COncise adVice on Inpatient Diabetes (COVID:Diabetes):

HYPERGLYCAEMIA/DIABETES GUIDANCE FOR PEOPLE WITH COVID-19 INFECTIONS MANAGED IN A VIRTUAL WARD: A GUIDE FOR HEALTHCARE PROFESSIONALS

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NATIONAL INPATIENT DIABETES COVID-19 RESPONSE GROUP*

INTRODUCTION

Dexamethasone and other glucocorticoids are an effective treatment for people with COVID-19 infection experiencing hypoxia. Hyperglycaemia is a common side effect of glucocorticoid treatment and COVID-19 infection itself has also been found to predispose to hyperglycaemia in those with and without a prior diagnosis of diabetes. Hyperglycaemia has been associated with adverse outcomes in those with COVID-19 infection and so effective treatment is desirable. This guidance has been produced to support safe management of hyperglycaemia in those receiving glucocorticoid treatment for COVID-19 infection outside of a hospital environment. Detailed guidance around the COVID virtual ward model is available from NHS England. It is recommended that services leading virtual COVID wards establish links with the local diabetes services to agree any necessary processes or pathways required to support this guidance.

ORAL GLUCOSE-LOWERING AGENTS

- It is recommended that SGLT2 inhibitor medications (eg empagliflozin®, dapagliflozin®) be temporarily stopped because of the increased risk of developing ketosis
- Metformin should be continued where possible as it has been associated with better outcomes in the context of COVID-19 infection

HbA1c ASSESSMENT

- A sample should be taken for HbA1c analysis at the time of initial assessment

HbA1c can be used to differentiate stress hyperglycaemia from previously undiagnosed diabetes. In those known to have diabetes it will give an idea of usual glucose levels, and an elevated HbA1c can be helpful in identifying those with pre-existing significant insulin resistance. Management in hospital rather than in a 'virtual ward' may be more appropriate for those with an elevated HbA1c (anecdotal evidence suggests an HbA1c over 70mmol/mol may be associated with an increased risk of hyperglycaemia and significant insulin resistance).

GLUCOSE MONITORING

- Everybody initiated on dexamethasone treatment should have regular glucose monitoring for at least 48 hours, whether or not they have pre-existing diabetes
- For people not on any glucose lowering medication, glucose monitoring could be stopped if all glucose readings are below 12 mmol/l in the first 48 hours. Further glucose checks should be undertaken in the event of any clinical deterioration

Regular glucose monitoring is essential for detection of hyperglycaemia requiring treatment. It is recognised that some care environments may be able to offer less support than others. Minimum recommendations are provided in Table 1 below, as well as an optimal recommended monitoring regimen for situations where this is available. Treatment is most likely to be influenced by readings taken before breakfast and before the evening meal.

Table 1. Glucose monitoring

	FREQUENCY	TIMING
Minimum (e.g. for a person who is unable to monitor independently, being cared for at home)	Once daily	Check once, ideally between 1 and 7pm
Optimal (e.g. for those in care homes with trained staff available or those living at home and able to check independently)	Four times daily	Before mealtimes and before bed

Some areas may consider the use of Freestyle Libre® monitoring in a pre-specified group of people with diabetes. This will need to be done according to a defined local protocol by a specialist team with experience of using Freestyle Libre® and the capacity to provide appropriate support.

KETONE MONITORING

- The facility to check ketones should be available for everybody with hyperglycaemia treated in a virtual ward environment
- Capillary ketone monitoring is ideal but urine ketone monitoring is acceptable
- For people with type 1 diabetes who are able to self-monitor, ketone monitoring should ideally be available with information about how to use corrective insulin doses ("sick day rules")

People with COVID-19 infection are at risk of hyperglycaemia and ketosis which may progress to a diabetes emergency if left untreated. For this reason there are some clinical scenarios where checking ketones (if possible) is recommended:

Table 2. Ketone Monitoring

SCENARIO	ADVICE / ACTION
Patient clinically deteriorated	› Arrange urgent review and check blood glucose and ketone level*
People with type 1 diabetes with hyperglycaemia (glucose over 15mmol/l)	› Check blood ketones immediately if they have a ketone meter and are capable of doing so › If this is not possible they or third party carer should check urine ketones and if the test is positive (more than ++) then arrange a blood ketone check same day*
People with type 2 diabetes, other types of diabetes or type unknown with hyperglycaemia (glucose over 15mmol/l)	› Check blood or urine ketones › If urine ketones in virtual ward setting are positive (more than ++) arrange a blood ketone check (same day where possible)*

*see Table 3 below for actions depending on blood ketone level

Table 3. Recommended actions from capillary ketone levels

KETONE LEVEL	ACTION
Up to 0.5 mmol/l	› No action required
0.6 – 1.5 mmol/l	› Ensure person well hydrated and arrange repeat ketone check at next opportunity (next day at the latest)
1.6 – 2.9 mmol/l	› For all diabetes types follow "sick day rules" as advised for type 1 diabetes (Trend UK guidance is available here) › Where "sick day rules" not available use corrective insulin doses aiming for glucose less than 12 mmol/l – recheck ketones at next opportunity (next day at the latest)
3.0 or greater	› Requires urgent assessment/treatment for possible DKA

TREATMENT

- Treatment with insulin is recommended where two consecutive glucose readings are over 12 mmol/l, or 2 or more readings are over 12 mmol/l in a 24 hour period
- For those new to insulin, basal insulin should be commenced and adjusted according to need. The insulin selected will depend on factors such as local preference, which steroid is to be used, and whether third party administration will be required
- A once daily basal insulin regimen is recommended for simplicity, but a twice daily regimen may be used
- Where available, corrective insulin dosing may also be used using a rapid acting insulin analogue. See Table 7
- Where insulin is commenced in hospital and continued in a virtual ward, the regimen chosen should be compatible with how it can be administered within the virtual ward
- Where insulin treatment is already established this should continue and be adjusted according to need

FOR PEOPLE NEW TO INSULIN

ONCE DAILY BASAL INSULIN

- Where insulin is commenced in the virtual ward, a once daily basal regimen is recommended for simplicity
- Morning insulin administration is recommended (before midday)
- The choice of insulin may be influenced by steroid choice as well as local experience/preference
  - For dexamethasone, an analogue basal insulin (eg Abasaglar®/Lantus®/Levemir®/Semglee®) may be preferred
  - For prednisolone, NPH insulin (eg Humulin I®/Insulatard®/Insuman Basal®) may be preferred
  - Ultra-long acting insulins (eg Toujeo®/Tresiba®) are not recommended due to the need to de-escalate treatment rapidly once corticosteroid treatment stops

A measured or estimated weight can be used to decide the initial insulin dose. Table 4 below can be used as a guide.

- Use 0.2 units/kg as an initial dose. A dose reduction (0.1 units/kg) should be used as an initial dose in certain groups e.g. over 70 yrs/frail/renal impairment (Creatinine over 175 mmol/l or eGFR less than 30 ml/min)
- These doses are lower than those recommended in our inpatient guidance in order to optimise safety by reducing the risk of hypoglycaemia developing outside the acute setting

Table 4. Recommended once daily basal insulin dose – people new to insulin

WEIGHT (KG)	50	60	70	80	90	100	110	120
Standard dose (units)	10	12	14	16	18	20	22	24
Reduced dose (units)	5	6	7	8	9	10	11	12

Adjust doses daily, based on the glucose reading taken prior to the insulin dose, using Table 5 below.

Table 5. Dose adjustment advice for once daily basal insulin

MORNING GLUCOSE LEVEL (CHECKED JUST BEFORE INSULIN DOSE)	AFTERNOON GLUCOSE LEVEL (CHECKED BETWEEN 1 – 7PM)	RECOMMENDED DOSE ADJUSTMENT
4.0 mmol/l or less		Reduce dose by 20%
4.1-6.0 mmol/l		Reduce dose by 10%
6.1-12.0 mmol/l	Less than 15mmol/l	No change in dose
6.1-12.0 mmol/l	More than 15mmol/l	Increase dose by 10%
12.1-18.0 mmol/l		Increase dose by 10%
More than 18.0 mmol/l		Increase dose by 20%

TWICE DAILY BASAL INSULIN

- Where people have been started on twice daily basal insulin as an inpatient, this may be continued in the virtual ward where self-administration or twice daily third party administration is possible. Doses should be adjusted based on Table 6 below.

Table 6. Dose adjustment advice for twice daily basal or mixed insulin

GLUCOSE LEVEL	JUST BEFORE MORNING INSULIN DOSE	JUST BEFORE EVENING INSULIN DOSE
Up to 4.0 mmol/l	Reduce **evening** insulin by 20%	Reduce **morning** insulin by 20%
4.1-6.0 mmol/l	Reduce **evening** insulin by 10%	Reduce **morning** insulin by 10%
6.1-12.0 mmol/l	No change	No change
12.1-18.0 mmol/l	Increase **evening** insulin 10%	Increase **morning** insulin by 10%
18.1 mmol/l or more	Increase **evening** insulin by 20%	Increase **morning** insulin by 20%

CORRECTIVE INSULIN DOSING

› In the event of hyperglycaemia it is important to optimise hydration and ensure ketones are checked where appropriate (see Tables 2 and 3). Corrective insulin doses may be used where it is possible to do so (e.g. person in a care setting with trained staff available or person able to do this independently at home)
› Additional corrective insulin doses can be added no more than every 4 hours using rapid-acting insulin analogues (eg Apidra®/Humalog®/Novorapid®). Use total daily dose (TDD) of insulin to decide corrective insulin dose using Table 7 below. If TDD not known weight may be used

Table 7. Corrective insulin doses

GLUCOSE (MMOL/L)	TDD LESS THAN 50 UNITS WEIGHT LESS THAN 50KG	TDD 50-100 UNITS WEIGHT 50-100KG	TDD MORE THAN 100 UNITS WEIGHT OVER 100KG
12.0-14.9	2 units	3 units	4 units
15.0-16.9	2 units	3 units	5 units
17.0-18.9	3 units	4 units	5 units
19.0-20.9	3 units	5 units	6 units
21.0-22.9	4 units	6 units	7 units
23.0-24.9	4 units	7 units	8 units
25.0-27.0	5 units	8 units	9 units
Over 27	6 units	9 units	10 units

FOR PEOPLE WITH ESTABLISHED INSULIN TREATED DIABETES

A. Basal insulin – once daily

» If newly commenced on dexamethasone or other high dose glucocorticoid increase the dose by 20%
» Adjust doses further using Table 5 above

B. Basal or mixed insulin – twice daily

» If newly commenced on dexamethasone or other high dose glucocorticoid increase both doses by 20%
» Adjust doses further using Table 6 above

C. Corrective dosing

» Some people with type 1 diabetes will already have a recommended ratio for lowering high glucose readings (e.g. 1 unit to lower glucose by 3 mmol/l). However as glucocorticoid treatment can lead to increased insulin resistance be prepared to temporarily change this ratio
» All other people should use the above table to advise on corrective insulin doses, based on their usual total daily insulin dose (TDD)

***NATIONAL INPATIENT DIABETES COVID-19 RESPONSE GROUP:**

Professor Gerry Rayman (Chair), Professor Alan Sinclair, Dr Alistair Lumb, Chris Cottrell, Dr Dinesh Nagi, Professor Dipesh Patel, Debbie Voigt, Dr Ehtasham Ahmad, Esther Walden, Dr Hamish Courtney, Professor Jonathan Valabhji, Dr Julia Platts, Dr Kath Higgins, Professor Ketan Dhatariya, Dr Matt Inada-Kim, Dr Mayank Patel, Dr Omar Mustafa, Dr Parth Narendran, Philip Newland-Jones, Dr Rose Stewart, Dr Stuart Ritchie

Designed by: Leicester Diabetes Centre