Guidance for management of blood glucose in pregnant women with diabetes on obstetric wards and delivery units

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1. Members of the Multidisciplinary Team

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Antenatal steroid administration in patients with diabetes

Admit to ward 19

Patients with gestational diabetes (GDM) which is diet controlled

Monitor blood glucose pre and 1 hour post meal

If blood glucose is outside of the 5.0-8.0 mmol/l target, then start variable rate intravenous insulin infusion and intravenous fluid as outlined below.

Patients with type 1 diabetes, Type 2 diabetes or Gestational Diabetes treated with insulin or oral agents

- Insert a cannula and check urea & electrolytes
- Administer 1st dose of steroid

Continue with usual diet

- **Commence hourly blood glucose monitoring using the Precision PCX meter**
- **Continue with rapid acting (meal time) insulin if taken***
- **Continue with long acting basal insulin if taken***

- **Aim for target capillary blood glucose (CBG) of 5.0-8.0 mmol/l**
- **Check blood ketones if glucose > 11.0 mmol/l**

- Start a variable rate intravenous insulin infusion (VRII) (Actrapid 50 units in 49.5 ml of normal saline using a syringe driver) using the scale in table 1. Continuous intravenous insulin will be needed until 24 hours after the second dose of steroid.

- We also recommend 0.9% Saline with 5% Dextrose and Potassium Chloride 20 mmol/l or 40 mmol/l as fluid to avoid hypoglycaemia, hyponatraemia and hypokalaemia. The rate of infusion should take account of volume status but 50 ml/hr is a reasonable rate. Monitor urea & electrolytes daily.

- Additional fluid may be needed if the patient is not eating adequately. Fluid particularly dextrose containing fluids may need restriction in patients at risk of hyponatraemia, in some cases insulin without fluids maybe used. **Please consult senior obstetric staff/diabetes staff as needed.**

Table 1. VRII for use during administration of antenatal steroids

	Dosing algorithm				
Algorithm	1	2	3	Individualized if not controlled on 3	
	For most women	not controlled on 1 or needing > 80 units/day	Not controlled on 2 after advice		
CBG (mmol/l)	Insulin infusion (units/hr=ml/hr)				
<5.0	Stop insulin for 20 minutes and treat hypoglycaemia per guideline				
5.0-5.5	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
All women with diabetes should have capillary blood glucose (CBG) testing hourly whilst on VRII for management of steroid hyperglycaemia in pregnancy. Start VRII and fluid with first dose of steroids and continue for up to 24 hours after the second dose. **Algorithm 1** Most women start here **Algorithm 2** Use this algorithm for women who are likely to require more insulin (>80 units/day) or those not achieving targets on algorithm 1 **Algorithm 3 Use for patients not achieving target on algorithm 2** For those not achieving targets on these algorithms contact diabetes team or medical SpR out of hours.
Target CBG = 5.0-8.0 mmol/l
Check CBG every 1 hour on VRII
If blood glucose > 11.0 mmol/l check blood ketones
Move to a higher algorithm if CBG > target and not dropping
Move to a lower algorithm if CBG falls below 5.0 mmol/l or is dropping too quickly

For patients administering insulin the intravenous insulin should be timed to stop 30-60 minutes following a pre-meal dose of rapid acting Insulin

***Rapid acting insulins examples include: Novorapid, Fiasp, Humalog, Apidra**

****Basal insulins: Levemir, Lantus, Insulatard, Humulin I**

3. Management of women with diabetes in labour

The day prior to induction and during cervical ripening blood glucose monitoring, insulin and oral glucose lowering drugs should continue as normal.

Once in established labour

- Admit to labour Ward
- Inform Senior Obstetrician and Diabetes Specialist Nurse (in office hours)/review diabetes delivery plan in notes.

- **Commence hourly blood glucose monitoring using Precision PCX monitor**
- **Stop meal time insulin and Metformin if taken ***
- **Continue with long acting basal insulin if taken****

- **Aim to target capillary blood glucose to 5.0-8.0 mmol/l**

- If blood glucose is > 11.0 mmol/l check blood ketones

- If CBG is less than 5.0 mmol/l stop insulin for 20 minutes and treat hypoglycaemia according to the protocol or with IV dextrose if nil by mouth (NBM). Resume IV insulin when hypoglycaemia has resolved.

Type 1 Diabetes

- For patients with Type 1 Diabetes start a VRII according to Table 2.0 at the onset of labour.

Type 2 Diabetes or Gestational Diabetes (GDM)

- For patients with Type 2 DM or GDM if two consecutive blood glucose readings are above 8.0 mmol/l a VRII should be started. The second reading should be within 30 minutes of the first reading to prevent delay is a starting VRII

Caesarean Section

- If Caesarean section is planned in the morning a VRII can commence at 6 am or or earlier if blood glucose is unstable overnight. For patients admitted on the morning of surgery the VRII can commence on arrival at the ward. If Caesarean section is planned for the afternoon, then VRII can be started once the patient is nil by mouth.

***Rapid acting insulins examples include: Novorapid, Fiasp, Humalog, Apidra**

****Basal insulins: Levemir, Lantus, Insulatard, Humulin I**

Variable Rate Insulin Infusion (VRII)

- Start a (VRII) infusion using the appropriate connector according to the guidance in Table 2.
- Use Insulin Actrapid 50 units in 49.5 ml of 0.9% Sodium Chloride via a syringe driver.
- We recommend **0.9% Saline with 5% Dextrose and 20 mmol/KCl** at a rate of 50ml/hr as fluid to avoid hypoglycaemia, hyponatraemia and hypokalaemia.
- Additional fluid may be needed in some patients as per clinical need. Some fluids particularly dextrose may need restriction in the event of hyponatraemia. Particular care relating to fluid balance is needed in those with pre-eclampsia.

Monitoring

- Patients should have U&E's checked 6 hourly to maintain potassium and bicarbonate in target ranges. Check blood ketones if diabetic ketoacidosis suspected
- If ketone values are >1.5 mmol/l there is high risk of ketoacidosis consider diabetic ketoacidosis (DKA), seek urgent diabetic/medical review and manage according to the local DKA policy.

Table 2. Suggested VRII for use during labour

	Dosing algorithm				
Algorithm	1	2	3	Individualised not controlled on 3.	
	For most women	not controlled on 1 or needing > 80 units/day	Not controlled on 2 after advice		
CBG (mmol/l)	Insulin infusion (unit/hr=ml/hr)				
<5.0	Stop insulin for 20 minutes and treat hypoglycaemia per guideline				
5.0-5.5	0.2	0.5	1.0		
5.6-7.0	0.5	1.0	2.0		
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11.1-14.0	2.0	4.0	5.0		
14.1-17.0	2.5	5.0	6.0		
17.1-20.0	3.0	6.0	7.0		
>20.1	4.0	7.0	8.0		

Algorithm guide
All women with diabetes should have capillary blood glucose (CBG) testing hourly whilst on VRII for management of hyperglycaemia in pregnancy Start VRII and fluids if CBG > target or at start of labour if a woman has type 1 diabetes. **Algorithm 1** Most women start here **Algorithm 2** Use this algorithm for women who are likely to require more insulin (>80 units/day) or those not achieving targets on algorithm 1. **Algorithm 3** Use for patients not achieving target on algorithm 2. For those not achieving targets on these algorithms contact Diabetes team or medical SpR out of hours.
Target CBG = 5.0-8.0 mmol/l
Check CBG every 1 hour on VRII and every 30 mins during anaesthesia
If glucose > 11.0 mmol/l check blood ketones
Move to a higher algorithm if CBG > target and not dropping
Move to a lower algorithm if CBG falls below 5.0 mmol/l or is dropping too quickly

4. **Post delivery**

- Following delivery of the placenta the insulin infusion rate should be reduced by 50% in women with type 1 diabetes and type 2 diabetes treated with insulin. Intravenous insulin can be stopped for those with Type 2 diabetes treated with oral agents or gestational diabetes
- In women with pre-existing diabetes pre-pregnancy sub-cutaneous insulin regimes should resume once the patient is eating and drinking. The doses should be 25% less than the pre pregnancy dose or 50% less than the late pregnancy dose or as advised by the diabetes team.
- Capillary blood glucose may need to be monitored pre-meal and 1h post meal for patients with GDM for up to 24 hours to ensure normoglycaemia. Women with pre-existing diabetes should resume their pre-pregnancy monitoring regime.

Please note:

- If general anaesthetic is used monitoring of blood glucose should occur every half hour until the mother is conscious.
- Stopping of variable rate Insulin infusion when patient goes to theatre for Caesarian section will be at Obstetric Anesthetist's own discretion
- Ensuring that Insulin infusion is restarted in the room post operatively is responsibility of the Obstetric Anesthetist if they stop the insulin in theatre

Ongoing care

Patients with pre-existing Type 1 Diabetes or Type 2 Diabetes treated with insulin

- In women with pre-existing diabetes pre-pregnancy sub-cutaneous insulin regimes should be resumed once eating and drinking.
- The doses should be as pre-advised by the diabetes team or 25% lower than the pre-pregnancy dose or 50% lower than the late pregnancy dose
- Rapid acting insulin (Novorapid / Humalog or Apidra) should be given before/with the meal and the intravenous insulin infusion can be discontinued 30-60 minutes later.
- Hourly glucose monitoring should continue until the first meal
- Once eating and drinking check pre meal and pre bed aim for BG values of 6.0-10.0 mmol/l to avoid hypoglycaemia
- **Diet if bottle feeding**, Encourage healthy eating without any need for additional calories or carbohydrate
- **Diet if breast feeding,** Encourage healthy eating and extra carbohydrate. Breast feeding and expressing breast milk both predispose women to hypoglycaemia hence insulin doses may need to be reduced. Encourage women to take 10-15g of carbohydrate each time they feed or express milk. Insulin doses may need adjustment depending on calorie or carbohydrate intake.

Patients with Type 2 diabetes who were treated with oral agents' pre-pregnancy

- Insulin can stop at time of delivery of placenta,
- Continue with CBG monitoring every 4 hours until eating and drinking
- Once eating and drinking check pre meal and pre bed aiming for target values of 6.0-10.0 mmol/l
- When eating normally, resume oral agents if on metformin or glibenclamide. If on other new agents discuss with the diabetes team. Metformin and glibenclamide can continue whilst breast feeding.

Patients with Gestational Diabetes

- Insulin can stop at time of delivery of the placenta.
- Monitor blood glucose 4 hourly until eating and drinking.
- Subsequently monitor blood glucose pre meal and 1 hour post meal for 24 hours to capture pre-existing diabetes. Aim for a target of 4.0-10.0 mmol/l
- Patients with pre meal readings of >7.0 mmol/l or 11.1 mmol/l post meal need further review by the diabetes team regarding a possible diagnosis of new or existing Type 2 Diabetes

5. Diabetic ketoacidosis

Diabetic ketoacidosis (DKA) is a medical emergency requiring prompt recognition and treatment as it is associated with significant maternal and fetal mortality. Women suspected to have DKA should be managed on a delivery unit or critical care where they can receive medical and obstetric care.

In pregnancy DKA can occur at lower levels of hyperglycaemia (> 11.0 mmol/l) Patients in the third trimester are at greatest risk. Intercurrent illness or administration of steroid can also trigger DKA.

Symptoms include nausea and or vomiting, abdominal pain, polyuria and polydipsia, leg cramps. Later signs include dehydration, blurred eyesight, tachypnoea, tachycardia, DKA should always be considered in a pregnant woman with diabetes who feels unwell.

Diagnosis

1. **Presence of Diabetes. (any kind, DKA can occur in a woman with known diabetes and normal blood glucose) AND**
2. **Ketosis urinary ketones > 2+ or blood ketones > 3.0 mmol/l (>1.5 mmol/l high risk) AND**
3. **Acidosis pH < 7.3 and/or bicarbonate < 15.0 mmol/l**

Management

- Prompt assessment
- Measure blood glucose and ketones using a PCX meter
- If blood ketones > 1.5 check venous blood gas
- Send blood for FBC, Glucose, U&E, LFT, Urate, Coagulation. Group and Save
- Admit to labour ward HDU
- Seek urgent senior obstetric and diabetes specialist review (medical registrar after 5pm), seek anaesthetic support.
- Manage according to the local DKA protocol
- These patients require joint obstetric and medical management
- Obstetric patients need close maternal and fetal monitoring with specific attention to fluid balance
- Have a low threshold for critical care review.

This is a guideline only, DKA should always be considered in a pregnant patient who is unwell and specialist advice should be sought.

Uncontrolled hyperglycemia and ketonemia not meeting DKA criteria

Patients not meeting criteria for DKA also require intravenous fluid and intravenous insulin according to a VRII protocol. They should have close ongoing monitoring to ensure resolution of hyperglycemia and ketonemia. They should receive specialist diabetes or out of hours medical SpR review.

6.Insulin pump management for pregnant women

Please interpret this guidance along with the Use of continuous subcutaneous insulin infusion (CSII) pumps in hospitalised patient policy & procedure document found in the diabetes section of COIN.

The goal of insulin therapy in diabetes a management during pregnancy is to maintain glucose as close to normal as possible to obtain the best outcome for the pregnancy and reduce the risk to mother and baby. The aim of glycaemic control for delivery is to safely maintain near normal glucose levels and to safely manage the transition to post-delivery when insulin requirements fall and there is increased risk of hypoglycaemia.

Ante-natal care

Obstetric care will follow established protocols for patients with diabetes. The diabetes team are responsible for insulin pump management including glycaemic control and educational needs.

Inpatient use of insulin pump therapy

Insulin pump may continue provided the patient or partner are able to self-manage the insulin pump and perform the required glucose monitoring.

Inpatient steroid use

Please inform the Diabetes specialist team as soon as possible about the plan to use steroid therapy. Insulin pump can continue the diabetes team will inform the patient about changes required to the basal rate.

Use of steroids in women with diabetes is associated with worsening glycaemic control and usually requires an increase in medication. Target blood glucose for patients on CSII is 5.0-8.0 mmol/l

Glucose should be monitored by the patient or partner every 1-2 hours. This may be done using a real time continuous glucose monitor (RT CGM) e.g. the Dexcom or Guardian Connect systems. In addition blood glucose should also be measured using the hospital PCX meter at least pre-meal and pre bed as a minimum.

A temporary increase in the basal rate is likely and below is an outline of the typical changes in basal rates and bolus doses that are often required.

After administration of Betamethasone adjust the pump rates as follows

- 6-24 hours increase the basal rate to 125%
- Day 2-3-increase basal rate to 140% and increase the usual bolus rate by 40%
- Day 4-increase basal rate to 120% (of usual rate) and increase the usual bolus rate by 20%
- Day 5-increase basal rate to 110% and increase the bolus rate by 10%
- Day 6-7-the insulin infusion rate should return to normal

If adequate control in not achieved the patient can use a correction dose to achieve target values of 5.0-8.0 mmol/l. However, if this fails to achieve targets within 1-2 hours then convert to an intravenous insulin infusion as per hospital guidelines for women with diabetes treated with steroids. **In this situation then the insulin pump can remain in place with insulin infusing according to the usual basal rate.**

Staff responsibilities

While the patient remains on insulin pump the patient and partner are responsible for regularly monitoring glucose and giving corrections via CSII. The midwife is responsible for making sure that the patient/partner remain able and willing manage the insulin pump and that glucose levels are regularly checked and documented hourly. It is important that blood glucose is also measured at a minimum pre-meal and pre bed using the PCX system. If glucose is persistently above 8.0 mmol/l then the patient should convert to variable rate insulin infusion per protocol.

The intra-partum management of patients using insulin pump therapy

Women on insulin pump therapy may be converted to intravenous dextrose and insulin for delivery according to traditional management plans. Patients are converted to intravenous insulin on the basis of total daily dose requirements.

However, some patients may prefer to remain on insulin pump for delivery, provided that glucose is stable 5.0-8.0 mmol/l and patient and partner can manage their insulin pump and monitoring requirements. Although outside manufacturer's recommendation Insulin pumps and CGM are increasingly used during caesarean section with unipolar and bipolar diathermy. Patients should use a Teflon cannula and the pump and CGM should be sited away from the operative field. The decision should be made in advance of delivery and in consultation with the diabetes ante-natal team.

However, if problems arise start an intravenous dextrose/insulin infusion as per hospital guidelines prior to removing the pump. The insulin regime should be selected on the basis of total daily dose immediately pre-labour (data available on pump/patient notes).

Intra-partum

An intravenous cannula must be inserted.

The usual basal rate should continue and blood glucose **must** be measured **hourly using a hospital approved blood glucose meter** aiming for target glucose of 5.0-8.0 mmol/l.

Time from onset of labour to delivery can be lengthy. Blood glucose values fluctuate and will rise and/or fall outside the target range. Adjustments will need to be made on the pump to manage these fluctuations.

Hyperglycaemia

- If blood glucose is > 8.0 mmol/l a correction bolus should be administered, aiming for a blood glucose of 5.0 mmol/l.
- e.g. (1 unit of insulin will reduce blood glucose by 2.5 mmol/l unless otherwise documented e.g. if blood glucose is 10.0 mmol/l give 2 units.)
- After 1 hour if blood glucose is above 8.0 mmol/l repeat the correction bolus applying the same calculation.
- If after a further 30 mins blood glucose is above 8.0 mmol/l convert to IV dextrose/insulin as per protocol and remove the insulin pump. This should be recorded and stored safely.

Hypoglycaemia

If blood glucose is < 4.0 mmol/l treat hypoglycaemia as per hospital protocol initially, repeat glucose after 15 minutes to ensure resolution.

If glucose remains <4.0 mmol/l repeat the above until hypoglycaemia is corrected.

If the patient has unexplained hypoglycaemic episode reduce the basal rate by 25-50% using a temporary setting. This rate should continue for the remainder of labour and should not increase back to 100%.

If further hypoglycaemia occurs then convert to IV dextrose /insulin as per protocol

Post delivery

After delivery of the placenta

The patient/partner should reduce the basal rate by 50% of the pre-labour rate **or to the pre-pregnancy rate** if known often with an additional 10-20% reduction.

If breast feeding, the basal rate may need reducing by a further 10-20%.

Bolus doses can re-start once eating and drinking, use the pre-pregnancy ratios (or if doses unknown, 1 unit insulin per 12-15g of carbohydrate and insulin sensitivity factor of 1:4.0 mmol/l).

Caesarean Section (LSCS)

It is anticipated that the duration of time to undergo this procedure is short, i.e. < 2 hours. If diabetes is **stable** and anaesthetist is agreeable the insulin pump can continue during the LSCS at the current basal rate, hourly blood glucose measurements should continue. Although outside manufacturer's recommendation Insulin pumps and CGM are increasingly used during caesarean section with unipolar and bipolar diathermy. Patients should use a Teflon cannula and the pump and CGM should be sited away from the operative field. The decision should be made in advance of delivery and in consultation with the diabetes ante-natal team.

- If hypoglycaemia <4.0 mmol/l, correct with IV bolus of 20g glucose (80-100ml of 20% dextrose or 30-40ml of 50% dextrose), and repeat blood glucose after 15 mins to ensure resolution or repeat the above. Consider converting to intravenous dextrose/insulin infusion.

- If hyperglycaemia >10.0 mmol/l develops convert to an IV dextrose/insulin infusion. The pump should be switched off, removed, labelled and stored safely for post-partum use.

- **Re-starting the insulin pump (CSII)**

If the insulin pump has been discontinued and replaced with dextrose/Insulin infusion, then the insulin pump should re-start when eating and drinking normally. The dextrose/Insulin infusion should continue for **30-60** minutes after the first mealtime bolus dose.

Checklist

- Ensure the patient agreement is signed
- The patient has the pump log (appendix 2) and that they prospectively record and keep at the bedside
- Prescribe the insulin and delivery device on the drug chart
- Record the pump settings and frequency of blood glucose monitoring (appendix 3) and attach the form to drug chart

References

This guidance has been adapted from:

1. Joint British Diabetes Societies for inpatient care. Managing diabetes and hyperglycaemia during labour and birth. February 2022. Available at JBDS-12-Managing-diabetes-and-hyperglycaemia-during-labour-and-birth-27.1.22.pdf (diabetestimes.co.uk)

2. Adapted from CLINICAL GUIDELINE: Guidelines for managing continuous subcutaneous insulin infusion (CSII or 'insulin pump') therapy in hospitalised patients. Diabetes Technology Network UK: **https://abcd.care/sites/abcd.care/files/CSII_DTN_FINAL%20210218.pdf**

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Authorisation Form for Publication onto COIN

PLEASE ENSURE THAT ALL QUESTIONS ARE ANSWERED – IF NOT APPLICABLE PLEASE PUT N/A

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