

JBDS-IP Joint British
Diabetes Societies
for inpatient care

Management of glycaemic control in
pregnant women with diabetes on obstetric
wards and delivery units

May 2017





This document is coded JBDS 12 in the series of JBDS documents:

Other JBDS documents:

Management of adults with diabetes on the haemodialysis unit April 2016 JBDS 11

Discharge planning for adult inpatients with diabetes October 2015 JBDS 10

The use of variable rate intravenous insulin infusion (VRIII) in medical inpatients October 2014 JBDS 09

Management of Hyperglycaemia and Steroid (Glucocorticoid) Therapy October 2014 JBDS 08

Admissions avoidance and diabetes: guidance for clinical commissioning groups and clinical teams
December 2013 JBDS 07

The management of the hyperosmolar hyperglycaemic state (HHS) in adults with diabetes August 2012
JBDS 06

Glycaemic management during the inpatient enteral feeding of stroke patients with diabetes June 2012
JBDS 05

Self-Management of Diabetes in Hospital March 2012 JBDS 04

Management of adults with diabetes undergoing surgery and elective procedures: improving standards
April 2011 JBDS 03

The Management of Diabetic Ketoacidosis in Adults Revised September 2013 JBDS 02

The Hospital Management of Hypoglycaemia in Adults with Diabetes Mellitus Revised September 2013
JBDS 01

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www.diabetologists-abcd.org.uk/JBDS/JBDS.htm
and the Diabetes UK website at
www.diabetes.org.uk/joint-british-diabetes-society**

We are eager to find out about your experiences using this guideline, particularly any data from audits of its use in situ. This will be used in the next update of the guideline. Please contact Dr Umesh Dashora u.dashora@nhs.net

Scope of the guideline

This guideline provides guidance on the management of women with pre-existing diabetes (type 1 or type 2), or gestational diabetes when admitted to maternity units in the following situations:

- Induction of labour and delivery
- Steroid administration for lung maturation if risk of premature labour
- Specific issues in relation to diabetic ketoacidosis in pregnancy
(Please also see JBDS DKA guidelines)

This document is designed to support management of glycaemic control when pregnant women with diabetes are admitted to obstetric wards. It does not cover special circumstances when the patients may be under the joint care of anaesthetists and obstetricians during labour where less stringent targets may be used (please see Appendix 3)

Additional JBDS guidelines may be helpful in certain situations. We make the following recommendations for those circumstances.

Diabetic Ketoacidosis (DKA) The management of DKA in Adults [JBDS 02; March 2012, revised June 2013]
www.diabetologists-abcd.org.uk/JBDS/JBDS_IP_DKA_Adults_Revised.pdf

Hyperosmolar hyperglycaemic State (HHS) The management of the hyperosmolar hyperglycaemic state [JBDS 06; August 2012] **www.diabetologists-abcd.org.uk/JBDS/JBDS_IP_HHS_Adults.pdf**

Who should read these guidelines?

All members of the hospital diabetes specialist team (DST) and hospital obstetrics specialist team

All medical and nursing staff and allied healthcare professionals looking after pregnant ladies during delivery

Midwives involved with the care of pregnant ladies with diabetes

Trust Clinical Governance Leads and Risk Officers

Clinical and service managers covering obstetric and diabetes services

Terms and Abbreviations

ADA	American Diabetes Association
ARM	Artificial Rupture of Membranes
BG	Blood glucose
CBG	Capillary Blood Glucose
CEMACH	Confidential Enquiry into Maternal and Child Health
CGM	Continuous Glucose Monitoring
CSII	Continuous Subcutaneous Insulin Infusion
MDI	Multiple Daily Injections
DKA	Diabetic Ketoacidosis
GDM	Gestational Diabetes
GI	Glycaemic Index
HHS	Hyperosmolar Hyperglycaemic State
IOL	Induction of labour
IADPSG	International Association of Diabetes in Pregnancy Study Group
LSCS	Lower Segment Caesarean Section
MODY	Maturity Onset Diabetes of the Young
OGTT	Oral Glucose Tolerance Test
PCOS	Polycystic Ovary Syndrome
KCl	Potassium Chloride
PET	Pre Eclamptic Toxaemia
RDS	Respiratory Distress Syndrome
NaCl	Sodium Chloride
NICE	The National Institute for Health and Care Excellence
TDD	Total Daily Dose
TPN	Total Parenteral Nutrition
U + Es	Urea and Electrolytes
VRIII	Variable rate intravenous insulin infusion
WHO	World Health Organisation

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Foreword

It is recognised that there is considerable variation in the criteria used for diagnosing and managing diabetes in pregnancy and considerable variation in the protocols across NHS Trusts where they exist. While NICE advice on the target blood glucose range is clear (4.0 -7.8 mmol/L during pregnancy and 4.0-7.0 mmol/L during labour and delivery), there is no consensus on the urgency and/or the best route of insulin delivery (intravenous or subcutaneous) to achieve target glucose levels before and during delivery with increasing numbers of women preferring to continue their own insulin pumps and self-manage their diabetes.

It is also acknowledged that the type of diabetes (type 1, type 2 or gestational) would vary among this group of patients and may require different approaches depending upon the risk factors, antenatal treatment (diet, metformin, insulin), risk of hypoglycaemia, risk of anaesthesia and the presence of complications like macrosomia, polyhydramnios etc. Individual targets may therefore be needed. Many of these issues are beyond the scope of this guideline.

There is increasing consensus that achieving tight glycaemic control safely is desirable in all pregnant women with diabetes when admitted to maternity units. At such times, there are often multiple healthcare professionals involved in the care of the woman, many of whom have little knowledge of diabetes. Furthermore, these healthcare professionals are often caring for women who are expert in self-managing their own diabetes; some can feel highly vulnerable leaving their glucose control 'in the hands' of less experienced staff.

In response to these issues, the Joint British Diabetes Societies (JBDS) for Inpatient Care has produced this guideline. It has been designed to be a practical guide to be used by any healthcare professional who manages obstetric inpatients with hyperglycaemia. Its main aim is to provide a consensus guide to optimum management of diabetes in this group of patients to minimise risk to mothers and babies.

It is divided into several sections, including the evidence base for recommendations to control hyperglycaemia and the practicalities of using therapies. Appendices 1 and 2 have been designed to be used as stand-alone prescriptions and documents which can be easily adapted and used on the wards. Appendix 3 gives an alternative view on glycaemic management during the delivery period. It is hoped that its adoption nationally will help harmonise management of diabetes in obstetric settings and therefore enable local, regional and national audits to be carried out. This process will allow continuous refinement of the guidance.



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1 Key recommendations

- CBG should be monitored hourly when mothers are administered steroids in pregnancy. The most effective way to control steroid-induced hyperglycaemia is by using VRIII (Appendix 1).
- All women with diabetes of any type should have hourly CBG monitoring in established labour. CBG should also be done on the morning of elective caesarean section. If general anaesthesia is used, monitoring should be every half an hour until the baby is born and the mother is fully conscious.
- Maintain CBG in labour in the target range according to the NICE guidelines (4-7 mmol/L).
- All patients with type 1 diabetes and some patients with type 2 diabetes or GDM may require VRIII in established labour to keep the CBGs in this range. An example pre-printed prescription chart and guidance is attached with this guideline (see Appendix 2).
- Women who are on an insulin pump may choose to remain on CSII (in agreement with their treating physicians) unless they are not able or willing to continue pump therapy during labour.
- Reduce the rate of VRIII (if and when used) by 50% (or change to the lowest scale) once placenta is delivered. Contact the diabetes teams to review the on-going insulin requirement in insulin treated patients with type 1 and type 2 diabetes. The insulin dose may be 25% less than the doses needed at the end of first trimester.
- These mothers are at increased risk of hypoglycaemia especially when breast feeding and should have additional carbohydrate with meal or as a snack available during or before food.
- Stop all antidiabetic medications at delivery in all patients with gestational diabetes. Continue monitoring CBG pre and 1 hour post meal for up to 24 hours to capture pre-existing diabetes, new onset diabetes and to avoid hypoglycaemia.
- If breast feeding, women with pre-existing type 2 diabetes can take metformin and glibenclamide after birth, but should avoid other oral anti-diabetic treatments.
- Breast feeding women should continue to withhold other medications that were stopped after conception.

2 Introduction

Pre-existing diabetes (Type 1 and Type 2) is known to affect maternal wellbeing, fetal health and obstetric outcome. There is international consensus over the importance of tight glucose control before conception and throughout pregnancy to optimise pregnancy outcomes.

This guideline will aim to provide consensus target glucose levels which should be aimed for while managing diabetes in pregnant inpatients on maternity units.

The recommendations in this guideline are based on a combination of published research evidence, guidelines from other JBDS groups where relevant, and consensus of experts who contributed to the development of this guideline.

The emphasis throughout this guideline is on the safe use of insulin to achieve best possible obstetric outcome for both mother and baby.

It will not replace the need for referral to local diabetes team as soon as possible after admission so that individual patients' needs may be assessed and appropriate action taken. This may not be possible in some trusts depending on availability of expertise so local policies should be followed.

We recommend that healthcare professionals also complete free e-learning module on insulin treatment at: www.diabetesonthenet.com/

3 Background and Definitions

3.1 Background

Many women with diabetes require hospital admissions during pregnancy. They also require an individualised care plan which can cope with the changing insulin requirements before, during and after delivery. There is evidence that if blood glucose levels are poorly controlled, the obstetric outcomes for both mother and babies are poor.¹ This evidence is strong, both for women with pre-existing and for those with Gestational Diabetes (GDM).² While there is evidence that striving for near-normal glucose control improves clinical outcomes, achieving it has significant resource, clinical and public health implications.

3.2 Definitions

The main types of diabetes likely to be encountered on the obstetric wards are as follows.^{3,4}

- Type 1 diabetes.
- Type 2 diabetes.
- Gestational diabetes (GDM) i.e. diabetes first detected in pregnancy. This may include some patients with pre-gestational (pre-existing) diabetes.
- Specific types of diabetes due to other causes. This may include women with monogenic diabetes or maturity-onset diabetes of the young (MODY), cystic fibrosis, pancreatitis related diabetes and chemical or drug induced diabetes. The management of this group of patients is beyond the scope this guideline. Seek advice from the diabetes specialist team.

3.2.1 Variable Rate intravenous Insulin Infusion (VRIII)

Blood glucose targets are kept within a tight specific range throughout pregnancy (4.0 -7.8 mmol/L). Tight glycaemic target remains important during labour and delivery (4.0-7.0 mmol/L). It is commonly managed by an intravenous infusion of glucose and insulin that is adjusted according to hourly capillary blood glucose (CBG). This method is used in many centres in the UK on medical and surgical wards and can be adapted for obstetric wards.^{5,6}

3.2.2 Continuous Subcutaneous Insulin Infusion (Insulin pump):

Women with type 1 diabetes are increasingly using insulin pump therapy which can also be used to safely achieve optimal glucose control during pregnancy, labour and delivery.

4 Controversial areas

There are some areas in the management of diabetes during labour where practices vary from hospital to hospital. JBDS IP has suggested a consensus approach in this document but further work will be done by auditing the results of this approach in future to find the ideal way of controlling diabetes in these women.

4.1 What should be the target CBG be during labour and delivery?

There is no high quality evidence in the literature to guide us about the exact target CBG to aim for during delivery and labour. Some observational studies have suggested keeping the CBG within a tight range of 4.0-7.0 mmol/L to reduce the incidence of neonatal hypoglycaemia. The consequence of such a target is the increased support needed for monitoring these women closely, requirement of training of staff regularly and higher risk of maternal hypoglycaemia. Other studies have questioned these targets and their relationship to the occurrence of neonatal hypoglycaemia. Furthermore there is no clearly defined cut-off for neonatal hypoglycaemia. These studies have therefore suggested a slightly relaxed target of 4.0-8.0 mmol/L. The approach would result in avoidance of VRIII and possibly reduced maternal hypoglycaemia in some women but may increase the risk of neonatal hypoglycaemia which may potentially affect the baby's neurological development later in life.

Many anaesthetists have significant and legitimate concerns about the risk of hypoglycaemia during VRIII in women having general or regional anaesthesia. Clinical diabetes and obstetric teams should discuss these issues with anaesthetic colleagues in each Trust. See Appendix 3 for more details.

4.2 How to maintain CBG in the target range in women receiving steroids?

There is no consensus on how best to maintain CBG in the target range when steroids are administered for preterm labour. Practices vary depending upon the experience of the staff and the quality of resources available.

Continuing long-acting subcutaneous basal insulin but adding VRIII has the advantage of flexibility of rapid dose adjustment and more effective control but requires more intensive input from the midwifery staff.

In patients who are eating and drinking there is the additional problem of meal related glucose rise which may not be so effectively controlled with VRIII. Some trusts have protocols where both rapid-acting and long-acting insulin are continued as usual and VRIII is added to improve any remaining glucose excursions. This approach is likely to be more effective but can cause confusion amongst the staff who may not be familiar with this approach.

When giving VRIII the practice of adding substrate fluid also varies in different hospitals. Some units give only insulin but no dextrose containing fluids to avoid hyperglycaemia, fluid overload and hyponatraemia whereas other units give insulin with substrate glucose containing fluids to avoid the risk of hypoglycaemia.

Some clinicians control steroid-induced hyperglycaemia by adjusting subcutaneous insulin dose according to a set protocol at the time of starting steroids. This approach would avoid the use of VRIII but may not be always effective in controlling CBG.

5 Glycaemic control during steroid administration for promotion of fetal lung maturity

The CEMACH (Confidential Enquiry in to Maternal and Child Health) of women with type 1 and type 2 diabetes showed that the prevalence of delivery before 37 weeks was 36%⁷ With this high risk of preterm delivery, the use of steroids for lung maturation is a common occurrence in late pregnancy.

NICE guidelines (2015) recommend steroids are used in all women at risk of preterm labour to aid fetal lung maturation. This will usually be associated with a rapid deterioration in maternal glycaemic control and even precipitation of diabetic ketoacidosis (DKA). **NICE** therefore recommends women with insulin-treated diabetes are given additional insulin according to an agreed protocol and are monitored closely.⁴

5.1 Evidence base for glycaemic management with steroid use

There is limited research with only three studies of insulin regimes and glycaemic management during and after steroid administration.

Mathiesen and colleagues describe their experience of use of an insulin algorithm.⁸ Betamethasone 12 mg was given and repeated 24 hours later. Eight women (control group) were managed with usual insulin dose adjustments based on blood glucose levels. In the other eight women (study group) the following percentage increase in insulin regime was used (compared to the pre-steroid doses).

Day 1 (the day on which the first betamethasone injection is given), the night insulin dose increased by 25%

Day 2, all insulin doses increased by 40%

Day 3, all insulin doses increased by 40%

Day 4, all insulin doses increased by 20%

Day 5, all insulin doses increased by 10–20% (all compared to pre-steroid doses)

Days 6 and 7, insulin doses reduced to pre-steroid doses

There was substantial individual variation and it was difficult to achieve and maintain tight glycaemic control (4-7 mmol/L) in both the study and control groups.

In the UK study by Kaushal and colleagues, 8 women (5 pre-existing diabetes, 3 GDM) requiring steroids were given additional insulin via VRIII.⁹ This was started immediately before the first injection of dexamethasone and continued for at least 12 hours after the second injection. They found high doses of supplementary insulin were required (median dose 74 U, range 32–88 U) to maintain median glucose levels between 5.8-8.9 mmol/L with 75% of glucose levels between 4-10 mmol/L.

Dashora and Taylor showed that when steroids were used to control hyperemesis in pregnant ladies with diabetes, a 40% increase with the first dose of steroids maintained glycaemic control.¹⁰ Although this was not in the context of labour, it may help inform a clinician about the approximate increase in the insulin dose needed.

It should be noted that these studies predated the widespread use of insulin analogues.

5.2 Practical guidance for management of glycaemia during steroid use in patients on oral treatment and/or single or multiple dose insulin therapy

Administration of antenatal steroids for fetal lung maturity is considered for all women at risk for preterm birth up to 35⁺⁶ weeks.¹¹ Administration of steroids may result in a deterioration of glycaemic control for 2 to 3 days. This should be anticipated and actively managed.

- Check U+Es prior to starting VRIII to monitor fluid balance and electrolyte abnormalities. Repeat 24 hourly.
- With the first dose of steroids, start intravenous insulin infusion (VRIII) (50 units human soluble [Humulin® S] insulin or Actrapid® insulin made up to 50 ml with 0.9% NaCl). Use the scale in table below. Continuous intravenous insulin may be needed until 24 hours after the administration of the second dose of steroids.
- Basal insulin needs to be continued as usual. We recommend that meal time insulin should be stopped even if the patient is eating and drinking to keep the insulin regimen simple. Some centres may like to continue to use both meal time and basal insulin to control post prandial and pre-meal glucose.
- Target blood glucose (BG) 4-7.8 mmol/L pre and post-meal.
- Check CBG level hourly.
- We recommend 0.9% NaCl with 5% glucose and 0.15% KCl (20 mmol/L) or 0.3% KCl (40 mmol/L) as the substrate fluid with i.v. insulin to avoid hypoglycaemia, hyponatraemia and hypokalaemia. The rate of substrate infusion should take into account the volume status but generally 50 ml/hr would be reasonable. Please see the prescription chart (Appendix 1) for more details. Additional fluids intravenously may be needed if the patient is not eating or drinking reliably. Fluids, particularly dextrose containing fluids, may have to be restricted in patients who are at risk of or already have hyponatraemia. In some cases insulin without substrate fluids may have to be used (difficult i.v. access, fluid overload states, hyponatraemia or risk of hyponatraemia). Please consult senior medical/ obstetric staff as needed.

Table 1: VRIII for use during administration of antenatal steroids (50 units Human soluble insulin (Humulin® S or Actrapid®) insulin in 49.5 ml 0.9% NaCl via syringe driver)

	DOSING ALGORITHM (Please see the guide below)		
Algorithm >	1	2	3
	For most women	For women not controlled on algorithm 1 or needing > 80 units/day of insulin	For women not controlled on algorithm 2 (after specialist advice)
CBG Levels (mmol/L)	Infusion Rate (units/hr = ml/hr)		
< 4	STOP INSULIN FOR 20 MINUTES Treat hypo as per guideline (re-check CBG in 10 minutes)		
4.0 – 5.5	0.2	0.5	1.0
5.6 – 7.0	0.5	1.0	2.0
7.1 – 8.5	1.0	1.5	3.0
8.6 – 11.0	1.5	2.0	4.0
11.1 – 14.0	2.0	2.5	5.0
14.1 – 17.0	2.5	3.0	6.0
17.1 – 20.0	3.0	4.0	7.0
> 20.1	4.0	6.0	8.0

ALGORITHM GUIDE
<ul style="list-style-type: none"> • ALL women with diabetes should have Capillary Blood Glucose (CBG) testing hourly whilst on VRIII for the management of steroid hyperglycaemia during pregnancy • Start VRIII and Fluids with the first dose of steroids and continue for up to 24 hours after the last dose of steroids
Algorithm 1 Most women will start here
Algorithm 2 Use this algorithm for women who are likely to require more insulin (on steroids; on >80 units of insulin during pregnancy; or those not achieving target on algorithm 1)
Algorithm 3 Use this for women who are not achieving target on algorithm 2 (No patient starts here without diabetes or medical review)
If the woman is not achieving targets with these algorithms, contact the diabetes team (out of hours: Medical SpR on call)
Target CBG level = 4 – 7.8 mmol/L
Check CBG every hour whilst on VRIII
Move to the higher algorithm if the CBG is > target and is not dropping
Move to the lower algorithm if CBG falls below 4 mmol/L or is dropping too fast

For hypoglycaemia management see JBDS guidelines:

www.diabetologists-abcd.org.uk/subsite/JBDS_IP_Hypo_Adults_Revised.pdf

5.3 Insulin pump therapy during steroids

- The specialist diabetes team should be involved in the management of these patients.
- Women on insulin pump therapy may be able to safely maintain glycaemic control following steroid administration by use of correction boluses and temporary basal rate increases. In general approximately 40% increase in insulin doses may be needed.
- If optimal glycaemic control cannot be achieved (e.g. 2 consecutive blood glucose readings > 7.8 mmol/L), a variable rate intravenous insulin infusion (VRII) may need to be considered. Switch off insulin pump for future use.

6 Glycaemic control during labour and delivery

6.1 Evidence in relation to tight glycaemic control during labour

Neonatal hypoglycaemia results from excessive insulin production in the fetus as a result of maternal hyperglycaemia and glucose transfer through the placenta.¹² This can result in increased neonatal insulin production after delivery leading to neonatal hypoglycaemia. By contrast, babies of mothers with normal glucose tolerance have a slow insulin response resulting in higher glucose levels after birth.

Some but not all, studies in women with diabetes (see Table 6.2) suggest that maternal hyperglycaemia during labour is associated with an increased risk of neonatal hypoglycaemia.¹²⁻¹⁸ In the UK study by Taylor and colleagues, there was a moderate correlation between maternal hyperglycaemia during labour and neonatal hypoglycaemia. Neonatal hypoglycaemia (<2.5 mmol/L) was associated with maternal glucose levels above 8 mmol/L. In contrast, when maternal glucose levels were maintained below 7 mmol/L during labour, no babies developed hypoglycaemia.¹³

Another study of 137 women (23 pre-existing diabetes and 114 GDM)¹⁹ has shown that with watchful management, a VRIII can often be avoided. In this Australian study 75% women with pre-existing diabetes and 90% with GDM maintained glucose levels between 4-8 mmol/L without VRIII. In contrast to previous studies, these authors found that most neonatal hypoglycaemia (<2.6 mmol/L) occurred in mothers who maintained satisfactory intrapartum glucose control. In another study reporting on the impact of relaxing CBG targets during labour, Taylor and colleagues recommended a target of 4-8 mmol/L during labour to reduce the risk of maternal hypoglycaemia without increasing neonatal hypoglycaemia.²⁰

Fetal hyperinsulinaemia may not only be because of high glucose level during labour but may also have its origin in poor diabetes control during pregnancy.²¹ Consequently tight glycaemic control during labour may be helpful but may not completely reverse fetal hyperinsulinaemia and its consequences.

6.2 Table showing a summary of evidence

Author	Year	Number	Diabetes type	Results
Andersen ¹⁴	1985	53	Type 1 and 2	Negative correlation between maternal BG and fetal BG, $r = -0.46$, $p < 0.001$.
Miodovnik ¹⁵	1987	122	Type 1	47% babies hypo if maternal BG > 5 mmol/L vs 14% if maternal BG < 5 mmol/L.
Curet ¹⁶	1997	233	Type 1 and 2	Maternal BG was lower when no neonatal hypoglycaemia.
Lean ¹⁷	1990	25	Insulin treated	Negative correlation between maternal BG and fetal BG, $r = -0.58$, $p = 0.01$.
Balsells ¹⁸	2000	85	GDM	Association between maternal BG in last 2 hours before delivery and neonatal hypoglycaemia.
Taylor ¹³	2002	107	Type 1	Negative correlation between maternal BG and fetal BG, $r = -0.33$, $p < 0.001$.
Barrett ¹⁹	2009	114	GDM, type 1 and type 2	Neonatal hypoglycaemia occurred in spite of CBG in the range of 4-8 mmol/L. Target CBG maintained without VRIII.
Carron Brown ²⁰	1999	120	Type 1	Neonatal hypoglycaemia did not increase if the mother's CBG remained between 4-8 mmol/L. Maternal hypoglycaemia reduced (from 40% to 22.5% with the relaxed targets).

6.3 Evidence and recommendations in the UK

The above evidence has been reviewed by NICE guidelines (2015) committee and the final recommendations suggest:⁴

*Monitoring of plasma glucose hourly during labour and birth in **all** women with diabetes, ensuring it is maintained between 4 and 7 mmol/L. Intravenous dextrose and insulin infusion should be considered for women with type 1 diabetes from the onset of established labour. Use intravenous dextrose and insulin infusion during labour and birth for women with diabetes whose capillary blood glucose is not maintained between 4 and 7 mmol/L.*

JBDS-IP therefore recommends a target of 4-7 mmol/L. Patients who are undergoing regional analgesia or general anaesthesia are particularly vulnerable to maternal hypoglycaemia and an individualised and more relaxed target may be more appropriate and safer in some cases.²² This is discussed further in Appendix 3

JBDS-IP recommends that the midwives should have at least two hours of training and yearly updates on managing VRIII. The unit should be supported by a daily ward round from the diabetes team.

6.4 Practical guidance for management of glucose control during labour and delivery for women on metformin or Multiple Daily Injections (MDI)

- The day prior to induction, and during cervical ripening, CBG testing, insulin and oral glucose lowering drugs should continue as usual.
- Once in established labour, check CBG hourly. Stop meal time insulin (and metformin if taken) but continue long acting basal insulin once VRIII is started (See below).
- If CBG is less than 4.0 mmol/L, then treat hypoglycaemia with appropriate food/drink or commence iv 5% Dextrose infusion if nil by mouth.
- Start VRIII in all women with type 1 diabetes using multiple daily injections at the time of established labour.
- CBG should also be done on the morning of elective caesarean section. If general anaesthesia is used, monitoring should be every half an hour until the baby is born and the mother is fully conscious.
- In women with type 2 diabetes or GDM, VRIII should be started if two consecutive blood glucose levels are above 7 mmol/L. The second CBG should be within half an hour of the first high reading to prevent any delay in starting VRIII. For VRIII, a syringe pump is set up with 50 units human soluble insulin Humulin® S or Actrapid® insulin in 49.5 ml of normal saline (see table below for regime and Appendix 2 as an example).
- If elective caesarean section is planned in the morning, a VRIII can be set up at about 6 a.m., or earlier if blood glucose levels are unstable overnight.
- Women using insulin Glargine (Lantus®, Toujeo®), Detemir (Levemir®), NPH insulin (Insulatard®), Insuman® Basal or Humulin® I as background insulin should continue their basal insulin during labour but discontinue the short-acting insulin when VRIII is started.
- For all women on hourly monitoring CBG should be maintained within target (4-7 mmol/L).
- We recommend 0.9% NaCl with 5% glucose and 0.15% KCl (20 mmol/L) or 0.3% KCl (40 mmol/L) as the substrate fluid with VRIII to avoid hypoglycaemia, hyponatraemia and hypokalaemia. The fluid should run at 50 ml/hr (the rate may have to be adjusted to the volume status of the patient). Please see Appendix 2 for more details. Additional fluids intravenously may be needed as per clinical need. Fluids, particularly dextrose containing fluids, may have to be restricted in patients who are at risk of or already have hyponatraemia (patients receiving oxytocin). In some cases insulin without substrate fluids may have to be used (difficult i.v. access, fluid overload states, hyponatraemia or risk of hyponatraemia). Particular care relating to the fluid management is needed in those women with diabetes who additionally are on a pre-eclamptic toxoemia protocol and thus require fluid restriction plus intravenous medications such as oxytocin, labetalol, magnesium infusion or a combination of these.
- Check U+Es 4–6 hourly during labour to maintain potassium and bicarbonate. Use blood ketones if available and if ketoacidosis is suspected (see the section of ketoacidosis).
- Following delivery of the placenta the insulin infusion rate should be reduced by 50% in women with type 1 and type 2 diabetes and stopped in women with GDM. In women with pre-existing diabetes, pre-pregnancy insulin regimen should be resumed once eating and drinking. The doses should be as pre-advised by diabetes team or 25% less than early pregnancy doses. CBG may need to be monitored before and 1 hour after meal for up to 24 hours in gestational diabetes to ensure euglycaemia and pick up new or pre-existing diabetes. Women with pre-existing diabetes should resume their usual pre-pregnancy monitoring regimen.

Table 2: Suggested VRIII for use during labour: (50 units Actrapid® or Humulin® S insulin in 49.5 ml 0.9% NaCl via syringe driver)

	DOSING ALGORITHM (Please see the guide below)		
Algorithm >	1	2	3
	For most women	For women not controlled on algorithm 1 or needing > 80 units/day of insulin	For women not controlled on algorithm 2 (after specialist advice)
CBG Levels (mmol/L)	Infusion Rate (units/hr = ml/hr)		
< 4	STOP INSULIN FOR 20 MINUTES Treat hypo as per guideline (re-check CBG in 10 minutes)		
4.0 – 5.5	0.2	0.5	1.0
5.6 – 7.0	0.5	1.0	2.0
7.1 – 8.5	1.0	1.5	3.0
8.6 – 11.0	1.5	2.0	4.0
11.1 – 14.0	2.0	2.5	5.0
14.1 – 17.0	2.5	3.0	6.0
17.1 – 20.0	3.0	4.0	7.0
> 20.1	4.0	6.0	8.0

ALGORITHM GUIDE
<ul style="list-style-type: none"> ALL women with diabetes should have Capillary Blood Glucose (CBG) testing hourly in established labour and at least once on admission for induction of labour or elective C-section Start VRIII and Fluids if CBG > target (see below) or at the start of established labour if the woman has type 1 diabetes
<p>Algorithm 1 Most women will start here</p> <p>Algorithm 2 Use this algorithm for women who are likely to require more insulin (on steroids; on > 80 units of insulin during pregnancy; or those not achieving target on algorithm 1)</p> <p>Algorithm 3 Use this for women who are not achieving target on algorithm 2 (No patient starts here without diabetes or medical review)</p>
<p>If the woman is not achieving targets with these algorithms, contact the diabetes team (out of hours: Medical SpR on call)</p>
Target CBG level = 4 – 7 mmol/L
Check CBG every hour whilst on VRIII and every half an hour during anaesthesia
Move to the higher algorithm if the CBG is > target and is not dropping
Move to the lower algorithm if CBG falls below 4 mmol/L or is dropping too fast

For hypoglycaemia management see JBDS guidelines:

www.diabetologists-abcd.org.uk/subsite/JBDS_IP_Hypo_Adults_Revised.pdf

6.5 Practical guidance for management of glucose control during labour and delivery for women on insulin pump therapy

6.5.1 Labour

Women with insulin pumps may prefer to use them whilst in labour. Most typically they will self-manage their pump with assistance from their partner as required. They will use correction boluses and/or temporary basal rate changes to maintain optimal glycaemic control.

If the woman is unable to manage her own insulin needs, or becomes unstable, i.e. blood glucose >7.0 mmol/L on two consecutive occasions, or has urinary ketones ++ or more on urinary dipstick or high capillary blood ketones (> 1.5 mmol/L) then a VRIII should be commenced immediately and pump switched off.

Women using continuous glucose monitoring (CGM) should also be reminded that capillary glucose tests are more accurate during labour and delivery.

Her own insulin pump should remain in place on the basal settings; this will allow safe transition to her postnatal regimen.

6.5.2 Caesarean section

Women with stable glucose control may continue to use their own insulin pump. If the woman is unable to manage her own insulin needs, or becomes unstable, i.e. blood glucose >7.0 mmol/L on two consecutive occasions, or has urinary ketones ++ or more on urinary dipstick or high capillary blood ketones (> 1.5 mmol/L) then a VRIII should be commenced.

The insulin pump settings can be changed to post-partum doses by the woman or her partner just before the commencement of surgery.

7 Postnatal management

Insulin requirements drop immediately after delivery. Commonly used reductions include reducing to the pre-pregnancy dose, 25% reduction from the lowest stable dose in pregnancy or 50% of the late pregnancy doses. Closed loop data supports using 50% of late pregnancy dose. Any of these approaches is acceptable but insulin doses should be reviewed daily and in conjunction with diabetes team before discharge.

7.1 Patients on insulin pump

If she hasn't already done so, the woman **must** change the pump settings to her postnatal settings as described on her individual care plan provided by the diabetes team. If the woman's pump has been discontinued it should be re-connected for one hour prior to discontinuing the VRIII. Only discontinue VRIII when the woman feels able to manage her own pump.

In the absence of a documented individual care plan, ensure the woman changes her pump following the advice below:

- Basal rates should be reduced to 0.5 units per hour
- Insulin to carbohydrate ratios should be changed to 1 unit of insulin per 15g of carbohydrate
- Insulin sensitivity should be increased to 4 mmol/L
- Blood glucose targets should be increased to 6-10 mmol/L

Please note that an insulin bolus is usually not required for the first light meal taken post-delivery. The emphasis is now on avoidance of maternal hypoglycaemia so glycaemic targets are relaxed.

- Refer to specialist diabetes pump team as soon as possible

7.2 Patients with pre-existing type 1 or insulin treated type 2 diabetes

a. Insulin infusion: Reduce the rate of VRIII by 50% after delivery and stop 30-60 minutes after the first meal. Resume postpartum insulin regimen as per individual care plan. If there is no documented plan, look at lowest dose in pregnancy (about 12 weeks' gestation) and reduce by 25%. An alternative is to reduce to at least 50% of the late pregnancy dose.

b. Blood glucose monitoring (until first meal): Continue hourly monitoring. Insulin is not usually required with the first light meal after delivery.

c. Subsequent blood glucose monitoring: Pre-meals and pre-bedtime (or as per usual pre-pregnancy practice), aim for 6 – 10 mmol/L to avoid hypoglycaemia.

d. Insulin regime when eating normally: insulin as pre-advised by diabetes team or 25% less than early pregnancy doses.

e. Diet if bottle feeding: encourage healthy eating without any need for additional calories or carbohydrate.

f. Diet if breastfeeding/expressing: encourage healthy eating with increased carbohydrate as recommended for all women in order to establish lactation. Up to 450 extra calories per day may be needed when feeding is fully established. Breastfeeding and expressing breast milk both predispose women to hypoglycaemia hence insulin doses should be reduced as mentioned above. Advise women to snack (10-15 g carbohydrate) and drink each time they feed or express milk (including night feeds). Insulin doses may need adjustments based on calorie and carbohydrate intake.

7.3 Patients with pre-existing diabetes who were on oral glucose lowering drugs before pregnancy

- a. Insulin infusion or injections:** Stop when the placenta is delivered.
- b. Blood glucose monitoring (until first meal):** Continue 4-hourly.
- c. Subsequent blood glucose monitoring:** Pre-meals and pre-bedtime (or as per locally agreed trust policy) and aim for 6 – 10 mmol/L to avoid hypoglycaemia. NICE recommends babies should be monitored for at least 24 hours post-delivery.
- d. Treatment regime when eating normally:** Return to usual pre-pregnancy oral glucose lowering drugs if on metformin or glibenclamide. Other oral glucose lowering drugs should be discussed with the diabetes team. Metformin and glibenclamide can be continued whilst breastfeeding. Metformin does not cause hypoglycaemia.
- e. Diet:** Encourage healthy diet choices with low GI diet plus weight management advice as applicable.

7.4 Patients with gestational diabetes

- a. Insulin infusion and oral glucose lowering drugs:** Stop when the placenta is delivered.
- b. Blood glucose monitoring (until first meal):** Continue 4-hourly.
- c. Subsequent blood glucose monitoring:** Monitor CBG before and 1 hour after meal (in line with pre-delivery habit) for up to 24 hours after delivery to capture pre-existing diabetes.⁴ Patients with pre-meal readings higher than 7 mmol/L and post meal readings higher than 11.1 mmol/L need review by the diabetes team as they may have pre-existing or new onset diabetes which needs treatment with diet, oral glucose lowering drugs or insulin.
- d. Diet:** Encourage healthy diet choices with low GI diet plus weight management advice as applicable.

7.5 Post-natal advice

This should include

- a. Contraception/plans for future pregnancy**
- b. Arrangements for on-going diabetes care**
- c. Fasting plasma glucose arrangements at 6-13 weeks post-natal:** Fasting plasma glucose should be done at 6-13 weeks after delivery to diagnose diabetes post-partum. HbA_{1c} after 13 weeks can be an alternative if the fasting plasma glucose could not be done for 13 weeks post-partum.⁴
- d. Life style modifications**
- e.** Women with type 1 diabetes should be screened for **post-partum thyroiditis** with a TSH at 3 and 6 months postpartum.²³

8 Diabetic Ketoacidosis (DKA)

This is a new protocol based on national guidance (ref: www.diabetologists-abcd.org.uk/JBDS/JBDS_IP_DKA_Adults_Revised.pdf) which uses a fixed rate of insulin infusion (FRIII) and a variable amount of intravenous glucose to prevent hypoglycaemia.

This guidance is only for use in DKA, a “traditional” intravenous insulin sliding scale (now called VRIII) should still be used for uncontrolled hyperglycaemia. For HHS an approach similar to DKA may be used but may require less insulin and more fluids (see JBDS guidelines www.diabetologists-abcd.org.uk/JBDS/JBDS_IP_HHS_Adults.pdf)

Diabetic ketoacidosis is a medical emergency requiring prompt treatment, and is different to a ketosis of pregnancy. Women who are suspected of having DKA are admitted to the delivery suite or the high dependency unit where they can receive medical and obstetric care.

DKA is associated with a significant fetal mortality as ketones are toxic to fetus.

DKA may manifest as abdominal pain – always consider as a possible alternative to pre-term/term labour.

DKA can occur with only very modest elevation of glucose levels in women during pregnancy.

Symptoms include nausea and/or vomiting, abdominal pain, polyuria and polydipsia, and leg cramps. Later signs/symptoms include dehydration (manifesting as dry skin and mouth), blurred eyesight, tachypnoea, rapid pulse, a distinct smell on the breath (sometimes described as ‘pear drops’) and coma. **Ketoacidosis should always be considered when a pregnant woman with diabetes feels unwell. These women must be assessed by a medical or diabetes team.**

8.1 Diagnosis of DKA:

1. Presence of diabetes mellitus (of any kind, **DKA can occur in pregnancy in a woman with known diabetes with a normal blood glucose**). **AND:**
2. **Ketosis:** urinary ketones >++ or blood ketones >3.0 mmol/L (high risk 1.5 mmol/L) **AND**
3. **Acidosis:** blood gas pH <7.3 and/or bicarbonate <15 mmol/L (N.B. bicarbonate is reduced in pregnancy). Use venous blood gases.

Encourage women to contact the obstetric team if not well or vomiting – may need hospital admission for intravenous insulin regime. Always ask when they last ate and when they had their last insulin: if they have omitted their insulin advise admission immediately.

Some women are testing blood ketones on a home meter. The normal range in pregnancy is not established, but outside pregnancy <1.0 mmol/L is normal.

8.2 Treatment of DKA:

If the woman is using an insulin pump discontinue the insulin pump and start intravenous insulin infusion at a fixed rate.

Use the JBDS guidelines for management of DKA or the local trust guidelines.

www.diabetologists-abcd.org.uk/JBDS/JBDS_IP_DKA_Adults_Revised.pdf²⁴

Some of the salient specific points in DKA in pregnancy are:

- Involve the medical or diabetes team urgently
- DKA in pregnancy should be managed in HDU or ITU
- Start iv fluids immediately whilst awaiting the diabetes/ medical team

8.2.1 Start i.v. insulin infusion and monitor blood glucose

- Set up an insulin infusion of **50 units of soluble insulin (Humulin®S) or Actrapid® insulin in 49.5 ml 0.9% NaCl via syringe driver** and deliver insulin at a fixed rate of 0.1 unit/kg of body weight/hour.
- A maximum dose limit of 14 units per hour should be adhered to unless specifically over-ridden by medical SpR or consultant.
- The fixed rate may have to be increased by 1 unit/hour if there is inadequate response (less than 3 mmol/L drop in CBG per hour or less than 0.5 mmol/L drop in blood ketone or less than 3 mmol/L rise in venous bicarbonate per hour). Check the lines and involve the medical team.
- Measure CBG hourly.
- Glucose level is not an accurate indicator of resolution of acidosis in euglycaemic ketoacidosis, so the acidosis resolution should be verified by venous gas analysis. **
- Continue with the basal insulin i.e. Glargine (**Lantus®, Toujeo®**), **Detemir (Levemir®)** or Degludec (**Tresiba®**) but discontinue short acting insulin.

8.2.2 Administer fluids and potassium

- The fluid requirement may be lower in pregnancy. Start with 1L 0.9% NaCl over 60 minutes and continue with the hydration fluids as per clinical need. Often patients with severe dehydration and typical DKA would need 1 litre of normal saline each in subsequent 2, 2, 4, 4, and 6 hours after the first bag.
- Add 10% dextrose to run alongside 0.9% NaCl when capillary glucose <14 mmol/L. Initially this should be administered at a rate of 125 ml/hr but rate of infusion may need to be adjusted to prevent hypoglycaemia and avoid fluid overload or hyponatraemia.
- Potassium may not be needed in the first bag. Aim for keeping K+ between 4.0 and 5.5 mmol/L. Add 40 mmol/L of normal saline from the 2nd litre of fluids onward. Use the pre-prepared 3% KCl with 0.9% NaCl.
- Insulin may be infused in the same line as the intravenous replacement fluid provided that a Y connector with a one way, anti-siphon valve is used and a large-bore cannula has been placed.

8.2.3 Monitor glucose, potassium, pH and fetus

- Monitor CBG and capillary ketones (if available) hourly, venous bicarbonate and potassium at 1 hour, 2 hours and 4 hours, plasma electrolytes 4 hourly.²³
- Monitor fluid status as needed.
- The fetus should be continually monitored but abnormalities of the fetal heart may improve with improvement of the maternal condition.

**** If ketones and glucose are not falling as expected always check the insulin infusion pump is working and connected and that the correct insulin residual volume is present (to check for pump malfunction).**

9 Audit standards

Institutional standards:	
Indicator	Standard
Access:	
Has the Trust adopted these national guidelines or their own alternative, evidence based and audited internal guidelines for the management of diabetes during delivery?	Yes
Does the Trust collect data about the outcomes for women (maternal and baby) delivering in the hospital?	Yes
Does the Trust have the services of a dedicated Diabetes Inpatient Specialist Nurse (DISN) at staffing levels most recently recommended by Diabetes UK and TREND-UK (1.0 WTE per 300 beds)?	Yes
Does the Trust have mandatory diabetes training programme for midwives looking after pregnant women with diabetes?	Yes
Institutional accountability and integrity:	
Does the Trust have a clinical lead for the management of diabetes during delivery with responsibility of implementation of these guidelines?	Yes

NPSA standards:	
Indicator	Standard
All regular and single insulin bolus doses are measured and administered using an insulin syringe or commercial insulin pen device. Intravenous syringes must never be used for insulin administration	100%
The term 'units' is used for insulin measure in all contexts. Abbreviations such as 'U' or 'IU' are never used	100%
All clinical areas on obstetric wards have adequate supplies of insulin syringes and subcutaneous needs which they can obtain at all times	100%
An insulin pen is always used to measure and prepare insulin for an intravenous infusion	100%
A training programme is in place (JBDS recommends 2 hours initially and 1 hours per year refresher) for all midwives involved in the care of pregnant women with diabetes	100%
Policies and procedures are in place to ensure compliance with the above indicators	100%

Department of Health 'Never Event' standard:	
Indicator	Standard
Death or severe harm as a result of maladministration of insulin by a health professional	Never

Local standards:	
Indicator	Standard
Access:	
Percentage of obstetric staff involved in the care of pregnant women with diabetes who have received training in blood glucose measurement	100%
Percentage of deliveries where there is one to one ratio of midwife to patients during labour	100%
Percentage of obstetric staff involved in the care of pregnant women with diabetes who have received appropriate education (JBDS recommends 2 hours initially and 1 hour refresher every year) from the diabetes team	100%
Safety, quality and effectiveness during the patient stay in the hospital:	
Percentage of women admitted on obstetric ward for delivery with a clear plan including a prescription chart (either the one recommended by JBDS or a locally agreed and audited alternative) from the antenatal clinic. Unexpected or unbooked admissions will be exempted from this standard	100%. Where necessary, information should be shared with the antenatal clinic doctors and nurses to improve the standard.
Percentage of women with diabetes in established labour whose CBG is monitored hourly. Women delivering or having caesarean section within 2 hours of admission may be exempt from this criterion	100%
Percentage of eligible women on hourly CBG monitoring whose CBG levels are within the agreed target range (see guidelines)	80%
Percentage of women with CBG levels higher than the target CBG receiving VRIII. Women delivering or having caesarean with 2 hours of being in higher than target range can be exempted from the standard	100%
Percentage of women who receive VRIII appropriately and CBGs are to target (80% of the readings) but still deliver babies with neonatal hypoglycaemia	Not known
Percentage of women in whom VRIII is omitted inappropriately or was not effective in keeping CBGs to target and babies develop neonatal hypoglycaemia	Not known
Percentage of women who do not receive VRIII as the CBGs are in the target range but the babies still develop neonatal hypoglycaemia	Not known
Percentage of women with CBG levels within the target CBG receiving inappropriate VRIII	0%
Percentage of women with diabetes during pregnancy who required VRIII during delivery	Not defined
Percentage of women on VRIII with correct configuration of the one-way and anti-siphon valve	100%
Percentage of women with diabetes on VRIII whose CBG is monitored hourly	100%
Percentage of women on VRIII who had at least one hypoglycaemic episode with CBG <4.0 mmol/L	JBDS recommends <10%
Percentage of women with diabetes who were on VRIII during delivery and whose hypoglycaemia was treated as per JBDS or an agreed trust guidelines.	100%
Percentage of women with diabetes whose babies developed neonatal hypoglycaemia [<2.2 mmol/L ²⁵ or the locally agreed trust criterion]	0%

Percentage of babies who delivered to women with diabetes during pregnancy and developed neonatal hypoglycaemia that required NICU admission	Not defined
Percentage of babies who delivered to women with diabetes during pregnancy and developed neonatal hypoglycaemia that required iv glucose	Not defined
Percentage of babies with neonatal hypoglycaemia who developed residual deficit.	0%
Percentage of babies with neonatal hypoglycaemia whose mothers received VRlll	Not defined
Percentage of mothers in the row above whose CBG was to target during VRlll	Not defined
Percentage of babies with no neonatal hypoglycaemia whose mothers received VRlll	Not defined
Percentage of mothers in the row above whose CBG was above target during VRlll	Not defined
Percentage of babies with neonatal hypoglycaemia whose mothers did not receive VRlll as the CBGs were within the target range	Not known
Percentage of babies with neonatal hypoglycaemia in women with diabetes during pregnancy whose mothers received CBG monitoring during labour appropriately	100%
Percentage of babies with neonatal hypoglycaemia delivered by caesarean section, normal delivery or assisted delivery	Not known
Women in the row above where an appropriate action was taken if CBGs were above target	100%
Percentage of women with diabetes in pregnancy and who are admitted for an elective caesarean section and are able to have the section on priority (first third of the morning or afternoon list)	Not defined
Percentage of women with gestational diabetes whose treatment was stopped after the placenta was delivered	100%
Percentage of women with type 1 and type 2 diabetes on VRlll during delivery whose insulin dose was reduced by 50% after the delivery of placenta and changed to subcutaneous regimen appropriately	100%
Percentage of women with diabetes during pregnancy who developed hypoglycaemia after delivery	0%
Percentage of women in the row above whose treatment was not adjusted according to the guidelines	0%
Percentage of women with diabetes during pregnancy who are visited by the diabetes specialist teams during their admission for delivery	100%. The Trusts might like to collect this data for week days and weekends separately
Percentage of women with GDM delivering in the hospital who have received a plan for a diagnostic test after delivery (OGTT or Fasting Glucose)	100%
Percentage of pregnant women with diabetes who receive CBG as per JBDS or an agreed and audited trust guideline after delivery	100%
Type of delivery (Caesarean, normal, assisted) in women with diabetes during pregnancy	Not defined. The Trusts might like to stratify all the audit criteria according to the type of delivery for more comprehensive understanding
Maternal outcomes (Pre-eclampsia, inadequately controlled glycaemia, post delivery hypoglycaemia)	Not defined

Fetal outcomes (stillbirth, baby weight >4 kg, neonatal hypoglycaemia 2.2 mmol/L, admission to NICU, shoulder dystocia, neonatal jaundice, hypocalcaemia, hypomagnesaemia, RDS, birth defects)	Not defined
Institutional accountability and integrity:	
Percentage of women with diabetes during pregnancy identified as such on the hospital patient administration system	100%
Percentage of women with diabetes during pregnancy coded correctly in the coding system	100%
Patient and staff satisfaction:	
Percentage of obstetric staff who feel they have appropriate, timely and adequate support from the diabetes team	100%
Percentage of patients who express satisfaction with their care using validated tools such as Diabetes Treatment Satisfaction Questionnaire (DTSQ) and the Diabetes Treatment Satisfaction Questionnaire for Inpatients (DTSQ-IP)	90%

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Appendix 1 Intravenous Insulin Prescription and Fluid Protocol
FOR MANAGEMENT OF STEROID HYPERGLYCAEMIA DURING PREGNANCY

<p>For use for ALL patients receiving Variable Rate Intravenous Insulin Infusion (VRIII) for the management of steroid hyperglycaemia during pregnancy NEVER use an IV syringe to draw up insulin ALWAYS draw up insulin using an insulin syringe ALWAYS continue subcutaneous intermediate* or basal insulin** *Intermediate: Insulatard, Humulin I, Insuman basal **Basal: Lantus, Toujeo (Glargine), Levemir (Detemir) Doctor: All prescriptions for insulin and fluids must be signed Nurse: All entries must be signed</p>				Ward	Consultant	Admission Date:				
						Discharge Date:				
				Surname		First Name				
				Hospital Number		Date of Birth / Age				
				NHS Number						
Address										
		DOSING ALGORITHM (Please see the guide below)		ALGORITHM GUIDE						
Algorithm >	1	2	3	<ul style="list-style-type: none"> ALL women with diabetes should have Capillary Blood Glucose (CBG) testing hourly whilst on VRIII for the management of steroid hyperglycaemia during pregnancy Start VRIII and Fluids with the first dose of steroids and continue for up to 24 hours after the last dose <p>Algorithm 1 Most women will start here</p> <p>Algorithm 2 Use this algorithm for women who are likely to require more insulin (on steroids; on >80 units of insulin during pregnancy; or those not achieving target on algorithm 1)</p> <p>Algorithm 3 Use this for women who are not achieving target on algorithm 2 (No patient starts here without diabetes or medical review)</p> <p>If the woman is not achieving targets with these algorithms, contact the diabetes team (out of hours: Medical SpR on call)</p> <p>Target CBG level = 4 – 7.8 mmol/L</p> <p>Check CBG every hour whilst on VRIII</p> <p>Move to the higher algorithm if the CBG is > target and is not dropping</p> <p>Move to the lower algorithm if CBG falls below 4 mmol/L or is dropping too fast</p>						
	For most women	For women not controlled on algorithm 1 or needing >80 units/day of insulin	For women not controlled on algorithm 2 (after specialist advice)							
CBG Levels (mmol/L)	Infusion Rate (units/hr = ml/hr)									
<4	STOP INSULIN FOR 20 MINUTES Treat hypo as per guideline (re-check CBG in 10 minutes)									
4.0 – 5.5	0.2	0.5	1.0							
5.6 – 7.0	0.5	1.0	2.0							
7.1 – 8.5	1.0	1.5	3.0							
8.6 – 11.0	1.5	2.0	4.0							
11.1 – 14.0	2.0	2.5	5.0							
14.1 – 17.0	2.5	3.0	6.0							
17.1 – 20.0	3.0	4.0	7.0							
>20.1	4.0	6.0	8.0							
Signed										
Print Name										
Date										
Drug (approved name) Please tick	Dose	Volume	Route	Prescriber's Signature	Prescriber Print name	Date	SYRINGE PREPARATION			
Human Actrapid <input type="checkbox"/> Humulin S <input type="checkbox"/>	50 units	Made up to 50ml with NaCl 0.9% (1 unit per ml)	1V				Prepared and administered by	Date	Time started	Time stopped
INTRAVENOUS SUBSTRATE FLUID PRESCRIPTION										
Date	Intravenous Fluid and Rate		Alternative Rate	Prescriber's Signature	Nurse's Signature					
	500 ml 0.9% NaCl + 5% Dextrose with 20 mmol/L KCl (0.15%) to run at 50 ml/hr									
	500 ml 0.9% NaCl + 5% Dextrose with 20 mmol/L KCl (0.15%) to run at 50 ml/hr									
PRESCRIPTION OF INTRAVENOUS MANAGEMENT OF HYPOGLYCAEMIA										
Date	Time	Preparation	Volume	Route	Duration	Prescriber's signature	Print name	Given by:	Time given:	
		20% Dextrose	100ml	IV	15 min					
Patients with type 1 DM on insulin pumps should be referred to the Diabetes Specialist Team										
Maintain IV insulin infusion for 30 minutes after re-starting original insulin regime – IV insulin has a 5 minute half-life										

INTRAVENOUS INSULIN, CBG AND KETONES MONITORING RECORD SHEET

Guide:

Only use for patients on intravenous insulin regimen.
Use different chart for patients on subcutaneous insulin
Make sure the patient's hands are clean

**Check CBG hourly for further 24 hours after the last dose of steroid
OR as per advice form the Diabetes Team**

ADDRESSOGRAPH
LABEL

Date	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00
CBG												
Insulin rate												
Blood ketones												
Initials												
Date	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00
CBG												
Insulin rate												
Blood ketones												
Initials												
Date	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00
CBG												
Insulin rate												
Blood ketones												
Initials												
Date	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00
CBG												
Insulin rate												
Blood ketones												
Initials												
Date	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00
CBG												
Insulin rate												
Blood ketones												
Initials												
Date	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00
CBG												
Insulin rate												
Blood ketones												
Initials												
Date	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00
CBG												
Insulin rate												
Blood ketones												
Initials												
Date	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00
CBG												
Insulin rate												
Blood ketones												
Initials												
Date	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00
CBG												
Insulin rate												
Blood ketones												
Initials												
Date	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00
CBG												
Insulin rate												
Blood ketones												
Initials												

Appendix 2 Intravenous Insulin Prescription and Fluid Protocol FOR PREGNANCY AND LABOUR ONLY

<p>For use during pregnancy and labour for ALL patients receiving Variable Rate Intravenous Insulin Infusion (VRIII)</p> <p>NEVER use an IV syringe to draw up insulin</p> <p>ALWAYS draw up insulin using an insulin syringe</p> <p>ALWAYS continue subcutaneous intermediate* or basal insulin**</p> <p>*Intermediate: Insulatard, Humulin I, Insuman basal</p> <p>**Basal: Lantus and Toujeo (Glargine), Levemir (Detemir)</p> <p>Doctor: All prescriptions for insulin and fluids must be signed</p> <p>Nurse: All entries must be signed</p>				Ward	Consultant	Admission Date:							
						Discharge Date:							
				Surname		First Name							
				Hospital Number		Date of Birth / Age							
				NHS Number									
				Address									
DOSING ALGORITHM (Please see the guide below)				ALGORITHM GUIDE									
Algorithm >	1	2	3	<ul style="list-style-type: none"> ALL women with diabetes should have Capillary Blood Glucose (CBG) testing hourly in established labour and at least once on admission for induction of labour or elective C-section Start VRIII and Fluids if CBG > target (see below) or at the start of established labour if the woman has type 1 diabetes <p>Algorithm 1 Most women will start here</p> <p>Algorithm 2 Use this algorithm for women who are likely to require more insulin (on steroids; on >80 units of insulin during pregnancy; or those not achieving target on algorithm 1)</p> <p>Algorithm 3 Use this for women who are not achieving target on algorithm 2 (No patient starts here without diabetes or medical review)</p> <p>If the woman is not achieving targets with these algorithms, contact the diabetes team (out of hours: Medical SpR on call)</p> <p style="text-align: center;">Target CBG level = 4 – 7 mmol/L</p> <p style="text-align: center;">Check CBG every hour whilst on VRIII and every half an hour if under anaesthesia</p> <p style="text-align: center;">Move to the higher algorithm if the CBG is > target and is not dropping</p> <p style="text-align: center;">Move to the lower algorithm if CBG falls below 4 mmol/L or is dropping too fast</p>									
	For most women	For women not controlled on algorithm 1 or needing >80 units/day of insulin	For women not controlled on algorithm 2 (after specialist advice)										
CBG Levels (mmol/L)	Infusion Rate (units/hr = ml/hr)												
<4	STOP INSULIN FOR 20 MINUTES Treat hypo as per guideline (re-check CBG in 10 minutes)												
4.0 – 5.5	0.2	0.5	1.0										
5.6 – 7.0	0.5	1.0	2.0										
7.1 – 8.5	1.0	1.5	3.0										
8.6 – 11.0	1.5	2.0	4.0										
11.1 – 14.0	2.0	2.5	5.0										
14.1 – 17.0	2.5	3.0	6.0										
17.1 – 20.0	3.0	4.0	7.0										
>20.1	4.0	6.0	8.0										
Signed													
Print Name													
Date													
Drug (approved name) Please tick	Dose	Volume	Route	Prescriber's Signature	Prescriber Print name	Date	SYRINGE PREPARATION						
Human Actrapid <input type="checkbox"/> Humulin S <input type="checkbox"/>	50 units	Made up to 50ml with NaCl 0.9% (1 unit per ml)	1V				Prepared and administered by	Date	Time started	Time stopped			
INTRAVENOUS SUBSTRATE FLUID PRESCRIPTION													
Date	Intravenous Fluid and Rate			Alternative Rate	Prescriber's Signature	Nurse' Signature							
	500 ml 0.9% NaCl + 5% Dextrose with 20 mmol KCl/L (0.15%) at 50 ml/hr												
	500 ml 0.9% NaCl + 5% Dextrose with 20 mmol KCl/L (0.15%) at 50 ml/hr												
PRESCRIPTION OF INTRAVENOUS MANAGEMENT OF HYPOGLYCAEMIA													
Date	Time	Preparation		Volume	Route	Duration	Prescriber's signature	Print name	Given by:	Time given:			
		20% Dextrose		100ml	IV	15 min							
CAPILLARY BLOOD GLUCOSE MONITORING													
Date	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	GESTATIONAL DIABETES: STOP VRIII and IV Substrate Fluid regime once placenta is delivered
CBG													
Insulin rate													
Blood ketones													TYPE 1 DM and INSULIN TREATED TYPE 2 DM Reduce the rate of VRIII by HALF once placenta is delivered. Contact diabetes team to review on-going insulin requirements
Initials													
Date	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00	
CBG													
Insulin rate													
Blood ketones													
Initials													
Patients with type 1 DM on insulin pumps should be referred to the Diabetes Specialist Team													
Maintain IV insulin infusion for 30 minutes after re-starting original insulin regime – IV insulin has a 5 minute half-life													

Ward		Admission Date:	
		Discharge Date:	
Surname		First Name	
Hospital Number		Date of Birth / Age	
NHS Number			
Address			
DIABETES CARE PLANNING DOCUMENT			
For use to communicate care plans for ALL patients with diabetes during and after pregnancy Please complete ALL required information To be completed by the Diabetes Team			
ANTENATAL INFORMATION			
TYPE OF DIABETES			
<input type="checkbox"/> Type 1 DM	<input type="checkbox"/> Type 2 DM	<input type="checkbox"/> Gestational DM	
Age at diagnosis	Age at diagnosis	Diagnosed:	<input type="checkbox"/> OGTT: Date:
		_____ weeks	<input type="checkbox"/> OGTT: Date:
			Fasting: mmol/L
			2 hours: mmol/L
PRE-PREGNANCY DIABETES MEDICATIONS		HbA_{1c} Record	
Medication	Dose	Time	Baseline
			Date:
			Value: mmol/mol
			Additional HbA _{1c} :
			Date:
			Value: mmol/mol
			Notes:
			Date:
			Value: mmol/mol
			Date:
			Value: mmol/mol
COMPLICATIONS DEVELOPED OR EXACERBATED BY PREGNANCY		DELIVERY DATES	
		Expected date of delivery	Date for IOL
			Date for C-section
POST NATAL PLAN			
PROPOSED POST-PREGNANCY DIABETES MEDICATIONS (FOR TYPE 1 OR TYPE 2 DM)		DISCUSSED WITH PATIENT:	
		Issues:	Yes No Date discussed:
Medications	Dose	Time	Contraception/plan for further pregnancy
			Arrangement for on-going diabetes care
			OGTT arrangement
			Lifestyle modifications
			Completed by:
			Name: Designation: Sign:
POST NATAL CBG MONITORING Pre-existing diabetes: as per usual practice GDM: pre-meal and 1 hour post-meal for up to 24 hours High levels (>7 mmol/L pre-meal and <11.1 mmol/L post-meal) may need a diagnostic test for diabetes			
Date:	Pre-breakfast	1 hr after breakfast	Pre-lunch
			1 hr after lunch
			Pre-evening meal
			1 hr after evening meal
			Pre-bed
MATERNAL OUTCOMES		POST NATAL OUTCOMES (tick ALL that applies)	
Delivery	Tick ALL that applies	Complications	Tick ALL that applies
Normal		Pre-eclampsia	
Assisted/forceps		Inadequately controlled glycaemia	
C-section		Post-delivery hypoglycaemia	
Other:		Other:	
			Stillbirth
			Neonatal jaundice
			Baby weight >4 kg
			Hypocalcaemia
			Neonatal hypoglycaemia
			Hypomagnesaemia
			Admission to NICU
			RDS
			Shoulder dystocia
			Birth defects
			Other:
			Other:

Appendix 3

Management of women with diabetes during delivery undergoing regional analgesia, Caesarean Section or other special circumstances: an Anaesthetic perspective

Authors

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- In perioperative conditions (patient undergoing regional analgesia or general anaesthesia) a capillary blood glucose target of either 5-8 mmol/L or 6-8 mmol/L may be preferred by some anaesthetist teams because of the risk of maternal hypoglycaemia.
- Obstetric anaesthetists are keen often to discuss with colleagues relaxing the glycaemic target because:
 - a. Patients lose neuroglycopenic awareness under anaesthesia
 - b. A category 1 section may be called at any time, and the patient must therefore have their glucose maintained at a safe level at all times.
 - c. Anaesthetists recognise that the majority of midwives are direct entry, and often have no nursing background, and therefore have limited exposure and training in managing patients with diabetes.
- Clinical diabetes and obstetric teams should discuss these issues with obstetric anaesthetic colleagues in their Trust, to ensure effective implementation of these guidelines.
- These issues, from the anaesthetic perspective, are outlined in more detail at www.oaa-anaes.ac.uk/diabetes-in-pregnancy-guidelines

