetes (E)[24].
- For women on insulin therapy, education should be offered on the management and prevention of hypoglycaemic events resulting from physical activity (E)[24].
- Levels of recommended physical activity should be discussed with the obstetrician and endocrinologist (√).
- Any new physical activity regime should be discussed with the obstetrician and reviewed according to gestational age (√).

3.2.3 Diabetes complications: assessment and management during pregnancy

Ideally, diabetes complications will have been identified and treated prior to pregnancy however assessment should continue throughout the antenatal period.

3.2.3.1 Retinal assessment during pregnancy

- All women with type 1 diabetes should undergo a retinal assessment by an ophthalmologist in the first trimester with close follow-up, as clinically required, throughout pregnancy and for 1 year postpartum (B)[24].
- Progression of retinopathy may warrant laser therapy (A)[24].
- Diabetic retinopathy should not delay rapid optimisation of glycaemic control in the pregnant woman[10].
- Diabetic retinopathy should not be considered a contraindication to vaginal delivery[10].

3.2.3.2 Renal assessment during pregnancy

- Evaluation of renal function should take place at the first antenatal visit (E)[24].
- All stages of nephropathy*, including microalbuminuria, are associated with adverse pregnancy outcomes, especially IUGR, pre-eclampsia and pre-term delivery[10].
- Referral for specialist care to a physician experienced in the management of diabetic renal disease should be considered when proteinuric hypertension is evident before 20 weeks' gestational age.

3.2.3.3 Cardiovascular assessment during pregnancy

- Blood pressure should be monitored at each antenatal visit (C)[24].
- Women with pre-gestational hypertension should be monitored closely for pre-eclampsia (A)[24].

3.2.3.4 Assessment of autonomic neuropathy during pregnancy

- Bladder atony during pregnancy may lead to persistent UTI's and close monitoring of possible infection is essential[33].
- Nausea and vomiting in pregnancy secondary to autonomic neuropathy can result in severe weight loss, dehydration and erratic metabolic control[24].
- Uterine atony may lead to an inability of the uterus to contract in labour, thus necessitating delivery by caesarean section. Uterine atony is also the leading cause of postpartum haemorrhage (√).
- Autonomic neuropathy may also lead to an inability to detect fetal movements' (√).

3.2.3.5 Diabetic ketoacidosis

- Women should be educated about diabetic ketoacidosis (DKA) and its prevention through SMBG, appropriate diet, suitable insulin therapy and sick day management (A)[24].
- Equipment and information should be provided for self monitoring of ketones in the event of illness or hyperglycaemia[10].
- Women who present with nausea, vomiting, abdominal pain and hyperglycaemia should be investigated for DKA[10].
- Management of DKA includes correction of dehydration, insulin deficit and electrolyte imbalance, continuous fetal monitoring where a viable gestational age has been reached, and determination of the underlying cause (A)[24].
- Women admitted with DKA should be managed in a high dependency area of care (E)[10, 24].
- Immediate delivery may not be necessary as fetal heart rate abnormalities may resolve with the correction of the metabolic state[24].

Women admitted with DKA should be managed in a high dependency area of care

** Clinical (overt) diabetic nephropathy (DN) is presumed if there is persistent microalbuminuria or proteinuria (dipstick positive) before 20 weeks in a woman with pre gestational diabetes; in the absence of other causes[24].*

3.2.3.6 Thyroid assessment during pregnancy

- All women with type I diabetes should be screened for thyroid dysfunction with thyroid stimulating hormone (TSH) levels and thyroid peroxidase antibodies during the first trimester of pregnancy (B)[24].
- Hyperthyroidism should be treated with propylthiouracil in pregnancy. The woman's T4 level should be maintained at or just above the normal range to prevent fetal hypothyroidism (B)[24].
- Hypothyroidism during pregnancy has been shown to increase the risk of pregnancy loss, placental abruption[24], preterm labour and long-term neurodevelopmental delay in the offspring of hypothyroid women.
- For hypothyroidism diagnosed prior to pregnancy, the preconception thyroxine dose should be adjusted to reach a TSH level not higher than 2.5μU/ml. The thyroxine dose usually needs to be increased by 4-6 weeks' gestation and may require a 30-50% increase in dosage[45].
- Elevated TSH (>2.5μU/ml in the first half of pregnancy; >3.0μU/ml during the second half) should be treated during pregnancy to maintain euthyroidism (TSH <2.5μU/ml first half; <3.0μU/ml second half)[45].
- The paediatrician should be alerted to the newborn of a mother with elevated TSH-receptor antibodies (TRAb) (E)[24].

3.2.4 Obstetric management

- A consultant obstetrician or physician with experience in the management of diabetes in pregnancy should care for women with pre-existing diabetes, as part of the multidisciplinary team (√).

3.2.4.1 Fetal Surveillance

- Ultrasound examination should be performed in early pregnancy to confirm gestational age and fetal viability (E)[24].
- An ultrasound scan to screen for fetal anomalies should be performed at 18-20 weeks gestation (A)[12].
- Third trimester ultrasound assessment should include fetal growth, assessment of liquor volume and fetal movements. Estimation of fetal growth should be performed at least twice to assess fetal growth velocity (√).
- Timing of ultrasound assessment will depend on clinical factors but is usually performed from 30 weeks gestation. Clinicians should be aware that the accuracy of fetal weight estimation is ± 20% in term babies and that accuracy decreases with increasing birth weight[46].
- No fetal surveillance protocol has been shown to reduce the risk of perinatal mortality in diabetic pregnancies. Where biophysical testing is undertaken, the frequency of such testing should be determined according to the fetal growth pattern, amniotic fluid volume and presence of additional pregnancy complications (√).
- Biophysical profile testing and doppler velocity to assess umbilical blood flow and middle cerebral artery blood flow may be considered in cases of excessive or poor growth or when there are co-morbid conditions, such as pre-eclampsia (E)[24].
- In the event of identified macrosomia a clear management plan should be put in place by a consultant obstetrician. This plan should address timing of follow-up scans, fetal surveillance and timing and mode of delivery (C)[37].

- Sonographic estimation of fetal weight should be combined with the clinical judgment of an obstetrician experienced in the management of pregnancies complicated with diabetes when evaluating the most appropriate mode of delivery for the patient (√).
- As pregnancy progresses, women should be advised to monitor fetal movement and report any concerns immediately to the healthcare team (C)[36].

Women with pre-existing diabetes should be offered ultrasound screening for fetal anomalies at 18-20 weeks gestation

3.2.4.2 Management of obstetric complications

3.2.4.2.1 Pre-eclampsia

- Pre-eclampsia is approximately four times more common in pregnancies complicated by diabetes than in the background population[33].
- Management should be as for the non-diabetes population with pre-eclampsia[11].
- In some cases preterm delivery will be required in maternal or fetal interest[33].
- Anaesthetic consultation should be considered in the presence of medical complications of maternal diabetes[10].

3.2.4.2.2 Preterm delivery

- If there is a risk of preterm labour between 24-34 weeks gestation, a course of antenatal corticosteroids should be administered to accelerate fetal lung maturity (A)[47].
- Antenatal steroids adversely affect maternal glycaemic control and this should be anticipated; intensive insulin therapy and frequent glucose monitoring is required to prevent hyperglycaemia (A)[48].
- Hospitalisation is necessary for metabolic supervision during steroid administration[11].
- Tocolytic drugs are not contraindicated in diabetes but beta agonist drugs should be avoided as they can cause severe insulin resistance and glucose intolerance (E)[24].

Table 4 Quick guide to antenatal care (type 1 diabetes) – by trimester

Trimester	Antenatal Care for women with pre-existing diabetes
1st Trimester	Book as soon as pregnancy confirmed in combined diabetes/obstetric clinic for early assessment Review present medication and commence/continue folic acid 5mg Refer to dietitian for initial review Perform baseline laboratory tests - FBC, U&E, Creatinine, HbA1c, Fructosamine, TFTs, blood type, antibody screen and viral studies as per local protocol. Perform retinal assessment Perform ultrasound scan at 7-10 weeks to confirm viability and assign dates Encourage frequent contact by telephone and/or clinic visits to monitor glycaemic control Hospitalise if glycaemic control sub-optimal Assess self care ability and educate as necessary
2nd Trimester	Maintain frequent clinic visits Maintain regular telephone contact between clinic reviews for glycaemic review and insulin dose adjustment Perform ultrasound scan for fetal anomalies at 18-20 weeks Arrange retinal assessment Observe for maternal complications; PET, PIH, worsening of diabetes complications Dietitian review
3rd Trimester	Perform a minimum of two ultrasound scans for fetal growth evaluation Continue frequent visits as recommended by specialists Observe for macrosomia, polyhydramnios Advise woman to monitor fetal movements Arrange anaesthetic review in the presence of medical complications Arrange retinal assessment Provide information on proposed mode and timing of delivery Dietitian review

3.2.5 Management of labour and delivery

- Delivery should take place in a hospital with full obstetric and anaesthetic facilities and with access to neonatal intensive care facilities (C)[37].
- Continuous fetal monitoring throughout labour and delivery is advised[11].

3.2.5.1 Diabetes management during labour and delivery

- Intrapartum metabolic control is essential for mother and fetus (B)[24].
- Blood glucose should be maintained between 4-7mmol/L[11].
- Women should maintain their routine diet, insulin and SMBG regime until in active labour[32].
- During active labour; one hourly measurement of capillary blood glucose should be performed[10] and a sliding scale prescribed by an endocrinologist to provide supplemental insulin as required (√).
- In the event of a planned caesarean section, delivery should be carried out early in the morning to prevent prolonged fasting and to maintain optimum glycaemic control[32].
- Women on CSII pump therapy should continue to use their pump throughout labour and delivery. In the event of fasting for caesarean section, the background basal rate of insulin should continue without the need for bolus doses (√).

3.2.5.2 Timing and mode of delivery

- Decision on timing and mode of delivery should be individualised and be taken in conjunction with the consultant obstetrician with experience in diabetes in pregnancy and the delivery plan should be clearly documented within the patient record (√).
- In the setting of excellent glycaemic control, adherence to treatment and absence of maternal and fetal compromise, women with diabetes may await spontaneous labour up to 39-40 weeks gestation (E)[49, 50].
- Macrosomia and shoulder dystocia occur more frequently in pregnancies that are complicated by diabetes; these risks should be taken into account when planning mode of delivery (A)[12].
- In the presence of obstetric or diabetes complications, elective delivery should be considered at 38 weeks' gestation (√).
- An elective caesarean section is best performed at 39 weeks rather than 38 weeks gestation in the absence of obstetric or diabetes complications to reduce neonatal respiratory morbidity[51].
- Frequency of fetal monitoring should be increased if the pregnancy is allowed to progress beyond 40 weeks gestation (√).

3.2.5.3 Caesarean section

- Caesarean sections should be performed early in the morning to prevent prolonged fasting and maintain optimum glycaemic control[32].
- Frequent measurement of capillary blood glucose should be performed and an insulin regime prescribed by an endocrinologist should be employed to maintain blood glucose between 4-7mmol/L[11].

3.2.5.4 Induction of labour

- Women do not need to fast for induction of labour.
- Intravenous fluids and insulin, together with a supplemental sliding scale of subcutaneous insulin should be prescribed by an endocrinologist and used for the duration of established labour and delivery (√).
- Blood glucose should be maintained between 4-7mmol/L[11].

3.2.5.5 Vaginal delivery

- Intravenous fluids and insulin, together with a supplemental sliding scale of subcutaneous insulin should be prescribed by an endocrinologist and used for the duration of established labour and delivery (√).
- Monitoring of blood glucose and administration of supplemental insulin should be managed by an experienced midwife when the woman is in active labour (√).
- Hourly measurement of capillary blood glucose should be performed[10] when in active labour.
- Blood glucose should be maintained between 4-7mmol/L[11].

3.2.5.6 Anaesthesia

- Women with complications of diabetes and/or obesity should have anaesthetic assessment in the antenatal period[10].
- Blood glucose should be monitored frequently in the event of general anaesthesia[10].

3.3 Postnatal Care

3.3.1 Key messages

- Following delivery, insulin requirements decline rapidly. Prevention of maternal hypoglycaemia is essential (A)[12].
- Neonates should be nursed at the mother's bedside unless admission to intensive care is necessary (C)[37].
- Breastfeeding within one hour of birth should be encouraged (C)[37].
- All women with diabetes should be encouraged to attend a pre-pregnancy clinic prior to any future pregnancies[10].

3.3.2 Glycaemic control during the postnatal period

- Following delivery, insulin requirements decline rapidly. Prevention of maternal hypoglycaemia is essential (A)[12].
- A postpartum insulin regime (similar to the pre-pregnancy dose of insulin) should be prescribed prior to delivery if possible and this should commence immediately following the third stage of labour (A)[12].
- Frequent measurement of capillary blood glucose should be performed and the post partum insulin regime prescribed by an endocrinologist should be employed to maintain blood glucose between 4-7mmol/L (√).
- Close contact with the diabetes team is essential in the postpartum period to allow for assessment of glycaemic control and adjustment of insulin dose (√).

3.3.3 Neonatal Care

- Neonates should be nursed at the mother's bedside unless admission to intensive care is necessary (C)[37].
- Early breast feeding within one hour of birth should be encouraged (C)[37].
- Neonates of women with diabetes are at an increased risk of hypoglycaemia, macrosomia, respiratory distress and hypocalcaemia[52].
- Following delivery, neonatal blood glucose concentration falls quickly then rises and stabilises by approximately 2-3 hours of birth[53].
- Routine blood glucose measurement in the well baby at term during the first 2–3 hours after birth should be avoided; however where there is clinical concern blood sampling should be performed (C)[37].
- Screening for hypoglycaemia should generally be performed prior to the second feed (approximately 4-6 hrs) in the well baby at term[54].
- The diagnosis of neonatal hypoglycaemia is controversial. No conclusive evidence exists that defines the optimum cut off point below which serious adverse short and long term neurodevelopmental outcomes occur. An operational threshold of a blood glucose level <2.6mmol/L has been proposed[55].
- Blood glucose should be tested using a quality assured method which has been certified for neonatal use[10].
- Hypoglycaemia should be confirmed by laboratory testing[56].
- Babies who display clinical signs of hypoglycaemia should be transferred to neonatal intensive care for intravenous dextrose bolus and intravenous fluids[56].

Neonates should be nursed at the mother's bedside unless admission to intensive care is necessary

Early blood glucose testing in the well baby at term should be avoided

3.3.4 Breastfeeding

- Where feasible, mothers with diabetes should be offered an opportunity for skin-to-skin contact with their babies immediately after delivery (C)[37].
- Breastfeeding within one hour of birth should be encouraged (C)[37].
- Breastfeeding should be actively encouraged in women with pre-existing diabetes, not only for the proven benefits offered to the general population but also for the protective effects against type 2 diabetes in the offspring in later life[4].
- Women should be advised regarding the risk of hypoglycaemia while breastfeeding and should be encouraged to monitor blood glucose levels closely to allow for correct insulin dose adjustment[10].
- Mothers may require less insulin due to the calories expended with breastfeeding and may require a carbohydrate containing snack before or during breast feeding[24].
- Diabetes medications which were discontinued for safety reasons in the pre-conceptual or antenatal period should continue to be avoided during lactation[10].
- Women should be advised to maintain frequent contact with the diabetes service during the postpartum period to allow for glycaemic assessment and insulin dose adjustment (√).

3.3.5 Health education, health promotion and follow-up in the postnatal period

- These discussions should take place at the six week postnatal appointment if not already discussed in the immediate postpartum period (√).
- Health education should include the importance of achieving and maintaining an ideal body weight through diet and physical activity and sustaining optimal glycaemic control[24].
- Appropriate lifestyle changes should be advocated e.g. smoking cessation and healthy eating (√).
- Breastfeeding should be supported and encouraged (C)[37].
- Pre-pregnancy planning should be discussed with the woman and her partner, with emphasis on the importance of tight glycaemic control and high dose folic acid supplementation in the pre-conception and early pregnancy period[11].
- Methods of contraception agreeable with the woman and her partner should be discussed and prescribed as appropriate[32].
- Referral to routine diabetes care should be made in the postnatal period[10].
- All women with diabetes should be encouraged to attend a pre-pregnancy clinic prior to any future pregnancies[10].

SECTION 4

Guidelines for the Management of Type 2 Diabetes Mellitus from the Pre-conception to the Postnatal period

4.1 Pre-conception Care

4.1.1 Key messages

- The possibility of pregnancy should be identified, by direct questioning, at each diabetes consultation, in all women of child-bearing age with diabetes (C)[24].
- Women with diabetes who wish to conceive should be informed of the need to establish tight glycaemic control prior to conception (E)[24].
- All women with type 2 diabetes planning pregnancy should be screened for complications of diabetes (E)[24].
- Medications with known teratogenic effects should be substituted with appropriate medication prior to conception (E)[24].
- High dose folic acid (5mgs) should be prescribed as part of pre-pregnancy care[11].
- Insulin therapy may need to be prescribed together with non teratogenic oral hypoglycaemic (OHA) medication in order to achieve optimal glycaemic control (√).
- Women with diabetes who are planning to become pregnant should be offered individualised dietary advice by a qualified dietitian (B)[24].
- Assessment of self care ability should be undertaken and any shortcomings addressed (√).

The possibility of pregnancy should be identified, by direct questioning, at each diabetes consultation, in all women of child-bearing age with diabetes

4.1.2 Contraception in the pre-conception period

- The choice of contraceptive method is the same as that in the general population. In the presence of vascular complications of diabetes or other contraindications, the combined oestrogen-progestogen pill should be avoided and other methods discussed[11].
- Contraception should be continued until optimal glycaemic control is achieved (E)[24].

4.1.3 Education in the pre-conception period

For all women with diabetes, information on the following should be offered in the pre-conception period:

- Achieving and maintaining a healthy body weight, and its possible improvement on maternal and neonatal outcomes (√).
- Diet and physical activity and the importance of an appropriate healthy eating meal plan[25].
- The need for assessment and treatment of any complications of diabetes prior to conception and during pregnancy[25].
- The increased risk of congenital defects, neonatal morbidity and perinatal mortality associated with diabetes and pregnancy[26, 25].
- The risk of possible transient exacerbation of pre-existing retinopathy (B)[24] or nephropathy.
- The risk of hypoglycaemia and of hypoglycaemia unawareness in pregnancy[10].

Women with pre-existing diabetes who are contemplating pregnancy, should be offered advice on the possible teratogenic effect of diabetes on pregnancy

4.1.4 Blood glucose targets in the pre-conception period

- Expected glycaemic targets should be discussed with the woman and realistic individualised goals should be agreed[10].
- The following capillary glucose targets are recommended in the pre-conception period:
- Fasting 3.5 – 5.0mmols/L
- 1 hr post prandial < 7.0mmols/L (√).
- HbA_{1c} levels should be as low as possible, without excessive hypoglycaemia, before conception is attempted (B)[24].
- Frequent assessment by the healthcare team is required as hypoglycaemia can occur and should be avoided (√).
- HbA1c levels should be measured monthly during the pre-conception period[10].
- Woman with an HbA_{1c} level above the target level should be strongly advised to avoid conception (√).

Women with diabetes should be educated on the need for tight glycaemic control prior to conception

4.1.5 Blood glucose testing in the pre-conception period

- Frequency of self monitored blood glucose (SMBG) should include fasting, pre and post-prandial and bedtime recordings (A)[12], (E)[24].
- Management of hypoglycaemia should be comprehensively discussed. The woman and her family must be advised of the role of glucagon and should be given clear instructions on its administration (E)[24].

4.1.6 Safety of diabetes medications in the pre-conception period

- Medications with known teratogenic effects should be substituted with medication appropriate to pregnancy prior to conception (E)[24].

4.1.7 Health promotion in the pre-conception period

- Women attending pre-pregnancy care must be encouraged to stop smoking and to avoid alcohol consumption(√).
- Body mass index (BMI) should be assessed and if necessary, weight loss encouraged prior to conception, as obesity is a proven independent risk factor for fetal anomalies and adverse pregnancy outcomes (B)[28].
- Appropriate physical activity should be advocated[24].
- High dose folic acid supplementation (5mg daily) is advised for at least three months before conception, to be continued until 12 weeks gestational age(√).

4.1.8 Dietary advice in the pre-conception period

- Dietary advice should be sensitive to the personal needs, willingness to change, and ability to make changes of the individual with diabetes (E)[24].
- Monitoring carbohydrate intake remains the key strategy in achieving glycaemic control (A)[24].
- A diet that includes carbohydrates from fruit, vegetables, whole grain, legumes* and low fat milk is encouraged for good health (B)[24].
- Dietary advice should be culturally appropriate (E)[24].

4.1.9 Physical activity in the pre-conception period

- Physical activity has beneficial effects on insulin resistance, thus regular physical activity is regarded as potentially advantageous to the majority of people with diabetes (E)[24].
- For women on insulin therapy, the management of hypoglycaemic events resulting from physical activity should be discussed (E)[24].

4.1.10 Diabetes complications: review and management in the pre-conception period

- A complete medical and obstetric history should be obtained at the preconception consultation[25].
- Pre-existing complications of diabetes need to be evaluated as complications may accelerate and may alter the outcome of pregnancy (A)[25].
- In the presence of advanced complications of diabetes, specialist advice should be sought from an endocrinologist specialising in diabetes in pregnancy, to evaluate the individualised risk of pregnancy in that patient (√).

** legumes: Well-known legumes include alfalfa, clover, peas, beans, lentils, mesquite, carob and soy.*

4.1.10.1 Retinal assessment in the pre-conception period

- Retinal assessment by an ophthalmologist should be conducted prior to pregnancy[11].
- The risk of advancement of retinopathy during pregnancy should be discussed (B)[24].
- The risk of advancement of diabetic retinopathy can be reduced through gradual improvement of metabolic control[25].

4.1.10.2 Renal assessment in the pre-conception period

- Women with a diagnosis of established nephropathy should be referred to and managed by a nephrologist[10].
- A baseline assessment of renal function through measurement of serum creatinine should be carried out prior to conception (E)[24].
- In the presence of overt diabetic nephropathy there is an increased risk of permanent deterioration in maternal renal function and poor obstetric outcomes[29, 30].
- Women with less severe nephropathy may have a transient deterioration of renal function during pregnancy (A)[25].
- When diabetic nephropathy occurs outcomes are worst in patients who are hypertensive at the onset of pregnancy[31].

4.1.10.3 Cardiovascular assessment in the pre-conception period

- Regular blood pressure monitoring should form part of the on-going assessment in the pre-conception period (C)[24].
- Blood pressure should be measured at the initial physical examination and anti-hypertensives appropriate to pregnancy prescribed as required (A)[24].
- Hypertensive women with diabetes who are contemplating pregnancy or who are at risk of becoming pregnant should be prescribed anti-hypertensives appropriate to pregnancy. Specifically, ACE inhibitors should be avoided, where possible, in this group (A)[24].
- Pre-existing or suspected coronary artery disease (CAD) warrants cardiology review before conception[25].
- Untreated CAD is associated with a high maternal mortality rate during pregnancy[25].

4.1.10.4 Thyroid assessment in the pre-conception period

- Thyroid function should be measured at initial physical assessment as both hypothyroidism and hyperthyroidism can adversely affect pregnancy outcomes if left untreated (B)[24].
- Repeat thyroid function tests should be carried out in the pre-conception period as necessary (√).

4.2 Antenatal Care

4.2.1 Key messages

- Pregnancy should be confirmed as early as possible and ideally, care commenced with a multi-disciplinary team that includes a consultant endocrinologist or a physician experienced in diabetes care in pregnancy, consultant obstetrician, diabetes nurse/midwife specialist and senior dietitian in a dedicated combined Obstetric-Endocrine clinic (A)[25].
- If not already commenced, folic acid 5mg daily should be initiated and any teratogenic medication discontinued, where the specialist team, in consultation with the woman, deems it appropriate to do so (√).
- An assessment should be undertaken of maternal medications balancing any possible harmful fetal effects with maternal benefit.
- Frequency of visits will vary according to the stage of pregnancy and glycaemic control[9], but usually occur every 2-3 weeks (√).
- Blood pressure, body weight and urinalysis should be measured at each visit as the risk of hypertensive disorders increases when pregnancy is complicated by diabetes[33].
- Non teratogenic OHA's may be continued until insulin is commenced to avoid hyperglycaemia which is a known teratogen (E)[24].
- As pregnancy progresses, women should be advised to monitor fetal movement and report any concerns immediately to the healthcare team (C)[36].
- Delivery should take place in a hospital with full obstetric, anaesthetic and neonatal intensive care facilities and with an experienced paediatrician available for delivery (C)[37].

Women with diabetes in pregnancy should be offered care by a specialised diabetes-obstetric multi-disciplinary team

4.2.2 Diabetes management during pregnancy

4.2.2.1 Blood glucose targets during pregnancy

The following capillary glucose levels are recommended for pregnancy:

- Pre-prandial and pre-bed: 3.5-5.0mmol/L
- Post-prandial: <7.0mmol/L[38, 39].
- HbA_{1c} levels should be as low as possible during pregnancy, without excessive hypoglycaemia (B)[24].

Target capillary blood glucose levels and HbA_{1c} targets should be explained
Pre prandial and pre-bed <5.0mmol/L 1hour post prandial <7.0mmol/L
HbA_{1c} as near to normal as possible

4.2.2.2 Blood glucose testing during pregnancy

- Self monitoring of blood glucose (SMBG) should be performed 7 times a day – pre-meals plus one hour post all meals plus once before bed (A)[12, 10], (E)[24].
- SMBG readings should be frequently reviewed by the endocrinologist and insulin dose adjusted as required(√).
- HbA_{1c} together with SMBG levels should be used to determine glycaemic control; however caution must be employed when haemoglobin variants exist (A)[24].
- HbA_{1c} should be measured frequently during pregnancy (A)[40].
- Measurement of fructosamine (corrected for albumin) may be employed when HbA_{1c} is altered (A)[41].

4.2.2.3 Hypoglycaemia during pregnancy

- Women should be educated about the increased risk of hypoglycaemia and hypoglycaemia unawareness in pregnancy, especially in the first trimester[10].
- The management of hypoglycaemia should be individualised and discussed with the woman and her partner[11].
- Patterns of hypoglycaemia should be examined and preventative measures explained[42].
- Women who experience hypoglycaemia unawareness or altered hypoglycaemia awareness require specific advice, particularly in relation to driving and operating machinery(√).
- Women with diabetes should be encouraged to carry identification and rapid acting glucose with them at all times (E)[24].

The risk of hypoglycaemia and hypoglycaemic unawareness in pregnancy should be explained to all women on insulin treatment

4.2.2.4 Poor glycaemic control during pregnancy

- In the event of sub-optimal glycaemic control, precipitating factors such as diet, intercurrent illness, stress and lifestyle must be examined. Insulin therapy, diet and lifestyle will need to be adjusted[32].
- In some cases, hospitalisation may be the only way to achieve optimal glycaemic control[32].
- In the event of persistent hyperglycaemia, the possibility of hyperosmolar non-ketotic syndrome (HONK) should be investigated(√).

4.2.2.5 Insulin requirements and regimens during pregnancy

- Women with type 2 diabetes are characteristically insulin resistant and may require large doses of insulin to achieve good glycaemic control.
- If food intake is altered through excess hunger or nausea, insulin requirements will increase or decrease accordingly[33].
- As pregnancy progresses, insulin requirements increase in the second trimester, while most women experience a reduction in insulin requirements in the latter part of the third trimester[32].

- The flexibility of a basal bolus regime allows for easier adjustment of insulin doses and has been proven to improve glycaemic control and pregnancy outcomes (A)[43].
- Optimum glycaemic control needs to be balanced against the risk of hypoglycaemia[24].

4.2.2.6 Diabetes medications during pregnancy

- If not already discontinued prior to pregnancy, medications with known teratogenic effects should be substituted with medication appropriate for the antenatal period where the specialist team, in consultation with the patient, deems it appropriate to do so (√).
- Non teratogenic OHA's may be continued until insulin is started to avoid hyperglycaemia which is a known teratogen (E)[24].

4.2.2.7 Health Promotion during pregnancy

- Women should be encouraged, supported and provided with appropriate information from the multidisciplinary team to make positive lifestyle changes e.g. cessation of smoking and alcohol consumption (√).

4.2.2.8 Dietary advice during pregnancy

- Women with type 2 diabetes should be offered individualised dietary advice by a dietitian, familiar with components of diabetes in pregnancy, regularly throughout the antenatal period (E)[24].
- Advice should be appropriate to glycaemic control and gestational age (√).
- A diet that includes carbohydrates from fruit, vegetables, whole grain, legumes and low fat milk is encouraged for good health (B)[24].
- Dietary advice should be culturally appropriate (E)[24].

4.2.2.9 Physical activity during pregnancy

- Physical activity has beneficial effects on insulin resistance, thus regular physical activity is regarded as potentially advantageous to the majority of people with diabetes (E)[24].
- For women on insulin therapy, education should be offered on the management and prevention of hypoglycaemic events resulting from physical activity (E)[24].
- Levels of recommended physical activity should be discussed with the obstetrician and endocrinologist (√).
- Any new physical activity regime should be discussed with the obstetrician and reviewed according to gestational age (√).

4.2.3 Diabetes complications: assessment and management during pregnancy

- Ideally, diabetes complications should have been identified and treated prior to pregnancy, however assessment should continue throughout the antenatal period.

4.2.3.1 Retinal assessment during pregnancy

- All women with type 2 diabetes should undergo a retinal assessment by an ophthalmologist in the first trimester with close follow-up, as clinically required, throughout pregnancy and for 1 year postpartum (B)[24].
- Progression of retinopathy may warrant laser therapy (A)[24].
- Diabetic retinopathy should not delay rapid optimisation of glycaemic control in the pregnant woman[10].
- Diabetic retinopathy should not be considered a contraindication to vaginal delivery[10].

4.2.3.2 Renal assessment during pregnancy

- Evaluation of renal function should take place at the first antenatal visit (E)[24].
- All stages of nephropathy*, including microalbuminuria, are associated with adverse pregnancy outcomes, especially IUGR, pre-eclampsia and pre-term delivery[10].
- Referral for specialist care to a physician experienced in the management of diabetic renal disease should be considered when proteinuric hypertension is evident before 20 weeks' gestational age (√).

4.2.3.3 Cardiovascular assessment during pregnancy

- Blood pressure should be monitored at each antenatal visit (C)[24].
- Women with pre-gestational hypertension should be monitored closely for pre-eclampsia (A)[24].

4.2.3.4 Hyperosmolar Non-Ketotic Syndrome (HONK)

- Women who present with nausea, vomiting, abdominal pain and hyperglycaemia should be investigated for HONK (√).
- Management of HONK includes correction of dehydration, insulin deficit and electrolyte imbalance, continuous fetal monitoring where a viable gestational age has been reached, and determination of the underlying cause (√).
- Women admitted with HONK should be managed in a high dependency area of care (√).
- Fetal heart rate monitoring and ultrasound should be carried out to assess fetal well-being.
- Immediate delivery may not be necessary as fetal heart rate abnormalities may resolve with the correction of the metabolic state[24].

Women admitted with HONK should be managed in a high dependency area of care

** Clinical (overt) diabetic nephropathy (DN) is presumed if there is persistent microalbuminuria or proteinuria (dipstick positive) before 20 weeks in a woman with pre gestational diabetes; in the absence of other causes[24].*

4.2.3.5 Thyroid assessment during pregnancy

- All women with pre-pregnancy type 2 diabetes should be screened for thyroid dysfunction with thyroid stimulating hormone (TSH) levels and thyroid peroxidase antibodies during the first trimester of pregnancy (B)[24].
- Hyperthyroidism should be treated with propylthiouracil in pregnancy. The woman's T4 level should be maintained at or just above the normal range to prevent fetal hypothyroidism (B)[24].
- Hypothyroidism during pregnancy has been shown to increase the risk of pregnancy loss, placental abruption[24], preterm labour and long-term neurodevelopmental delay in the offspring of hypothyroid women.
- For hypothyroidism diagnosed prior to pregnancy, the pre-conception thyroxine dose should be adjusted to reach a TSH level not higher than 2.5µU/ml. The thyroxine dose usually needs to be increased by 4-6 weeks' gestation and may require a 30-50% increase in dosage[45].
- Elevated TSH (>2.5µU/ml in the first half of pregnancy; >3.0µU/ml during the second half) should be treated during pregnancy to maintain euthyroidism (TSH <2.5µU/ml first half; <3.0µU/ml second half)[45].
- The paediatrician should be alerted to the newborn of a mother with elevated TSH-receptor antibodies (TRAb) (E)[24].

4.2.4 Obstetric management

- A consultant obstetrician or physician with experience in the management of diabetes in pregnancy should care for women with pre-existing diabetes, as part of the multidisciplinary team (√).

4.2.4.1 Fetal Surveillance

- Ultrasound examination should be performed in early pregnancy to confirm gestational age and fetal viability (E)[24].
- An ultrasound scan to screen for fetal anomalies should be performed at 18-20 weeks gestation (A)[12].
- Third trimester ultrasound assessment should include fetal growth, assessment of liquor volume and fetal movements. Estimation of fetal growth should be performed at least twice to assess fetal growth velocity (√).
- Timing of ultrasound assessment will depend on clinical factors but is usually performed from 30 weeks gestation. Clinicians should be aware that the accuracy of fetal weight estimation is ± 20% in term babies and that accuracy decreases with increasing birth weight[46].
- No fetal surveillance protocol has been shown to reduce the risk of perinatal mortality in diabetic pregnancies. Where biophysical testing is undertaken, the frequency of such testing should be determined according to the fetal growth pattern, amniotic fluid volume and presence of additional pregnancy complications (√).
- Biophysical profile testing and doppler velocity to assess umbilical blood flow and middle cerebral artery blood flow may be considered in cases of excessive or poor growth or when there are co-morbid conditions, such as pre-eclampsia (E)[24].
- In the event of identified macrosomia a clear management plan should be put in place by a consultant obstetrician. This plan should address timing of follow-up scans, fetal surveillance and timing and mode of delivery (C)[37].

- Sonographic estimation of fetal weight should be combined with the clinical judgment of an obstetrician experienced in the management of pregnancies complicated with diabetes when evaluating the most appropriate mode of delivery for the patient (√).
- As pregnancy progresses, women should be advised to monitor fetal movement and report any concerns immediately to the healthcare team (C)[36].

Women with pre-existing diabetes should be offered ultrasound screening for fetal anomalies at 18-20 week's gestation

4.2.4.2 Management of obstetric complications

4.2.4.2.1 Pre-eclampsia

- Pre-eclampsia is approximately four times more common in pregnancies complicated by diabetes than in the background population[33].
- Management should be as for the non-diabetes population with pre-eclampsia[11].
- In some cases preterm delivery will be required in maternal or fetal interest[33].
- Anaesthetic consultation should be considered in the presence of medical complications of maternal diabetes[10].

4.2.4.2.2 Preterm delivery

- If there is a risk of preterm labour between 24-34 weeks gestation, a course of antenatal corticosteroids should be administered to accelerate fetal lung maturity (A)[47].
- Antenatal steroids adversely affect maternal glycaemic control and this should be anticipated; intensive insulin therapy and frequent glucose monitoring is required to prevent hyperglycaemia (A)[48].
- Hospitalisation is necessary for metabolic supervision during steroid administration[11].
- Tocolytic drugs are not contraindicated in diabetes but beta agonist drugs should be avoided as they can cause severe insulin resistance and glucose intolerance (E)[24].

Table 5 Quick guide to antenatal care (type 2 diabetes) – by trimester

Trimester	Antenatal Care for women with pre-existing diabetes
1st Trimester	Book as soon as pregnancy is confirmed in combined diabetes/obstetric clinic for diabetes and obstetric assessment Review present medication, commence insulin as necessary and folic acid 5mg daily Refer to dietitian for initial review Perform baseline laboratory tests - FBC, U&E, Creatinine, HbA1c, Fructosamine, TFTs, blood type, antibody screen and viral studies as per local protocol. Perform retinal assessment Perform ultrasound scan at 7-10weeks to confirm viability and to assign dates Encourage frequent contact by telephone and/or clinic visits to monitor glycaemic control Hospitalise if glycaemic control sub-optimal Assess self care ability and educate as necessary
2nd Trimester	Maintain frequent clinic visits Maintain regular telephone contact between clinic reviews for glycaemic review and insulin dose adjustment Perform ultrasound scan for fetal anomalies at 18-20weeks Arrange retinal assessment Observe for maternal complications; PET, PIH, worsening of diabetes complications Dietitian review
3rd Trimester	Perform a minimum of two ultrasound scans for fetal growth evaluation Continue frequent visits as recommended by specialists Observe for macrosomia, polyhydramnios Advise woman to monitor fetal movements Arrange anaesthetic review in the presence of medical complications Arrange retinal assessment Provide information on proposed mode and timing of delivery Dietitian review

4.2.5 Management of labour and delivery

- Delivery should take place in a hospital with full obstetric and anaesthetic facilities and with access to neonatal intensive care facilities (C)[37].
- Continuous fetal monitoring throughout labour and delivery is advised[11].

4.2.5.1 Diabetes management during labour and delivery

- Intrapartum metabolic control is essential for mother and fetus (B)[24].
- Blood glucose should be maintained between 4-7mmol/L[11].
- Women should maintain their routine diet, insulin and SMBG regime until in active labour[32].
- During active labour; one hourly measurement of capillary blood glucose should be performed[10] and a sliding scale prescribed by an endocrinologist to provide supplemental insulin as required(√).

- In the event of a planned caesarean section, delivery should be carried out early in the morning to prevent prolonged fasting and to maintain optimum glycaemic control[32].

4.2.5.2 Timing and mode of delivery

- Decision on timing and mode of delivery should be individualised and be taken in conjunction with the consultant obstetrician with experience in diabetes in pregnancy and the delivery plan should be clearly documented within the patient record (√).
- In the setting of excellent glycaemic control, adherence to treatment and absence of maternal and fetal compromise, women with diabetes may await spontaneous labour up to 39-40 weeks gestation (E)[49, 50].
- Macrosomia and shoulder dystocia occur more frequently in pregnancies that are complicated by diabetes; these risks should be taken into account when planning mode of delivery (A)[12].
- In the presence of obstetric or diabetes complications elective delivery should be considered at 38 weeks' gestation.
- An elective caesarean section is best performed at 39 weeks rather than 38 weeks gestation in the absence of obstetric or diabetes complications to reduce neonatal respiratory morbidity[51].
- Frequency of fetal monitoring should be increased if the pregnancy is allowed to progress beyond 40 weeks gestation (√).

4.2.5.3 Caesarean section

- Caesarean sections should be performed early in the morning to prevent prolonged fasting and maintain optimum glycaemic control[32].
- Frequent measurement of capillary blood glucose should be performed and an insulin regime prescribed by an endocrinologist should be employed to maintain blood glucose between 4-7mmol/L[11].

4.2.5.4 Induction of labour

- Women do not need to fast for induction of labour.
- Intravenous fluids and insulin, together with a supplemental sliding scale of subcutaneous insulin should be prescribed by an endocrinologist and used for the duration of established labour and delivery (√).

4.2.5.5 Vaginal delivery

- Intravenous fluids and insulin, together with a supplemental sliding scale of subcutaneous insulin should be prescribed by an endocrinologist and used for the duration of established labour and delivery (√).
- Monitoring of blood glucose and administration of supplemental insulin should be managed by an experienced midwife when the woman is in active labour (√).
- Hourly measurement of capillary blood glucose should be performed[10] when in active labour.
- Blood glucose should be maintained between 4-7mmol/L[11].

4.2.5.6 Anaesthesia

- Women with complications of diabetes and/or obesity should have anaesthetic assessment in the antenatal period[10].
- Blood glucose should be monitored frequently in the event of general anaesthesia[10].

4.3 Postnatal Care

4.3.1 Key messages

- Following delivery, insulin requirements decline rapidly. Prevention of maternal hypoglycaemia is essential (A)[12].
- Women with T2DM who intend to formula feed their infant may be switched from insulin therapy to OHA's.
- Neonates should be nursed at the mother's bedside unless admission to intensive care is necessary (C)[37].
- Breastfeeding within one hour of birth should be encouraged (C)[37].
- All women with diabetes should be encouraged to attend a pre-pregnancy clinic prior to any future pregnancies[10].

4.3.2 Glycaemic control during the postnatal period

- Following delivery, insulin requirements decline rapidly. Prevention of maternal hypoglycaemia is essential (A)[12].
- Following delivery women with T2DM may be switched from insulin therapy to OHA's. Careful consideration of the type of agent is needed in the lactating mother. Glipizide, Glyburide, Metformin and Acarbose are considered compatible with breast feeding (√).
- Women with type 2 diabetes who intend to formula feed their infant may recommence OHA therapy as per pre-pregnancy management (√).
- Blood glucose levels should be recorded as recommended by the endocrinologist (√).
- Close contact with the diabetes team is essential in the postpartum period to allow for assessment of glycaemic control and adjustment of insulin dose (√).

4.3.3 Breastfeeding

- Where feasible, mothers with diabetes should be offered an opportunity for skin-to-skin contact with their babies immediately after delivery (C)[37].
- Breastfeeding within one hour of birth should be encouraged (C)[37].
- Breastfeeding should be actively encouraged in women with pre-existing diabetes, not only for the proven benefits offered to the general population but also for the protective effects against type 2 diabetes in the offspring in later life[4].
- Women should be advised regarding the risk of hypoglycaemia while breastfeeding and should be encouraged to monitor blood glucose levels closely to allow for correct insulin dose adjustment[10].
- Diabetes medications which were discontinued for safety reasons in the pre-conceptual or antenatal period should continue to be avoided during lactation[10].

- Mothers may require less insulin due to the calories expended with breastfeeding and may require a carbohydrate containing snack before or during breast feeding[24].
- Women should be advised to maintain frequent contact with the diabetes service during the postpartum period to allow for glycaemic assessment and insulin dose adjustment (√).

4.3.4 Neonatal Care

- Neonates should be nursed at the mother's bedside unless admission to intensive care is necessary (C)[37].
- Early breast feeding, within one hour should be encouraged (C)[37].
- Neonates of women with diabetes are at an increased risk of hypoglycaemia, macrosomia, respiratory distress and hypocalcaemia[52].
- Following delivery, neonatal blood glucose concentration falls quickly then rises and stabilises by approximately 2-3 hours of birth[53].
- Routine blood glucose measurement in the well baby at term during the first 2–3 hours after birth should be avoided; however where there is clinical concern blood sampling should be performed (C)[37].
- Screening for hypoglycaemia should generally be performed prior to the second feed (approximately 4-6 hrs) in the well baby at term[54].
- The diagnosis of neonatal hypoglycaemia is controversial. No conclusive evidence exists that defines the optimum cut off point below which serious adverse short and long term neurodevelopmental outcomes occur. An operational threshold of a blood glucose level <2.6mmol/L has been proposed[55].
- Blood glucose should be tested using a quality assured method which has been certified for neonatal use[10].
- Hypoglycaemia should be confirmed by laboratory testing[56].
- Babies who display clinical signs of hypoglycaemia should be transferred to neonatal intensive care for intravenous dextrose bolus and intravenous fluids[56].

Neonates should be nursed at the mother's bedside unless admission to intensive care is necessary

Early blood glucose testing in the well baby at term should be avoided

4.3.5 Health education, health promotion and follow-up in the postnatal period

- These discussions should take place at the six week postnatal appointment if not already discussed in the immediate postpartum period (√).
- Health education should include the importance of achieving and maintaining an ideal body weight through diet and physical activity and sustaining optimal glycaemic control[24].
- Appropriate lifestyle changes should be advocated e.g. smoking cessation and healthy eating (√).
- Breastfeeding should be supported and encouraged (C)[37].
- Pre-pregnancy planning should be discussed with the woman and her partner, with emphasis on the importance of tight glycaemic control and high dose folic acid supplementation in the pre-conception and early pregnancy period[11].
- Methods of contraception agreeable with the woman and her partner should be discussed and prescribed as appropriate[32].
- Referral to routine diabetes care should be made in the postnatal period[10].
- All women with diabetes should be encouraged to attend a pre-pregnancy clinic prior to any future pregnancies[10].

SECTION 5

Guidelines for the Management of Gestational Diabetes Mellitus

5.1 Key messages for the management of gestational diabetes mellitus (GDM)

- Selective screening for GDM should be carried out on identified at risk pregnant women between 24-28 weeks gestation using the 75g oral glucose tolerance test (OGTT).
- Optimal outcomes are best achieved through care by a multidisciplinary diabetes-obstetric team (A)[12].
- Conformity with treatment depends on the woman's understanding of the possible implications of GDM for herself and her baby (A)[40].
- Pregnancy complicated by gestational diabetes is considered high risk; therefore frequent hospital based antenatal visits are required (B)[16].
- Women with GDM should be advised to monitor fetal movements, and report any concerns immediately to the healthcare team (A)[57],(C)[36].
- A 75g OGTT, using the WHO[58] criteria for the non-pregnant population should be performed at 6 weeks postpartum and yearly thereafter[59].

5.2 Screening and diagnosis of gestational diabetes

Universal screening for gestational diabetes remains controversial. To date, the American Diabetes Association[8], the International Diabetes Federation9 and the National Institute for Health and Clinical Excellence[10] recommend selective screening for gestational diabetes. Therefore; we recommend the following:

At the booking antenatal visit, all patients should be screened for recognised risk factors for gestational diabetes. Identification of any of the following risk factors should prompt a 75g OGTT at 24-28 weeks' gestational age[10]:

- Family history of diabetes in a first degree relative
- Body mass index ≥30kg/m2
- Maternal age ≥ 40years
- Previous unexplained perinatal death
- Current glycosuria
- Women on long term steroids
- Previous delivery of a baby weighing ≥4.5kg
- Polycystic Ovary Syndrome
- Polyhydramnios and/or macrosomia in existing pregnancy
- Ethnicity associated with a high prevalence of diabetes: (India/ Pakistan/ Bangladesh/ Black Caribbean/ Saudi Arabia/ United Arab Emirates/ Iraq/ Jordan/ Syria/ Oman/ Qatar/ Kuwait/ Lebanon/Egypt[10]

- If GDM is suspected at an earlier or later gestation than 24-28 weeks, on the basis of fetal macrosomia, polyhydramnios or glycosuria, a 75g OGTT should be performed. If negative at an early gestation, the OGTT should be repeated between 24-28 weeks gestation[9].
- While some centres re-screen women with a history of gestational diabetes with a 75g OGTT at 24-28 weeks gestation, it is recommended that the woman be referred at booking for combined diabetes/obstetric antenatal care (√).

5.2.1 Two hour 75g oral glucose tolerance test (OGTT) during pregnancy

- The OGTT is a diagnostic procedure; therefore women with pre-existing diabetes do not require this test.
- Women should consume their normal diet for three days prior to test.
- Each woman should be advised not to alter her current diet prior to test.
- Each woman should fast (no food or fluids, except water) for 12 hours prior to the test.
- Fasting blood glucose should be reserved.
- 75g of carbohydrate (CHO) is administered to drink over a 10-15 minute period.
- The patient should be directed to sit quietly during the test.
- Smoking is discouraged.
- A venous sample of blood glucose is reserved 1 hour and 2 hours from commencing the CHO drink.
- Date and time each sample.

5.2.2 Diagnosis of gestational diabetes

A diagnosis of gestational diabetes is made when one or more values are met or exceeded[60].

Diagnosis of GDM with 75g OGTT60	
Fasting	5.1mmol/L
1 hour	10.0mmol/L
2 hour	8.5mmol/L

5.3 Diabetes management of gestational diabetes

- Optimal outcomes are best achieved through care by a multidisciplinary diabetes-obstetric team (A)[12].
- Once GDM is diagnosed, patient education, diet and lifestyle alteration, blood glucose monitoring and regular maternal and fetal surveillance is recommended (A)[18, 19].

All women with GDM should receive intensive treatment by a multi-disciplinary diabetes-obstetric team

5.3.1 Education during pregnancy

Conformity with treatment depends on the woman's understanding of:

- The implications of GDM for herself and her baby;
- The role of diet and physical activity;
- The role of monitoring blood glucose levels;
- The possible need for insulin therapy;
- The need for increased maternal and fetal monitoring with GDM (A)[40].

5.3.2 Health promotion during pregnancy

- Women should be encouraged, supported and provided with appropriate information from the multidisciplinary team to make positive lifestyle changes e.g. cessation of smoking and alcohol consumption (√).

5.3.3 Dietary advice during pregnancy

- The cornerstone of care in pregnancy complicated by GDM is diet (A)[12].
- All women with GDM should receive individualised nutritional advice by a dietician familiar with components of diabetes in pregnancy (E)[24].
- Advice should be appropriate to glycaemic control and gestational age (√).
- Monitoring carbohydrate intake remains the key strategy in achieving glycaemic control (B)[24].
- Starvation ketosis should be avoided (C)[24].
- Severe calorie-restricted diets should be avoided as this can lead to maternal ketonuria and small for gestational age babies (√).
- Adequate energy intake that provides appropriate weight gain is recommended in pregnancy[10].
- Dietary therapy for GDM focuses on food choices for appropriate weight gain, normoglycaemia and absence of ketones (E)[24].
- Weight loss is not routinely recommended, however for overweight or obese women with GDM, modest energy and carbohydrate restriction may be required (E)[24].
- A diet that includes carbohydrates from fruit, vegetables, whole grain, legumes* and low fat milk is encouraged for good health (B)[24].
- Dietary advice should be culturally appropriate (E)[24].

** legumes: Well-known legumes include alfalfa, clover, peas, beans, lentils, mesquite, carob and soy.*

5.3.4 Physical activity during pregnancy

- Physical activity has beneficial effects on insulin resistance, thus regular physical activity is regarded as potentially advantageous to the majority of people with diabetes (E)[24].
- For women on insulin therapy, the management of hypoglycaemic events resulting from physical activity should be discussed (E)[24].

5.3.5 Blood glucose monitoring during pregnancy

- Self monitoring of blood glucose (SMBG) is suggested for all women with GDM. This includes women who are managed with diet alone as well as those with diet and insulin therapy[25].
- For women receiving insulin therapy, self monitoring of blood glucose (SMBG) should be performed 7 times a day – pre meals plus one hour post all meals plus once before bed (A)[12, 10].
- For women with diet controlled GDM, frequency of SMBG or laboratory measures of glucose values should be determined by the consultant endocrinologist (√).
- SMBG readings should be frequently reviewed by the endocrinologist and treatment adjusted as required (√).
- A baseline HbA_{1c} may be measured at diagnosis of GDM and repeated as clinically indicated (√).
- Measurement of Fructosamine (corrected for albumin) may be employed when HbA_{1c} is altered (A)[41].
- Patients monitoring techniques must be validated to ensure accuracy of results (√).

5.3.6 Blood glucose targets during pregnancy

The following target values are recommended for optimum maternal and fetal outcome:

- Fasting capillary glucose level: 3.5-5.0mmol/L

- 1 hour post-prandial capillary glucose level: <7.0mmol/L (√).

If these targets cannot be met with diet and physical activity alone, insulin therapy must be considered (A)[8].

Target capillary blood glucose levels should be explained
Pre prandial and pre-bed <5.0mmol/L
1hour post prandial <7.0mmol/L

5.3.7 Insulin therapy during pregnancy

- Insulin therapy must be considered when the glycaemic target values are exceeded on two or more occasions within a 1 to 2 week interval, especially in the presence of suspected or confirmed macrosomia (A)[40].
- A clinical decision regarding insulin therapy should be based on gestational age, fetal size and glycaemic control (√).
- Insulin given four times a day has been proven to improve glycaemic control and pregnancy outcomes (A)[43]. The flexibility of a basal bolus regime allows for easier adjustment of insulin doses.
- The woman should be educated about mode of action of insulin by the diabetes nurse/midwife specialist (√).

- The woman and her partner should be educated about the prevention and management of hypoglycaemia. The glucagon injection should be prescribed and it's use explained to the woman and her family[10].
- SMBG levels should be reviewed by clinic or telephone contact at least once weekly to allow for adjustment of treatment as required (√).
- Further dietary education should be given when commenced on insulin therapy (√).
- Over-treatment of GDM should be avoided as the risk of small for gestational age babies is increased (A)[6].

The risk of hypoglycaemia and hypoglycaemic unawareness in pregnancy should be explained to all women on insulin treatment

5.4 Obstetric Management of Gestational Diabetes

5.4.1 Maternal surveillance

- Pregnancy complicated by gestational diabetes is considered high risk; therefore antenatal visits should be hospital-based (B)[16].
- If GDM is diagnosed in the first or second trimester, antenatal visits and diabetes review should be as for those with pre-gestational diabetes (√).
- Blood pressure, body weight and urinalysis should be measured at each visit as the risk of hypertensive disorders is increased when pregnancy is complicated by diabetes (C)[24].
- Pre-eclampsia is more common in pregnancies complicated by diabetes than in the background population[33].
- Management of pre-eclampsia in women with GDM should be as for the background population[10].
- Pre-existing undiagnosed diabetes should be suspected in women who are diagnosed with GDM in the first or second trimester (√).

5.4.2 Fetal surveillance

- The frequency and methods of fetal monitoring are determined by maternal glycaemic control and the existence of other pregnancy complications (√).
- Biophysical profile testing and multivessel doppler studies may be considered in cases of excessive or poor growth or when there are co-morbid conditions, such as pre-eclampsia (A)[57].
- For women diagnosed with GDM in the first trimester, undiagnosed pre-existing diabetes should be considered and fetal surveillance should include a second trimester ultrasound to detect fetal anomalies and third trimester ultrasounds to assess fetal wellbeing and growth (A) [57].
- Screening for congenital anomalies should be performed in women who present with HbA_{1c} >7% (53mmol/mol) (A)[6].
- In the event of identified macrosomia, a clear management plan should be put in place by a consultant obstetrician. This plan should address timing of follow-up scans, fetal surveillance and timing and mode of delivery (C)[37].
- Women with GDM should be advised to monitor fetal movements, and report any concerns immediately to the healthcare team (A)[57], (C)[36].

- No fetal surveillance protocol has been shown to reduce the risk of perinatal mortality in diabetic pregnancies. Where biophysical testing is undertaken, the frequency of such testing should be determined according to the fetal growth pattern, amniotic fluid volume and presence of additional pregnancy complications (√).

5.4.3 Preterm delivery

- If there is a risk of preterm delivery between 24-34 weeks gestation, a course of antenatal corticosteroids should be administered to accelerate fetal lung maturity (A)[47].
- Antenatal steroids adversely affect maternal glycaemic control; intensive insulin therapy and frequent glucose monitoring is required to prevent hyperglycaemia (A)[48].
- Hospitalisation is necessary for metabolic supervision during steroid administration[11].
- Tocolytic drugs are not contraindicated in diabetes but beta agonist drugs should be avoided as they can cause severe insulin resistance (E)[24].

5.4.4 Timing and mode of delivery

- In the setting of excellent glycaemic control, adherence to treatment and absence of maternal and fetal compromise, women with diabetes may await spontaneous labour up to 39-40 weeks gestation (E)[49].
- Vaginal delivery is preferable unless obstetric or diabetes complications necessitate caesarean delivery (√).
- Macrosomia and shoulder dystocia occur more frequently in pregnancies that are complicated by diabetes; these risks should be taken into account when planning mode of delivery (A)[12].
- Sonographic estimation of fetal weight should be combined with the clinical judgement of an obstetrician experienced in the management of pregnancies complicated by gestational diabetes when evaluating the most appropriate mode of delivery for the patient.
- The frequency of fetal monitoring should be increased if the pregnancy is allowed to progress beyond 40 weeks' gestation (A)[6].
- The delivery plan should be clearly documented within the patient record (√).

5.4.5 Management of labour and delivery

- Continuous fetal monitoring throughout labour and delivery is advised[11].
- Intrapartum metabolic control is essential for mother and fetus (B)[24].
- Blood glucose should be maintained between 4-7mmol/L[11].
- For women with insulin treated GDM, an intravenous fluids and insulin regime, together with a supplemental sliding scale of insulin should be prescribed by an endocrinologist and used for the duration of established labour and delivery (√).
- Monitoring of blood glucose and administration of supplemental insulin should be managed by an experienced midwife when the woman is in active labour (√).
- In the event of a planned caesarean section, delivery should be carried out early in the morning to prevent prolonged fasting and to maintain optimum glycaemic control (√).
- Women with GDM who have maintained normoglycaemia on dietary therapy should be managed in labour as per the background population (√).

5.5 Postnatal Care

5.5.1 Blood glucose monitoring in the postnatal period

- Once the placenta is delivered, maternal blood glucose and insulin levels may rapidly return to normal (√).
- Insulin therapy should be discontinued immediately postpartum[10, 9].
- SMBG should be discontinued once blood glucose returns to normal levels (√).
- Overt diabetes should be suspected and investigated if hyperglycaemia persists (A)[6].
- A 75g OGTT, using the WHO[58] criteria for the non-pregnant population should be performed at 6 weeks postpartum and yearly thereafter[59].

A 75g OGTT should be performed at 6 weeks postpartum and yearly thereafter

- The following table summarises the WHO[58] recommendations for the diagnostic criteria for diabetes and intermediate hyperglycaemia in the non pregnant population.

Diabetes	
Fasting plasma glucose	≥7.0mmol/l
2–h plasma glucose*	**or**
	≥11.1mmol/l
Impaired Glucose Tolerance (IGT)	
Fasting plasma glucose	<7.0mmol/l
2–h plasma glucose*	**and**
	≥7.8 and <11.1mmol/l
Impaired Fasting Glucose (IFG)	
Fasting plasma glucose	6.1 to 6.9mmol/l
2–h plasma glucose*	**and (if measured)**
	<7.8mmol/l

** Venous plasma glucose 2–h after ingestion of 75g oral glucose load.*
** If 2–h plasma glucose is not measured, status is uncertain as diabetes or IGT cannot be excluded.*

5.5.2 Breastfeeding

- Where feasible, mothers with diabetes should be offered an opportunity for skin-to-skin contact with their babies immediately after delivery (C)[37].
- Early and frequent feeding should be encouraged to avoid neonatal hypoglycaemia and to stimulate lactation[11].
- Breastfeeding has been shown to reduce the risk of obesity and type 2 diabetes in later life in infants of mothers with GDM (C)[61].

5.5.3 Neonatal Care

- Neonates should be nursed at the mother's bedside unless admission to intensive care is necessary (C)[37].
- Early breast feeding (within 1 hr) should be encouraged.
- Neonates of women with diabetes are at an increased risk of hypoglycaemia, macrosomia, respiratory distress and hypocalcaemia[52].
- Following delivery, neonatal blood glucose concentration falls quickly then rises and stabilises by approximately 2-3 hours of birth[53].
- Routine blood glucose measurement in the well baby at term during the first 2–3 hours after birth should be avoided; however where there is clinical concern blood sampling should be performed (C)[37].
- Screening for hypoglycaemia should generally be performed prior to the second feed (approximately 4-6 hrs) in the well baby at term[54].
- The diagnosis of neonatal hypoglycaemia is controversial. No conclusive evidence exists that defines the optimum cut off point below which serious adverse short and long term neurodevelopmental outcomes occur. An operational threshold of a blood glucose level <2.6mmol/L has been proposed[55].
- Blood glucose should be tested using a quality assured method which has been certified for neonatal use[10].
- Hypoglycaemia should be confirmed by laboratory testing[56].
- Babies who display clinical signs of hypoglycaemia should be transferred to neonatal intensive care for intravenous dextrose bolus and intravenous fluids[56].

Neonates should be nursed at the mother's bedside unless admission to intensive care is necessary

Early blood glucose testing in the well baby at term should be avoided

5.5.4 Health Education, Health Promotion and Follow-up

- These discussions should take place at the six week postnatal appointment if not already discussed in the immediate postpartum period(√).
- Women with a diagnosis of GDM have a 35–50% chance of reoccurrence in future pregnancies; this should be discussed in the postnatal period (C)[62].
- Education in the postnatal period should incorporate advice on
  - diet
  - physical activity
  - weight reduction/healthy weight maintenance
  - other lifestyle interventions e.g. smoking cessation
- The increased risk of developing T2DM in the future should be emphasised;

  Risk factors for developing T2DM include:
  - Pre-pregnancy overweight/obesity
  - High blood glucose levels at diagnosis of GDM
  - High insulin requirements during pregnancy

- Early gestation at diagnosis of GDM
- The need for insulin treatment in pregnancy
- Pre-term delivery
- An abnormal postpartum OGTT (C)[63].

- Future pregnancy planning should include evaluation of glycaemic control and if present, hyperglycaemia should be treated prior to conception (A)[6].
- Women with identified post-natal glucose intolerance or confirmed diabetes should be advised to seek pre-conceptual counselling for any future pregnancies (A)[6].
- Methods of contraception agreeable with the woman and her partner should be discussed and prescribed as appropriate (A)[6].

Women with GDM should be offered advice on:

- Diet and lifestyle
- Risk of GDM in subsequent pregnancies
- Risk of T2DM in future
- The need for an annual OGTT

5.5.5 Prevention of Type 2 diabetes

- Lifestyle interventions, including diet and moderate physical activity can reduce the risk of type 2 diabetes by as much as 40% to 60%[59].
- Weight management is the best strategy to prevent T2DM; therefore women should be encouraged to achieve and maintain a healthy body weight[59].
- Physical activity should be encouraged as this will reduce insulin resistance (√).
- Appropriate lifestyle changes should be advocated e.g. smoking cessation and healthy eating (√).
- Breastfeeding should be supported and encouraged (A)[6].

SECTION 6

References and Appendices

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6.2 Appendices

Appendix 1

Glossary of Terms and Definitions

Albuminuria
A condition where protein is secreted in the urine. It is usually a marker for renal disease.

Antenatal Care
Refers to routine care offered to all women during pregnancy.

Basal-Bolus Insulin Regime
A subcutaneous insulin regimen using short or rapid-acting insulin to simulate normal mealtime insulin levels together with delayed-acting insulin used to provide a background or basal concentration.

Beta Cells
Cells that make insulin, located in the islets of Langerhans in the pancreas.

Blood Pressure
Pressure exerted by the blood upon the walls of the arteries as it is pushed around the body by the heart. Blood pressure is measured using a sphygmomanometer and is reported as the systolic blood pressure over the diastolic blood pressure. Blood pressure is measured in millimetres of mercury (mm Hg).
Systolic blood pressure indicates the pressure created by the heart pumping out the blood.
Diastolic blood pressure indicates the pressure during filling the heart with blood.

Body Mass Index (BMI)
BMI is calculated from the formula: Body weight (kg) divided by Height (m) squared (kg/m^2).

Capillary Blood Glucose
The measurement of blood glucose concentrations from capillary blood.

Carbohydrate
Carbohydrates are the primary source of energy for the body. They are found in grains, vegetables, fruits, legumes and dairy products. The body takes in carbohydrate from theses foods and converts them to glucose.

Cardiovascular Exercise
National Guidelines on Physical Activity for Ireland define Cardiovascular Exercise as the body's large muscles moving in a rhythmic way for a sustained period of time. This improves cardio-respiratory fitness (heart and lungs). Examples include walking, running, swimming and cycling.

Congenital Abnormality
Any defect in fetal form, structure or function and may be categorised into chromosomal/genetic abnormalities, teratogenic causes, multifactorial causes and unknown causes.

Diabetes Complications

Conditions directly caused by diabetes; can be acute (hypoglycaemia, hyperglycaemia) or chronic (retinopathy, nephropathy, neuropathy, cardiovascular disease and foot ulceration).

Diabetic Ketoacidosis (DKA)

A medical emergency. Occurs because of a lack of insulin. In the absence of insulin, the body uses fat stores instead of glucose for energy and acidic waste products called ketones are produced, which when built up result in ketoacidosis.

Hyperglycaemia, ketonuria, dehydration, acidosis, confusion or coma and a possible underlying cause for DKA will be present. If fluids and insulin are not replaced immediately, coma and/or death may occur.

Embryogenesis

The name applied to the developing offspring from implantation to 8 weeks after conception. During embryogenesis, all the organs and systems of the body are formed. Maturation of the organs and systems occur in the further 7 months of pregnancy.

Established Labour

The presence of long, strong and regular uterine contractions, becoming longer, stronger and more frequent.

Euglycaemia

Normal blood glucose concentration.

Fasting Blood Glucose

Measurement of blood glucose following 8-12 hour fast from diet and fluids (with the exception of water).

Fetal Abdominal Circumference

Abdominal circumference (AC) is measured by ultrasound at the bifurcation of the main portal vein. It is a useful tool to monitor fetal growth patterns but not as useful to assess gestational age.

Fetal Auscultation

The use of a fetal stethoscope to listen to the fetal heart. Ultrasound equipment may be used so that the woman may hear the heartbeat.

Fetal Lung Maturity

Fetal lungs are mature at 34 weeks gestation.

Fructosamine

Fructosamine assay measures glycated plasma proteins to reflect average glycaemia in the preceding 2-3weeks. Useful tool when frequent or rapid changes in glycaemia control need to be assessed.

Gestational diabetes mellitus (GDM)

Defined as carbohydrate intolerance of variable severity with onset or first recognition during pregnancy[64]. This definition includes women with newly diagnosed type 1 diabetes mellitus presenting in pregnancy, previously undiagnosed type 2 diabetes mellitus or impaired glucose tolerance[65]. The definition is independent of the severity of hyperglycaemia and the method of treatment required.

Glucagon
Parenteral glucagon (1mg = 1unit) may be given by intravenous, subcutaneous or intramuscular injection in the treatment of severe hypoglycaemia.

Glycolysis
A series of enzymatically catalyzed reactions occurring within cells, by which glucose and other sugars are broken down to yield lactic acid or pyruvic acid, releasing energy in the form of adenosine triphosphate.

Glycosuria
Glycosuria in pregnancy is not diagnostic of diabetes as the renal threshold for glucose is lowered in pregnancy; however, two consecutive episodes of glycosuria would indicate the need for an oral glucose tolerance test.
Levels of glycosuria should not be used to monitor glycaemic control in the pregnant woman with pre-existing or gestational diabetes.

Haemoglobin A_{1c} (HbA_{1c})
HbA_{1c} is the measurement of glycoslated haemoglobin. It reflects the average blood glucose level in the preceding 6-8 weeks.

Health Promotion
The WHO defines Health Promotion as the process of enabling people to take control over and improve their own health.

Hyperglycaemia
A raised level of glucose in the blood.

Hyperosmolar non-ketotic syndrome (HONK)
A syndrome characterised by the gradual development of marked hyperglycaemia, dehydration and prerenal uraemia, without significant ketosis and acidosis.
Precipitating causes include infection, myocardial infarction and treatment with certain diabetogenic drugs. Omission of anti-diabetic drugs may contribute.
Treatment includes aggressive rehydration and electrolyte replacement[2].

Hyperinsulinaemia
High levels of insulin in the blood.

Hypocalcaemia
A low level of calcium in the blood. Hypocalcaemia may occur in the neonate of women with diabetes mellitus, for reasons which are uncertain.

Hypoglycaemia
A low level of glucose in the blood.

Impaired Fasting Glucose (IFG)
Raised fasting levels of glucose but below the level diagnostic of diabetes mellitus.

Impaired Glucose Tolerance (IGT)
Blood glucose levels that are higher than normal but below the level diagnostic of diabetes mellitus.

Insulin
A hormone which allows the cells of the body to absorb glucose from the blood and use it for energy. It also regulates lipid (fat) and protein metabolism.

Insulin Resistance
A reduced biological response to a physiological amount of insulin.

Insulin Sliding Scale
Supplemental insulin given according to blood glucose levels.

Intrauterine Growth Retardation (IUGR)
Symmetrically or asymmetrically small babies.

Intrapartum
The period during labour and delivery.

Ketones
Acidic by-products of fat metabolism. Used as a metabolic fuel source when glucose availability is limited e.g. diabetes, starvation.

Ketonuria
The presence of excess ketones in the urine; in conditions such as diabetes mellitus, disturbed carbohydrate metabolism or in response to starvation (starvation ketosis).

Ketonaemia
The presence of ketone bodies in the blood. In DKA, the plasma ketone body concentrations are often raised 200-300 times normal fasting values.

Macrosomia
Large for dates infant (>90th/95th centile), with a birth weight in excess of 4.5kg at term. Measurement of abdominal circumference by ultrasound is possibly the most reliable form of diagnosing macrosomia.

Microalbuminuria
Tiny amounts of protein in the urine are termed microalbuminuria.

Nephropathy
Diabetic nephropathy refers to the damage to the small vessels of the kidneys. It results in proteinuria, hypertension and progressive renal failure.

Neuropathy
Diabetic neuropathy refers to damage to the nerve fibres caused by diabetes.

Normoglycaemia
A normal level of glucose in the blood.

Obesity
The WHO defines obesity as a disease in which excess body fat has accumulated to the extent that health is adversely affected. A BMI < 30kg/m^2 is classified as obese.

Oral Glucose Tolerance Test (OGTT)
Considered the gold standard means of establishing a diagnosis of diabetes mellitus.

Oral Hypoglycaemic Agents (OHA's)
A group of drugs that lower the level of glucose in the blood, used in Type 2 diabetes if the pancreas still produces some insulin.

Organomegaly
Abnormal enlargement of an organ, particularly an organ of the abdominal cavity.

Perinatal
The period shortly before and after birth. Various definitions offer commencement of perinatal period at 22-28 completed weeks gestation and ending at 7-28 days after birth.

Polyhydramnios
Defined as a quantity of amniotic fluid exceeding 1500ml.

Post-prandial
After a meal.

Pre-eclampsia
Disorder of pregnancy featuring hypertension, proteinuria and oedema.

Pre-prandial
Before a meal.

Respiratory Distress Syndrome (RDS)
Condition caused by a deficiency of surfactant in the baby's lungs.

Retinopathy
Disease of the retina of the eye which may cause visual impairment and blindness.

Steroids
A synthetic hormone given in pregnancy between 24 and 34 weeks gestation, when premature delivery is expected. Used to promote maturation of the fetal lungs through increased surfactant production.

Teratogen
Any agent that can disturb the development of an embryo or fetus.

Tocolytics
Medications used to suppress premature labour.

Type 1 Diabetes Mellitus
Type 1 diabetes mellitus is characterised by an auto-immune destruction of the beta cells of the pancreas. People with Type 1 diabetes mellitus are completely reliant on exogenous insulin for survival.

Type 2 Diabetes Mellitus
Where there is a relative lack of insulin or insulin resistance. It occurs most frequently in adults but is increasingly being diagnosed in younger people. Type 2 diabetes is usually controlled by diet, lifestyle modification and medication. Insulin therapy may be required.

Appendix 2

Abbreviations

AC	Abdominal circumference
ACHOIS	Australian Carbohydrate Intolerance Study in Pregnant Women
ACE	Angiotensin converting enzyme
ACOG	American College of Obstetricians and Gynaecologists
ADA	American Diabetes Association
AGREE	the Appraisal of Guidelines for Research and Evaluation tool
ADIPS	the Australasian Diabetes in Pregnancy Society
BMI	Body mass index
BP	Blood pressure
CAD	Coronary artery disease
CEMACH	Confidential Enquiry into Maternal and Child Health (UK)
CHO	Carbohydrate
CINAHL	Cumulative Index to Nursing and Allied Health Literature
CREST	Clinical Resource Efficiency Support Team (Northern Ireland)
CSII	Continuous subcutaneous insulin infusion
DFI	Diabetes Federation of Ireland
DKA	Diabetic ketoacidosis
FBC	Full blood count
GDM	Gestational diabetes mellitus
HAPO	Hyperglycemia and Adverse Pregnancy Outcome Study (USA)
HbA1c	Glycosylated haemoglobin
HONK	Hyperosmolar non-ketotic syndrome
HSE	Health Service Executive (Ireland)
IDF	International Diabetes Federation
IES	Irish Endocrine Society
IFG	impaired fasting glucose
IGT	impaired glucose tolerance
INDI	Irish Nutrition and Dietetic Institute
IUGR	intra-uterine growth restriction
MiG	Metformin in Gestational Diabetes trial (New Zealand)
NCNM	National Council for the Professional Development of Nursing and Midwifery
NICE	National Institute for Health and Clinical Excellence (England and Wales)
OGTT	Oral glucose tolerance test
OHA	Oral hypoglycaemic agent
PCCC	Primary Community and Continuing Care
PET	Pre-eclamptic toxaemia
PIH	Pregnancy induced hypertension
RCT's	Randomised controlled trials
RDS	Respiratory distress syndrome
SIGN	Scottish Intercollegiate Guidelines Network
SMBG	Self-monitoring of blood glucose
TFT	Thyroid function test
TRAb	TSH-receptor antibodies
TSH	Thyroid stimulating hormone
T1DM	Type 1 diabetes mellitus
T2DM	Type 2 diabetes mellitus
T4	Thyroxine
UTI	Urinary tract infection
U&E	Urea and electrolytes
WHO	World Health Organisation

Appendix 3 Desk top guides

All women with diabetes who are contemplating pregnancy, should ideally be referred for specialist preconception and antenatal care

The possibility of pregnancy should be discussed at each diabetes consultation

Preconception Care

1. Refer for specialist preconception care
2. Start folic acid 5mgs daily
3. Encourage diet & lifestyle modification/ refer to dietitian
4. Replace/discontinue teratogenic medication
5. Achieve tight glycaemic control
6. Screen for complications
7. Avoid conception until good glycaemic control achieved

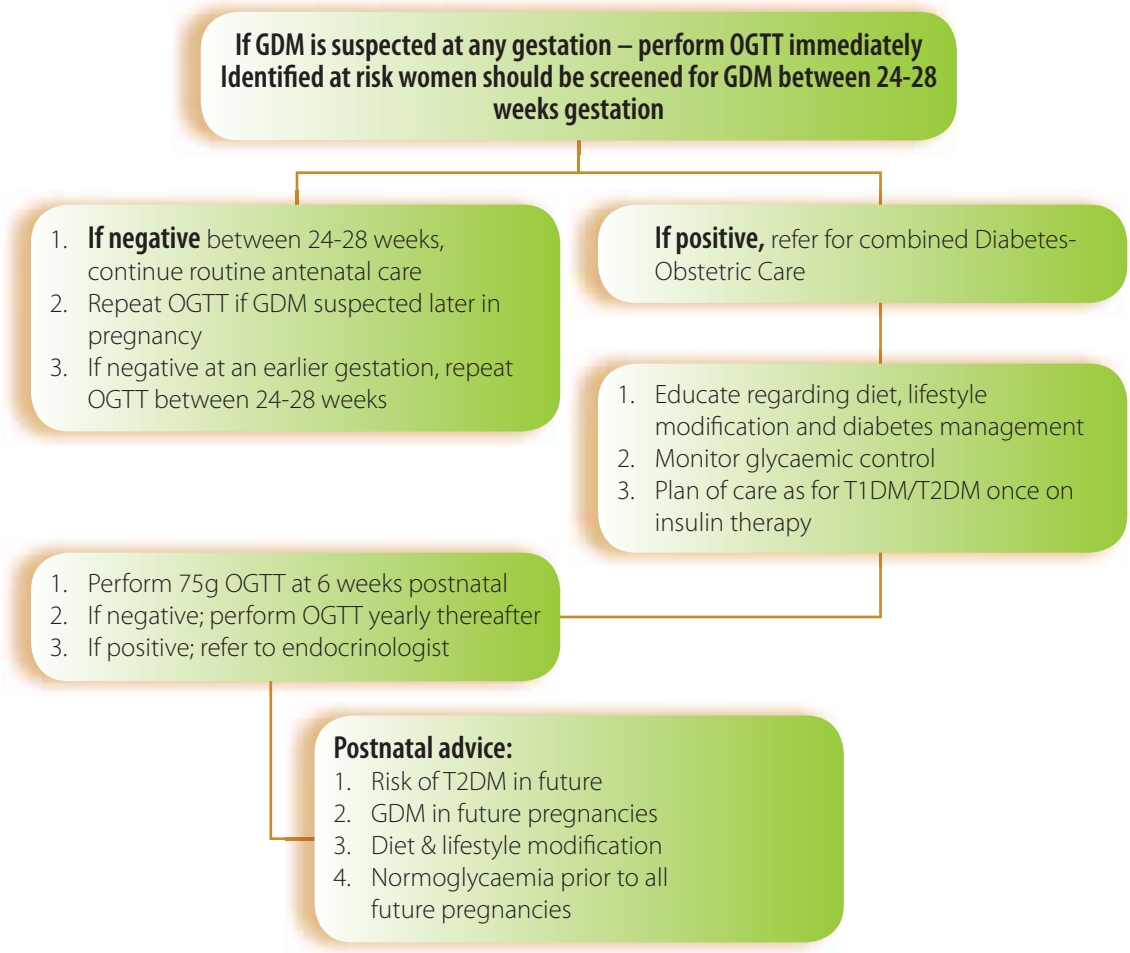
Antenatal Care

1. Refer for specialist multi-disciplinary care
2. Screen for diabetes complications
3. SMBG 7/day
4. Maintain normoglycaemia
5. Close fetal surveillance
6. Deliver in unit with neonatal care facilities

Postnatal Care

1. Resume pre-pregnancy insulin dose
2. Commence suitable OHA's/continue insulin if breastfeeding (T2DM)
3. Where possible, keep baby with mother
4. Discuss future pregnancies and contraception
5. Discuss diet & lifestyle

Appendix 3 Desk top guides (continued)



Appendix 4

Audit Tool

Audit objective

The objective of the audit is to measure actual diabetes in pregnancy practice against the recommended guidelines.

Clinical audit of guidelines can provide valuable information for standard setting and service accreditation[21].

Monitoring diabetes care is not solely employed to highlight success or failure; it should identify and direct us to areas of care where change is needed[66].

Audit criteria and standards

The desired outcomes are that all women should receive the recommended processes of care. In reality, there may be some reasons why this is not immediately achievable in some women.

The standards for each criterion given here are 100%. If these are not achievable in the short term, a more appropriate standard should be set following consultation with local clinicians. Nevertheless, the standards given remain the ultimate objective[10].

Data collection tool

A data collection tool is provided that can be used for the data collection part of the clinical audit by the relevant healthcare provider.

Patient group

The audit is for women with pre-gestational diabetes in pregnancy and gestational diabetes.

Data sources

Most relevant data should be available from patient records. Request for data may be necessary from other sources e.g. Patient records, Laboratory reports, Patient Administration Systems, Hospital Inpatient Enquiry System (HIPE), GP records, Community healthcare records.

Instructions for use

Each statement in the audit tool has been taken from the accompanying diabetes in pregnancy guidelines. Each care setting can assess to what degree they comply with the statements in their own area of practice. It is intended that this audit tool will provide each care setting with a baseline tool through which they can assess their own practice and identify areas which require improvements[22].

Users of this audit tool may add in additional statements, as they deem appropriate and adopt this tool for use in their own setting[22].

For further information or support please contact your local clinical audit team or to find out more about the clinical audit process please refer to:

Health Care Audit Criteria and Guidance (2008) http://hsenet.hse.ie/HSE_Central/Office_of_the_CEO/Quality_and_Risk/Documents/OQR014_2_Healthcare_Audit_Criteria_and_Guidance.pdf or

HSE (2008) Useful Resources for Audit http://www.hse.ie/eng/about/Who/Nursing_Services/Prescribing_of_medicinal_products/Appendix_15.pdf or

United Bristol Healthcare Trust (UBHT) Clinical Audit 'How to guides' 2005, available on http://www.ubht.nhs.uk/healthcare-professionals/clinical-audit.html/

Criteria and Standards for Diabetes in Pregnancy

Preconception Care	
Criterion 1	The possibility of pregnancy should be identified, by direct questioning, at each diabetes consultation, in all women of child-bearing age with diabetes
Target	100%
Exceptions	None
Source of Evidence	Guidelines for the management of pre-gestational diabetes and gestational diabetes from pre-conception to the post-natal period
Guideline Reference	3.1.1 4.1.1
Instructions for Data Collection	Patient case notes
Criterion 2	Women with pre-existing diabetes who are contemplating pregnancy, should be offered advice on the possible teratogenic effect of diabetes on pregnancy
Target	100%
Exceptions	None
Source of Evidence	Guidelines for the management of pre-gestational diabetes and gestational diabetes from pre-conception to the post-natal period
Guideline Reference	3.1.3 4.1.3
Instructions for Data Collection	Patient case notes
Criterion 3	Women with diabetes should be educated on the need for tight glycaemic control prior to conception
Target	100%
Exceptions	None
Source of Evidence	Guidelines for the management of pre-gestational diabetes and gestational diabetes from pre-conception to the post-natal period
Guideline Reference	3.1.4 4.1.4
Instructions for Data Collection	Patient case notes
Antenatal Care	
Criterion 4	Women with diabetes in pregnancy should be offered care by a specialised diabetes-obstetric multi-disciplinary team
Target	100%
Exceptions	None
Source of Evidence	Guidelines for the management of pre-gestational diabetes and gestational diabetes from pre-conception to the post-natal period
Guideline Reference	3.2.1 4.2.1 5.3
Instructions for Data Collection	Patient case notes

Criterion 5	Target capillary blood glucose levels and HbA1c targets should be explained Pre prandial and pre-bed <5.0mmol/L 1hour post prandial <7.0mmol/L HbA1c as near to normal as possible
Target	100%
Exceptions	These targets may not be safely achievable for all women
Source of Evidence	Guidelines for the management of pre-gestational diabetes and gestational diabetes from pre-conception to the post-natal period
Guideline Reference	3.2.2.1 4.2.2.1 5.3.6
Instructions for Data Collection	Patient case notes
Antenatal Care	
Criterion 6	The risk of hypoglycaemia and hypoglycaemic unawareness in pregnancy is explained to all women on insulin treatment
Target	100%
Exceptions	None
Source of Evidence	Guidelines for the management of pre-gestational diabetes and gestational diabetes from pre-conception to the post-natal period
Guideline Reference	3.2.2.3 4.2.2.3 5.3.7
Instructions for Data Collection	Patient case notes
Criterion 7	Women admitted with DKA/HONK should be managed in an high dependency area of care
Target	100%
Exceptions	None
Source of Evidence	Guidelines for the management of pre-gestational diabetes and gestational diabetes from pre-conception to the post-natal period
Guideline Reference	3.2.3.5 4.2.3.4
Instructions for Data Collection	Patient case notes
Criterion 8	Women with pre-existing diabetes should be offered ultrasound screening for fetal anomalies at 18-20 week's gestation
Target	100%
Exceptions	None
Source of Evidence	Guidelines for the management of type 1 diabetes from pre-conception to the post-natal period
Guideline Reference	3.2.4.1 4.2.4.1
Instructions for Data Collection	Patient case notes

Neonatal Care	
Criterion 9	Neonates should be nursed at the mother's bedside unless admission to intensive care is necessary
Target	100%
Exceptions	None
Source of Evidence	Guidelines for the management of pre-gestational diabetes and gestational diabetes from pre-conception to the post-natal period
Guideline Reference	3.3.3 4.3.3 5.5.3
Instructions for Data Collection	Patient case notes
Criterion 10	Early blood glucose testing in the well baby at term should be avoided
Target	100%
Exceptions	None
Source of Evidence	Guidelines for the management of pre-gestational diabetes and gestational diabetes from pre-conception to the post-natal period
Guideline Reference	3.3.3 4.3.3 5.5.3
Instructions for Data Collection	Patient case notes
Postnatal Care	
Criterion 11	Women with GDM should be offered advice on: Diet and lifestyle Risk of GDM in subsequent pregnancies Risk of T2DM in future The need for an annual OGTT
Target	100%
Exceptions	None
Source of Evidence	Guidelines for the management of pre-gestational diabetes and gestational diabetes from pre-conception to the post-natal period
Guideline Reference	5.5.4
Instructions for Data Collection	Patient case notes
Criterion 12	For women with GDM, a 75g OGTT should be performed at 6 weeks postpartum
Target	100%
Exceptions	None
Source of Evidence	Guidelines for the management of pre-gestational diabetes and gestational diabetes from pre-conception to the post-natal period
Guideline Reference	5.5.1
Instructions for Data Collection	Patient case notes

Criterion 13	Women with identified post-natal glucose intolerance should be advised to seek pre-conceptual counselling for any future pregnancies
Target	100%
Exceptions	None
Source of Evidence	Guidelines for the management of pre-gestational diabetes and gestational diabetes from pre-conception to the post-natal period
Guideline Reference	5.5.3
Instructions for Data Collection	Patient case notes

How to measure criteria

1. Add up the numbers of answers recorded for each option and express the total as a raw number and as a percentage.

2. For example, in an audit of 50 patients, the question, "Did the patient attend a preconception clinic?" produces 35 "Yes" answers and 15 "No's".

3. A good way of expressing this data is:
   "Did the patient attend a preconception clinic?" n=50
   Yes 32 (64%)
   No 18 (36%)

4. Notice the "n=50" in the top right corner. The 'n' number tells you how many patients were in the audit sample/population, and is used to calculate percentages, i.e. 32/50 = 64%[69].

Example of Data Collection Tool

Audit ID Number/Hospital Number				
Preconception Care				
Criterion		**Y**	**N**	**Exceptions**
1	Was the possibility of pregnancy identified, by direct questioning, at each consultation?			
2	Was advice offered on the possible teratogenic effect of diabetes on pregnancy?			
3	Was education given on the need for tight glycaemic control prior to conception?			
Antenatal Care				
4	Was care by a specialised diabetes-obstetric multi-disciplinary team offered?			
5	Were target capillary blood glucose levels and HbA1c targets explained?			
6	Was the risk of hypoglycaemia and hypoglycaemic unawareness in pregnancy explained to the woman on insulin treatment?			
7	Was the woman admitted with DKA/HONK managed in a high dependency area of care?			
8	Was ultrasound screening for fetal anomalies offered to the woman with pre-existing diabetes at 18-20 week's gestation?			
Neonatal Care				
9	Was the neonate nursed at the mother's bedside unless admission to intensive care was necessary?			
10	Was early blood glucose testing in the well baby at term avoided?			
Postnatal Care				
11	Was the woman with GDM offered advice on: Diet and lifestyle, risk of GDM in subsequent pregnancies and of T2DM in future, the need for an annual OGTT?			
12	Was a 75g OGTT performed at 6 weeks postpartum for the woman with GDM?			
13	Was the woman with identified post-natal glucose intolerance advised to seek pre-conceptual counselling for any future pregnancies?			

Appendix 5

Example of Insulin Regimen for Labour

Patient Label

1. Standard:

- One Litre of Solution 18 plus 20mmol KCL plus Novorapid_____ Units.
- Infusion is to run over 8 hours (125 mls per hour).
- If labour lasts more than 8 hours:
  Repeat instructions above.
- If LSCS is required:
  Continue insulin infusion

2. Monitoring of blood glucose levels:

- Glucometer readings every 2 hours, or more often if required.

3. Action for Hypoglycaemia:

If Glucometer reading is:	Action
Less than 3.5mmol/L	1. 50 mls Dextrose 10% I.V. stat 2. Re-check glucose levels after 10 minutes

4. Action for Hyperglycaemia using a Sliding Scale as well as the Intravenous regimen:

If Glucometer reading is:	Give this dose of short acting insulin subcutaneously
mmol/L	Novorapid iu
mmol/L	Novorapid iu
mmol/L	Novorapid iu
mmol/L	Novorapid iu

5. Instructions for management of Diabetes after Delivery

Women who have Type 1 Diabetes:

- Insulin infusion required until tolerating diet and fluids, then return to pre-pregnancy dose as prescribed below:

Women who have Type 1 Diabetes who cannot tolerate diet; need a new Insulin regimen as follows:

- Standard: One Litre of Solution 18 plus 20mmol KCL plus Novorapid_____ Units.
- Infusion is to run over 8 hours (125 mls per hour) until tolerating diet and fluids.

Women who have Type 2 Diabetes:

- Stop insulin after delivery and return to routine medical management.
- If breastfeeding continue insulin as prescribed or commence appropriate oral hypoglycaemic agent as prescribed below:

- Monitor glucose levels pre-meals.
- Contact diabetes team if glucose levels are >8 mmol/L.

Women who have Gestational Diabetes who required insulin during pregnancy:

- Stop insulin after delivery.
- Monitor blood glucose levels pre-meals x 48 hours.

Doctor's signature
Date

Example of Insulin regimen for women who use a Continuous Sub-cutaneous Insulin Infusion Pump (CSII) for Labour

Patient Label

1. Basal Rate:

Time	Rate

Continue basal rate if LSCS is required

2. Monitoring of glucose levels:

- Glucometer readings every 2 hours, or more often if required.

3. Action for Hypoglycaemia:

If Glucometer reading is:	Action
Less than 3.5mmol	1. 50 mls Dextrose 10% I.V. stat 2. Re-check glucose levels after 10 minutes

4. Action for Hyperglycaemia using a Sliding Scale as well as the CSII pump regimen:

Sliding Scale

If Glucometer reading is:	Give this dose of short acting insulin via the CSII pump
mmol/L	Novorapid or Humalog iu
mmol/L	Novorapid or Humalog iu
mmol/L	Novorapid or Humalog iu
mmol/L	Novorapid or Humalog iu
mmol/L	Novorapid or Humalog iu

5. Insulin regimen after delivery for CSII pump users

Basal Rate:

Time	Rate
12mn-7am	
7am -12md	
12md-6pm	
6pm-12mn	

Bolus:

Time	Ratio
Breakfast	1:
Lunch	1:
Dinner	1:

Doctor's signature
Date

Appendix 6

The HbA_{1c} test is used to assess the adequacy of blood glucose control over the preceding two to three months and is now universally used to guide diabetes management. The agreed commencement date for dual reporting of HbA_{1c} results in Ireland is July 1st, 2010[70].

HbA_{1c} Conversion Table

HbA_{1c} (IFCC) mmol/mol	HbA_{1c} (DCCT) %	HbA_{1c} (IFCC) mmol/mol	HbA_{1c} (DCCT) %
21	4.1	51	6.8
22	4.2	52	6.9
23	4.3	53	7.0
24	4.3	54	7.1
25	4.4	55	7.2
26	4.5	56	7.3
27	4.6	57	7.4
28	4.7	58	7.5
29	4.8	59	7.5
30	4.9	60	7.6
31	5.0	61	7.7
32	5.1	62	7.8
33	5.2	63	7.9
34	5.3	64	8.0
35	5.4	65	8.1
36	5.4	66	8.2
37	5.5	67	8.3
38	5.6	68	8.4
39	5.7	69	8.5
40	5.8	70	8.6
41	5.9	71	8.6
42	6.0	72	8.7
43	6.1	73	8.8
44	6.2	74	8.9
45	6.3	75	9.0
46	6.4	76	9.1
47	6.5	77	9.2
48	6.5	78	9.3
49	6.6	79	9.4
50	6.7	80	9.5

Source: HSE Project Team on the Implementation of the International Standardisation of HbA_{1c} (Chairperson: Dr. Ned Barrett).

HbA_{1c} Conversion Table

HbA_{1c} (IFCC) mmol/mol	HbA_{1c} (DCCT) %	HbA_{1c} (IFCC) mmol/mol	HbA_{1c} (DCCT) %
81	9.6	111	12.3
82	9.7	112	12.4
83	9.7	113	12.5
84	9.8	114	12.6
85	9.9	115	12.7
86	10.0	116	12.8
87	10.1	117	12.9
88	10.2	118	12.9
89	10.3	119	13.0
90	10.4	120	13.1
91	10.5	121	13.2
92	10.6	122	13.3
93	10.7	123	13.4
94	10.8	124	13.5
95	10.8	125	13.6
96	10.9	126	13.7
97	11.0	127	13.8
98	11.1	128	13.9
99	11.2	129	14.0
100	11.3	130	14.0
101	11.4	131	14.1
102	11.5	132	14.2
103	11.6	133	14.3
104	11.7	134	14.4
105	11.8	135	14.5
106	11.8	136	14.6
107	11.9	137	14.7
108	12.0	138	14.8
109	12.1	139	14.9
110	12.2	140	15.0

Source: HSE Project Team on the Implementation of the International Standardisation of HbA_{1c} (Chairperson: Dr. Ned Barrett).

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