

Table 1 Chronological order of insulin pump initiation and diagnosis of neuropathy

Chronological order	N = 1404
CSII first (≥ 5 years)	46
CSII first (1 to < 5 years)	113
CSII first (0.5 to < 1 year)	41
CSII first (< 0.5 years)	28
Simultaneously	575
Neuropathy first (< 0.5 years)	15
Neuropathy first (0.5 to < 1 year)	19
Neuropathy first (1 to < 5 years)	55
Neuropathy first (≥ 5 years)	29
Unknown	483

Values are number of observations. CSII, continuous subcutaneous insulin infusion.

CSII. With regard to everyday clinical practice, we agree with Rigalleau *et al.* in that CSII is often initiated in individuals who are capable of managing intensive insulin treatment but suffer from chronic and/or acute diabetic complications under insulin injection therapy. As discussed in our publication [1], the DPV registry is a prospective longitudinal standardized computer-based documentation system for people with diabetes. Data are documented locally by the participating centres on an electronic health record. Twice a year, anonymized data are exported and transmitted for central analysis. We assume that the criteria used to diagnose diabetic neuropathy in the participating centres are based on national guidelines [2]. Accordingly, history of neuropathy was obtained from medical records. Further, our results might reflect the difficulties of diagnosing neuropathy and its onset in everyday clinical practice due to the vast array and variability of symptoms and asymptomatic courses [3]. As Rigalleau and colleagues suggested, it is possible that the diagnosis of neuropathy in individuals on CSII may reflect more pain, rather than objective symptoms such as reduced sensitivity or abolished reflexes, yet we presume that the same diagnostic criteria for neuropathy in individuals on CSII were used to diagnose individuals on insulin injection therapy. In conclusion, it remains uncertain why older adults on CSII in the DPV registry are more likely diagnosed with neuropathy compared with those receiving insulin injection therapy. The number of older individuals on CSII within the DPV registry is lower compared to the number of individuals receiving insulin injection therapy, therefore generalizability is limited. We would like to emphasize again the need of extensive research on older individuals with diabetes, including but not limited to diabetes technology use.



Funding sources

The DPV registry and this analysis are supported by the German Center for Diabetes Research (DZD). Further financial support for the DPV registry was provided by the German Diabetes Association (DDG) and by the European Foundation

for the Study of Diabetes (EFSO). The DPV registry receives funding from the Innovative Medicines Initiative 2 Joint Undertaking (INNODIA) under grant agreement 115797, supported by the European Commission's Horizon 2020 Research and Innovation Program and the European Federation of Pharmaceutical Industries and Associations, JDRE, and The Leona M. and Harry B. Helmsley Charitable Trust.

Competing interests

None declared.

J. Grammes¹ , E. Küstner¹, A. Dapp², M. Hummel³, J.-C. Kämmer⁴, T. Kubiak¹ , I. Schütz-Fuhrmann⁸, S. Zimny⁵, E. Bollow^{6,7}, R. W. Holl^{6,7} and for the DPV Initiative

¹Health Psychology, Johannes Gutenberg University, Mainz, ²Medical Center, Spaichingen, ³Diabetology Outpatient Clinic, Rosenheim, ⁴Department of Gastroenterology, Cardiology, Diabetology, and Geriatrics, Vivantes Klinikum Berlin, Berlin, ⁵Department of Internal Medicine, Endocrinology and Diabetology, Helios Kliniken, Schwerin, ⁶ZIBMT, Institute of Epidemiology and Medical Biometry, University of Ulm, Ulm, ⁷German Center for Diabetes Research (DZD), Munich, Germany and ⁸Department of Internal Medicine, Krankenhaus Hietzing, Vienna, Austria

References

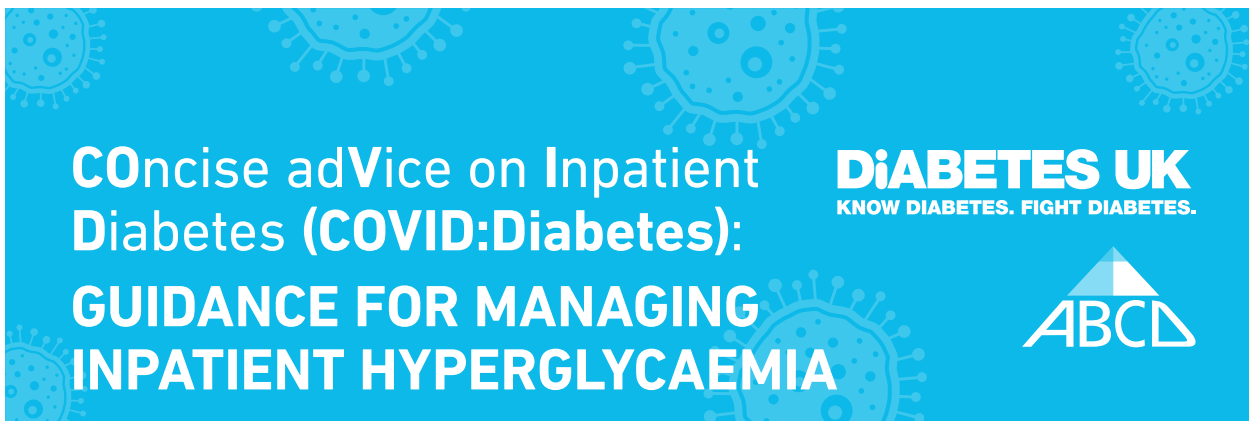
- Grammes J, Küstner E, Dapp A, Hummel M, Kämmer J-C, Kubiak T *et al.*, for the DPV Initiative. Comparative characteristics of older people with type 1 diabetes treated with continuous subcutaneous insulin infusion or insulin injection therapy: data from the German/Austrian DPV registry. *Diabet Med* 2020; 37: 858–864.
- Bundesärztekammer (BÄK), Kassenärztliche Bundesvereinigung (KBV), Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften (AWMF). *Nationale VersorgungsLeitlinie Neuropathie bei Diabetes im Erwachsenenalter – Langfassung*, 1. Auflage. Version 5. 2011. Available at www.dmneuropathie.rsorgungsleitlinien.de Last accessed 22 March 2020.
- Pop-Busui R, Boulton AJM, Feldman EL, Bril V, Freeman R, Malik RA *et al.* Diabetic neuropathy: A Position Statement by the American Diabetes Association. *Diabetes Care* 2017; 40: 136–154.

DOI: 10.1111/dme.14327

New Guidance on Managing Inpatient Hyperglycaemia during the COVID-19 Pandemic

Diabet. Med. 37, 1210–1213 (2020)

The COVID-19 pandemic has had a dramatic impact on the provision of acute inpatient care with specialists from all



NATIONAL INPATIENT DIABETES COVID-19 RESPONSE GROUP*

Use when:

- ✔ **Glucose above 12 mmol/l and a correction dose is appropriate for the individual patient**
- ✔ **DKA/HHS not present**

Can be used in place of variable rate intravenous insulin when infusion pumps not available

- ⚠ **DO NOT use for people with COVID-19 causing severe insulin resistance in the ICU. Contact your local diabetes team for advice in this circumstance.**
- ⚠ **After 9pm consider risk of hypoglycaemia overnight when thinking about the use of a corrective dose**

IF GLUCOSE > 12 MMOL/L AND NO INSULIN ADMINISTERED IN PREVIOUS 4 HRS CONSIDER A CORRECTIVE DOSE OF RAPID-ACTING ANALOGUE INSULIN (NOVORAPID®/HUMALOG®/APIDRA®)

- > Re-check glucose after 4 hours OR before next meal – further action may be required
- > Target glucose 6–10 mmol/l – aiming for higher end of range (up to 12 mmol/l acceptable)
- > Dose decided using one of the following 3 factors and the table below. Factors are listed in order of importance:
 1. If person uses pre-existing correction ratio (CR) (e.g. 1 unit insulin lowers glucose by 3 mmol/l) this should be used
 2. If person using insulin but doesn't have correction ratio, use their usual total daily insulin dose (TDD)
 3. If person not previously using insulin, or dose is unknown, use their weight
- > If the person has rapid-acting insulin with each meal the corrective dose can be added to their mealtime dose if appropriate.

GLUCOSE (MMOL/L)	CR* = 1UNIT ↓ 4 MMOL/L OR TDD** LESS THAN 50 UNITS OR WEIGHT LESS THAN 50KG	CR* = 1UNIT ↓ 3 MMOL/L OR TDD** = 50–100 UNITS OR WEIGHT BETWEEN 50–100 KG	CR* = 1UNIT ↓ 2 MMOL/L OR TDD** OVER 100 UNITS OR WEIGHT OVER 100 KG
12.0–14.9	1	1	2
15.0–16.9	2	2	3
17.0–18.9	2	3	4
19.0–20.9	3	3	5
21.0–22.9	3	4	6
23.0–24.9	4	5	7
25.0–27.0	4	5	8
Over 27	5	6	9

*CR = Correction ratio, **TDD = total daily insulin dose

⚠ **It is recommended that glucose is checked at least 4 times per day in people treated with insulin**

LONG-ACTING INSULIN (LEVEMIR®/ ABASAGLAR®/LANTUS®/SEMGLEE®/ HUMULIN I®/ INSULATARD®/INSUMAN BASAL®)

- > **Already using long-acting insulin:** Continue and titrate dose (see tables below)
- > **NOT already using long-acting insulin:** If 2 or more glucose readings in 24 hrs are > 12 mmol/l (eg, 2 or more corrective doses in previous 24 hrs)
 - >> ADD long-acting insulin – total dose 0.25 units/kg/day (eg, 0.25 x 80kg = 20 units OD OR 10 units BD depending on the choice of basal insulin – see below).
 - >> NOTE if:
 - Older (>70 yrs) or frail
 - Serum creatinine >175 umol/l
 Use a reduced long-acting insulin dose of 0.15 units/kg (eg 0.15 x 80kg = 12 units OD OR 6 units BD)

Recommended options (all acceptable – refer to local protocols):

Levemir® Insulin detemir 100 units/ml (U100)	<ul style="list-style-type: none"> > Two equal doses of 0.125 units/kg, 12 hrs apart > Not available in vials so insulin pen needles must be available to use with a pen device* > Can adjust either dose
Abasaglar®/Lantus®/Semglee® Insulin glargine 100 units/ml (U100)	<ul style="list-style-type: none"> > Single dose of 0.25 units/kg/24 hrs (minimises patient contact) or > Split above into 2 equal doses, 12 hrs apart > Abasaglar®/Semglee® not available in vials so insulin pen needles must be available to use with an insulin pen device**
Humulin I®/Insulatard®/Insuman Basal® Isophane insulin 100 units/ml (U100)	<ul style="list-style-type: none"> > Two equal doses of 0.125 units/kg/10–14 hrs apart > Particularly suited to steroid treatment – dose given as 2/3 total long-acting insulin dose am : 1/3 total long-acting insulin dose pm

* Only specific insulin syringes/needles should be used to administer insulin from vials

** DO NOT WITHDRAW INSULIN FROM A 3ML INSULIN PEN CARTRIDGE OR 3ML PREFILLED

FIGURE 1 Guideline.

DOSE ADJUSTMENT FOR LONG-ACTING INSULIN

Doses can be titrated daily, although longer-acting insulins may take 48–72 hours to reach steady state. Dose adjustments will affect blood glucose throughout the day.

ONCE daily long-acting insulin

GLUCOSE LEVEL JUST BEFORE INSULIN DOSE	
<4mmol/L	Reduce insulin by 20%
4.1–6mmol/L	Reduce insulin by 10%
6.1–12mmol/L	No change
12.1–18mmol/L	Increase insulin by 10%
>18mmol/L	Increase insulin by 20%

TWICE daily long-acting insulin

GLUCOSE LEVEL	JUST BEFORE MORNING INSULIN DOSE	JUST BEFORE EVENING INSULIN DOSE
<4mmol/L	Reduce evening insulin by 20%	Reduce morning insulin by 20%
4.1–6mmol/L	Reduce evening insulin by 10%	Reduce morning insulin by 10%
6.1–12mmol/L	No change	No change
12.1–18mmol/L	Increase evening insulin 10%	Increase morning insulin by 10%
>18mmol/L	Increase evening insulin by 20%	Increase morning insulin by 20%

Dose reduction should also be considered in the following circumstances:

- > Improving infection (as measured by falling CRP)
- > Enteral feed reducing or stopping
- > Corticosteroid treatment reducing or stopping
- > End of life care

⚠ In people recovering from COVID-19-related insulin resistance, doses may need to be reduced RAPIDLY to avoid hypoglycaemia.

As noted above, severe insulin resistance has been noted in some people with COVID-19 in the ICU. In this circumstance, suggested alternative treatment strategies include four times daily doses of Levemir[®] or twice daily doses of Lantus[®].

Contact your local diabetes team for advice.

*NATIONAL INPATIENT DIABETES COVID-19 RESPONSE GROUP:

Professor Gerry Rayman (Chair), Dr Alistair Lumb, Dr Brian Kennon, Chris Cottrell, Dr Dinesh Nagi, Emma Page, Debbie Voigt, Dr Hamish Courtney, Helen Atkins, Dr Julia Platts, Dr Kath Higgins, Professor Ketan Dhatariya, Dr Mayank Patel, Dr Parth Narendran, Professor Partha Kar, Philip Newland-Jones, Dr Rose Stewart, Dr Stephen Thomas, Dr Stuart Ritchie

Acknowledgements: London Diabetes Inpatient Network – COVID-19 • Designed by: [Leicester Diabetes Centre](#)

FIGURE 1 Continued

disciplines having to manage patients outside of their usual speciality areas. In many UK hospitals diabetes consultants and diabetes inpatient specialist nurses have been redeployed to the wards to care for COVID-19 positive or suspected cases. Consequently, clinicians relatively unfamiliar with managing hyperglycaemia have been required to do so as the usual input from diabetes specialist teams has not been possible in many areas.

The National Diabetes Inpatient COVID-19 Response Group was formed to provide guidance to those involved in the care of inpatients with diabetes during this crisis. We have published in a previous issue of this journal guidance on care at the 'front door' aimed at emergency departments and admitting teams [1]. We now present guidance on the management of inpatient hyperglycaemia (Figure 1). We recognise that most hospitals will already have established local guidance in place. The current guidance is intended to help supplement and update existing guidance with a particular reference to supporting those less experienced in insulin use. In this respect, it is tailored to manage hyperglycaemia but as much as possible reducing the risk of overcorrection resulting in hypoglycaemia. It thus sets more liberal glycaemic targets than have been suggested in previous UK guidelines [2]. The COVID specific diabetes algorithms aim to achieve a 'lower' target of 6.0 mmol/L (higher than the previous of 4.0mmol/L) yet to keep blood glucose levels less than 10.0 mmol/L with up to 12.0 mmol/L being acceptable.








Uniquely, it provides 3 different correction regimes for rapid acting analogue insulin based on the information available to the clinician. Firstly, if the person with diabetes knows their own 'correction dose' this should be used (e.g. for people with type 1 diabetes who are DAFNE trained, 1 unit reduces the blood glucose by 3.0 mmol/L). Secondly, if the total daily dose is known the correction is based on intervals of less than 50 units/day, 50-100 units/day and over 100 units/day. Finally, where none of the previous are known, the correction is based on weight with intervals of less than 50 kg, 50-100 kg and > 100 kg (for insulin naïve people or those newly presenting).

The guidance recommends commencement of a basal insulin if hyperglycaemia persists after several correction doses of rapid acting insulin within a 24 hr period. The algorithm recommends a starting dose related to the person's weight and specific issues such as age, fragility and renal function. There are then dosing regimens related to the particular basal insulin available in individual hospitals. There is also a dose adjustment regimen for the basal regimen based on the blood glucose levels immediately prior to the timing of the basal insulin.

Finally, the guidance recognises that the insulin dose may need adjustment, particularly the basal insulin dose when there is a change in insulin sensitivity such as can occur with improving infection, reduction in corticosteroid treatment

and in those recovering from COVID-19 related insulin resistance.

Although, this guidance has been introduced for use during the present pandemic it is possible that this more judicious glucose target that has been previously advocated by some [3] and the early intervention with basal insulin may become the established guidance for the future.

G. Rayman¹ , A. Lumb² , B. Kennon³, C. Cottrell⁴, D. Nagi⁵, E. Page⁶ , D. Voigt⁷, H. Courtney⁸, H. Atkins⁹, J. Platts¹⁰, K. Higgins⁹, K. Dhatariya¹¹ , M. Patel¹² , P. Narendran¹³ , P. Kar¹⁴, P. Newland-Jones¹⁵, R. Stewart¹⁶ , O. Burr¹⁷ and S. Thomas¹⁸

¹The Ipswich Hospital and Ipswich Diabetes Centre and Research Unit, East Suffolk and North Essex NHS Foundation Trust, Ipswich, ²Oxford University Hospitals NHS Foundation Trust, OCDEM, Oxford, UK, ³Queen Elizabeth University Hospital, Glasgow, Scotland, ⁴Swansea Bay University Health Board, Port Talbot, Wales, ⁵Department of Diabetes, Mid Yorkshire Hospitals NHS Trust, Wakefield, ⁶Ipswich Hospital NHS Trust, Diabetes Centre, Ipswich, UK, ⁷Tayside University Hospitals NHS Trust, Ninewells Hospital, Dundee, Scotland, ⁸Belfast Health and Social Care Trust, Belfast, Northern Ireland, ⁹Department of Diabetes, University Hospitals of Leicester NHS Trust, Leicester, UK, ¹⁰Cardiff and Vale University Local Health Board, College of Medicine, Cardiff, Wales, ¹¹Norfolk & Norwich University Hospital NHS Foundation Trust, Elsie Bertram Diabetes Centre, Norwich, ¹²University Hospital Southampton NHS Trust, Southampton, ¹³Department of Diabetes, Queen Elizabeth Hospital Birmingham, Birmingham,, ¹⁴Portsmouth Hospitals NHS trust and NHS England, NHS Diabetes Programme, Portsmouth, ¹⁵University of Southampton Faculty of Medicine, Diabetes and Endocrinology, Southampton, UK, ¹⁶Department of Diabetes, Wrexham Maelor Hospital, Betsi Cadwaladr University Health Board, Wrexham, Wales, ¹⁷Department of Diabetes, Diabetes UK, and ¹⁸Guy's and Saint Thomas' NHS Foundation Trust, Diabetes Centre, London, UK

References

- 1 Rayman G, Lumb A, Kennon B, Cottrell C, Nagi D, Page E *et al*. Guidelines for the management of diabetes services and patients during the COVID-19 Pandemic. *Diabet Med* 2020; 37: 1087–1089.
- 2 A good inpatient diabetes service. Joint British Diabetes Societies. https://abcd.care/sites/abcd.care/files/resources/A_good_inpatient%20Service_FINAL_Aug19.pdf. Accessed 12/05/2020
- 3 Levy N, Hall GM. National guidance contributes to the high incidence of inpatient hypoglycaemia. *Diabet Med* 2019; 36: 120–121.