

**JBDS-IP** Joint British  
Diabetes Societies  
for inpatient care

The Hospital Management of Hypoglycaemia  
in Adults with Diabetes Mellitus  
4th edition

Revised January 2020





**This document is coded JBDS 01 in the series of JBDS documents:**

**Other JBDS documents:**

Inpatient care of the Frail Older Adult with Diabetes October 2019 JBDS 15

A good inpatient diabetes service July 2019 JBDS 14

The management of diabetes in adults and children with psychiatric disorders in inpatient settings May 2017 JBDS 13

Management of glycaemic control in pregnant women with diabetes on obstetric wards and delivery May 2017 JBDS 12

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

**These documents are available to download from the ABCD website at <https://abcd.care/joint-british-diabetes-societies-jbds-inpatient-care-group> and the Diabetes UK website at [www.diabetes.org.uk/joint-british-diabetes-society](http://www.diabetes.org.uk/joint-british-diabetes-society)**

# Contents

<b>Foreword</b>	<b>4</b>
<b>Authorship</b>	<b>5-6</b>
<b>What has changed since the previous guideline?</b>	<b>7</b>
<b>Introduction</b>	<b>8</b>
<b>Clinical features</b>	<b>11</b>
<b>Risk factors for hypoglycaemia</b>	<b>12</b>
<b>Potential causes of inpatient hypoglycaemia</b>	<b>13</b>
<b>Management of hypoglycaemia</b>	<b>15</b>
<b>Treatment of hypoglycaemia</b>	<b>19-25</b>
Adults who are conscious, orientated and able to swallow	19
Adults who are conscious but confused and able to swallow	20
Adults who are unconscious or having seizures	21-22
Adults who are 'Nil by Mouth'	23
Adults requiring enteral feeding	24-25
<b>When hypoglycaemia has been successfully treated</b>	<b>26</b>
<b>Audit standards</b>	<b>27</b>
<b>Guideline update</b>	<b>27</b>
<b>References</b>	<b>28-29</b>
<b>Further reading</b>	<b>30</b>
<b>Traffic light algorithm for the treatment of hypoglycaemia</b>	<b>31</b>
<b>Flow chart for the treatment of hypoglycaemia</b>	<b>32</b>
<b>Appendices</b>	
Appendix 1 – List of insulins currently available	33
Appendix 2 – Example of contents of hypo box	34
Appendix 3 – Hypoglycaemia audit form	35-36
Appendix 4 – Example of treatment sticker	37
Appendix 5 – Injectable medicines monograph	38-39

# Foreword

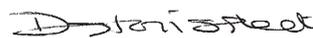
Hypoglycaemia continues to be one of the most feared short-term complications of diabetes mellitus amongst people with diabetes, healthcare professionals and lay carers alike. For people receiving insulin or sulfonylurea therapy as treatment for their diabetes, evidence would suggest that achieving good glycaemic control while avoiding hypoglycaemia remains very difficult. Intercurrent illness and the hospital setting compounds this situation with access to meals and snacks often being very different compared with the home environment.

Often people with diabetes are not admitted to hospital with a diabetes related issue and can thus be under the care of any medical or surgical specialty; this can result in them being treated by staff without specialist diabetes knowledge.

In response to these issues this guideline was produced by the Joint British Diabetes Societies (JBDS) to offer clear guidance for the effective management of hypoglycaemia in hospital. It appears clear that Trusts have welcomed this with 92% of 118 hospitals responding to a SurveyMonkey® questionnaire suggesting they have used it as the basis for hypoglycaemia management within their hospital. A review of the ABCD and Diabetes UK websites showed that this guideline has been downloaded more than 188,000 times. It is reviewed regularly and updated in response to new evidence, national changes and comments received. The authors would like to thank all involved for their comments and would encourage people to contact us with any further comments.

This is the fourth iteration of this guideline (Original March 2010, September 2013 and April 2018).

We hope that all healthcare professionals involved in the care of diabetes patients find this a useful document. By adopting the principles and adapting where necessary, these guidelines should help ensure good quality, timely and effective treatment for people with diabetes.



## Lead authorship

Esther Walden (RGN), Norfolk and Norwich University Hospitals NHS Foundation Trust  
Debbie Stanisstreet (RGN), East and North Hertfordshire NHS Trust  
Dr Alex Graveling, Aberdeen Royal Infirmary

## Supporting organisations

Association of British Clinical Diabetologists (ABCD), Chair: Dr Dinesh Nagi (Yorkshire)  
Diabetes Inpatient Specialist Nurse (DISN) UK Group, Chair: Esther Walden (Norwich)  
Diabetes UK: David Jones, Assistant Director of Improvement, Support and Innovation  
Joint British Diabetes Societies (JBDS) for Inpatient Care, Chair: Professor Ketan Dhatariya (Norwich)

## Writing group

Professor Stephanie Amiel, King's College Hospital NHS Foundation Trust  
Dr Clare Crowley, Oxford University Hospitals NHS Foundation Trust  
Dr Ketan Dhatariya, Norfolk and Norwich University Hospitals NHS Foundation Trust  
Professor Brian Frier, The Queen's Medical Institute, University of Edinburgh  
Dr Rifat Malik, King's College Hospital NHS Foundation Trust

## Distributed and incorporated comments from:

Diabetes Inpatient Specialist Nurse (DISN) UK Group membership  
Joint British Diabetes Societies (JBDS) Inpatient Care Working Group members  
Diabetes UK  
Diabetes UK User Group  
Association British Clinical Diabetologists (ABCD)  
The Diabetes Management & Education Group (DMEG) of the British Dietetic Association  
United Kingdom Clinical Pharmacy Association (UKCPA) Diabetes & Endocrinology Committee  
Guild of Healthcare Pharmacists (GHP)  
Royal College of Physicians (RCP)  
Training, Research and Education for Nurses in Diabetes (TREND UK)  
Ambulance Service Network

## Wider distribution:

Royal College of Nursing

## JBDS IP Review Group

Dr Ahmed Al-Sharefi, Imperial Healthcare NHS Trust  
Dr Belinda Allan, Hull and East Yorkshire Hospital NHS Trust  
Erwin Castro, East Sussex Healthcare NHS Trust  
Dr Umesh Dashora, East Sussex Healthcare NHS Trust  
Dr Parijat De, Sandwell and West Birmingham NHS Trust  
Professor Ketan Dhatariya (Norwich), Chair, Joint British Diabetes Societies (JBDS) for Inpatient Care  
Dr Daniel Flanagan, Plymouth Hospitals NHS Trust  
Dr Stella George, East and North Hertfordshire NHS Trust  
Dr Sandip Ghosh, University Hospitals Birmingham NHS Foundation Trust  
Dr Masud Haq, Maidstone and Tunbridge Wells NHS Trust  
Dr Christopher Harrold, University Hospitals Coventry and Warwickshire NHS Trust  
June James, University Hospitals of Leicester NHS Trust  
David Jones, Diabetes UK  
Dr Meera Ladwa, Kings College Hospital NHS Foundation Trust  
Dr Anthony Lewis, Belfast Health and Social Care Trust, Northern Ireland  
Dr Sue Manley, University Hospitals Birmingham NHS Foundation Trust  
Dr Omar Mustafa, Consultant Diabetologist, King's College Hospital NHS Foundation Trust  
Dr Dinesh Nagi, Mid Yorkshire Hospitals NHS Trust  
Phillip Newland-Jones, University Hospitals Southampton NHS Foundation Trust  
Professor Gerry Rayman, The Ipswich Hospital NHS Trust  
Dr Stuart Ritchie, NHS Lothian  
Dr Aled Roberts, Cardiff and Vale University Health Board  
Professor Mike Sampson (Norwich) Norfolk and Norwich University Hospitals NHS Foundation Trust  
Professor Alan Sinclair, Director, Diabetes Frail Ltd, and King's College, London  
Debbie Stanisstree, East and North Hertfordshire NHS Trust  
Esther Walden, Norfolk and Norwich University Hospital NHS Foundation Trust  
Dr Peter Winocour, East & North Hertfordshire NHS Trust

With special thanks to Christine Jones for her administrative work and help with these guidelines and with JBDS-IP

# What has changed since the previous guideline?

In terms of specific guidance not much has changed, however;

- The algorithms for the treatment of hypoglycaemia as well as the list of treatments for treating hypoglycaemia in adults requiring enteral/parenteral feeding have been amended to be in line with other key diabetes documents.
- In response to the government's 'sugar tax' on soft drinks Lucozade® and Ribena® have been removed as suitable examples of quick acting carbohydrates.
- The fact that glucagon can be given without a prescription for the purpose of saving a life has been highlighted (although this information was in the original guideline).
- Throughout the guideline where 4mmol had previously been written this has been changed to 4.0mmol to avoid any confusion.
- In section E for enterally fed patients the sentence "In patients receiving TPN, treatment should be administered orally or intravenously as appropriate" has been added.
- The insulin action table on page 33 has been updated to include newer insulins now available.
- The discussion sections have been updated with any new evidence available.

# Introduction

This guideline is for the management of hypoglycaemia in adults (aged 16 years or older) with diabetes mellitus within the hospital setting. Local policies may exist for the treatment of younger adults aged between 16 to 18 years and you may need to refer to these.

This guideline is aimed at all healthcare professionals involved in the management of people with diabetes in hospital. Since the introduction of the original guideline in 2010, the practice of using 50% intravenous (IV) glucose for the treatment of hypoglycaemia has become much less commonplace, although it is still occasionally used. Expert opinion would suggest that the use of hyperosmolar solutions such as 50% glucose increase the risk of extravasation injury. Furthermore, smaller aliquots used to deliver 10% glucose result in lower post treatment glucose levels (Moore and Woollard, 2005). **For these reasons 10% or 20% glucose solutions are preferred. The authors recommend the IV glucose preparation chosen is prescribed on an 'as required' (PRN) basis for all patients with diabetes. If agreed locally, glucagon (and IV glucose) may be given without prescription in an emergency for the purpose of saving a life or via a Patient Group Directive (Royal Pharmaceutical Society, 2016).** Please note that intramuscular (IM) glucagon is only licensed for the treatment of insulin overdose, although it is also used in the treatment of hypoglycaemia induced by sulfonylurea therapy.

Nurses using this guideline must work within the Nursing and Midwifery Council (NMC) professional code of conduct and work within their own competencies.

This guideline is designed to enable adaptation to suit local practice where required.

# Hypoglycaemia in Adults with Diabetes

Hypoglycaemia is the commonest side effect of insulin or sulfonylureas therapy used to treat diabetes mellitus. Because of their modes of action (i.e. they prevent glucose from rising rather than lowering glucose concentrations); metformin, pioglitazone, DPP-4 inhibitors, acarbose, SGLT-2 inhibitors and GLP-1 analogues prescribed without insulin or insulin secretagogue (sulfonylurea and meglitinide) therapy are unlikely to result in hypoglycaemia. Hypoglycaemia presents a major barrier to satisfactory long term glycaemic control and remains a feared complication of diabetes treatment. Hypoglycaemia results from an imbalance between glucose supply, glucose utilisation and current insulin levels. Hypoglycaemia must be excluded in any person with diabetes who is acutely unwell, drowsy, unconscious, unable to co-operate, presenting with aggressive behaviour or seizures.

## Definition

Hypoglycaemia is a lower than normal level of blood glucose. It can be defined as “mild” if the episode is self-treated and “severe” if assistance by a third party is required (DCCT, 1993). For the purposes of people with diabetes who are hospital inpatients, any blood glucose less than 4.0mmol/L should be treated.

## Frequency

People with type 1 diabetes mellitus (T1DM) experience around two episodes of mild hypoglycaemia per week. Studies such as the DCCT excluded patients with a history of severe hypoglycaemia and reported lower incidences of hypoglycaemia than would be observed in an unselected group of patients. In unselected populations, the annual prevalence of severe hypoglycaemia has been reported consistently at 30-40% in several large studies (Strachan, 2014).

Severe hypoglycaemia is less common in people with insulin treated type 2 diabetes mellitus (T2DM) but still represents a significant clinical problem. Patients with insulin treated T2DM are more likely to require hospital admission for severe hypoglycaemia than those with T1DM (30% versus 10% of episodes) (Donnelly et al., 2005). Sampson et al examined 2000 ambulance call outs for severe hypoglycaemia, over a third were repeat call outs suggesting a significant minority are having recurrent problems. The median age was 67 with 85% of call outs for people receiving insulin therapy, unfortunately the data does not distinguish whether the person treated with insulin had type 1 or type 2 diabetes (Sampson et al., 2017). The risk of hypoglycaemia with sulfonylurea therapy is often underestimated and as a consequence of the duration of action of the tablets, is frequently prolonged. Elderly patients or those with renal impairment are at particular risk. The UK Hypoglycaemia Group Study showed equivalent levels of severe hypoglycaemia in people with T2DM treated with sulfonylurea therapy compared with insulin therapy of less than two years duration (UK Hypoglycaemia Study Group, 2007).

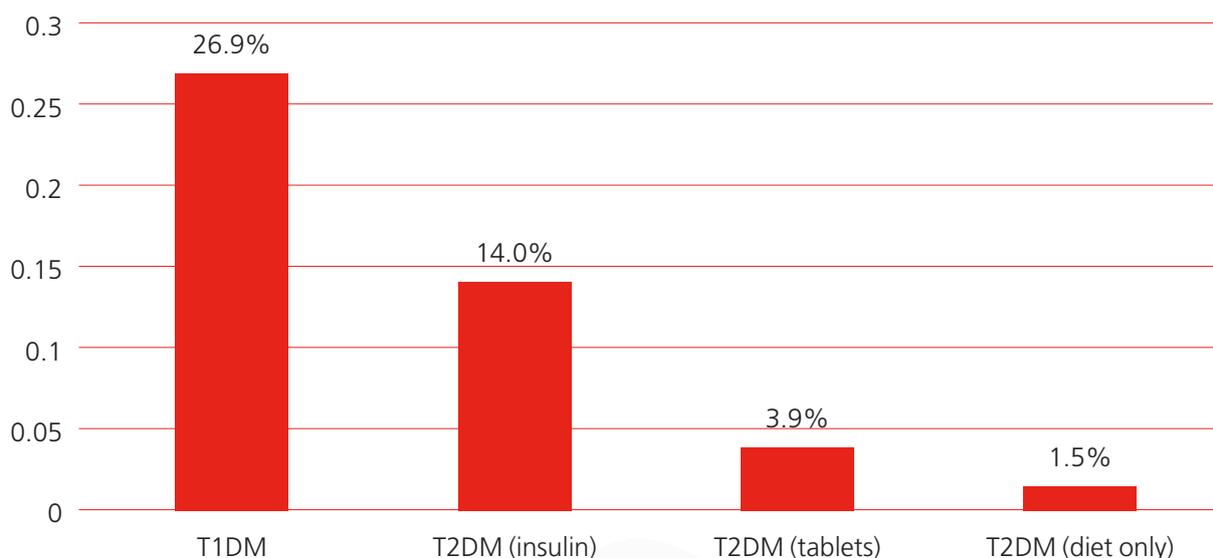
## Frequency in hospitalised patients

Seventeen percent of inpatients in England and Wales have known diabetes; in some hospital sites the prevalence was as high as 37.5% (NaDIA, 2016). The hospital environment presents additional obstacles to the maintenance of good glycaemic control and the avoidance of hypoglycaemia (Farrokhi et al., 2012).

NaDIA (National Diabetes Inpatient Audit 2016) data shows a year on year reduction in the frequency of hypoglycaemic episodes experienced over the 7 days prior to the day of audit. However, 20% of inpatients with diabetes still reported one or more hypoglycaemic episodes (blood glucose <4.0mmol/L) with 8.4% reporting one or more hypoglycaemic episodes less than 3.0mmol/L. Injectable treatment (i.e. intravenous glucose or intramuscular glucagon) was required to treat hypoglycaemia in 1.7% of patients. Figure 1 shows the breakdown by type of diabetes and treatment regimen of inpatients experiencing one or more episodes of hypoglycaemia (<3.0mmol/L) (NaDIA, 2016). Rajendran et al reported that 866 inpatients with insulin treated diabetes or sulfonylurea therapy experienced slightly less than 3 episodes of hypoglycaemia per inpatient stay (Rajendran et al., 2014). Studies from other countries have reported similar figures with 12-18% of inpatients with diabetes (type 1 or type 2) experiencing hypoglycaemia (Wexler et al., 2007).

Studies in both the United States and the UK have shown that significant hypoglycaemia (glucose <2.9mmol/L) is most likely to occur in inpatients overnight and first thing in the morning (Ulmer et al., 2015, Rajendran et al., 2014). Nocturnal hypoglycaemia (glucose <3.9mmol/L) was more common in patients treated with sulfonylurea therapy than insulin therapy (75.3% versus 59.3% respectively). The long gap between the evening meal and breakfast has been suggested as a potential contributing factor. NaDIA (2016) also demonstrates an interesting association between hypoglycaemia and medication errors; inpatients whose drug charts had more than one medication error were than twice as likely to experience a severe hypoglycaemic episode (15.5%) compared to inpatients who had no medication errors (7.5%).

**Figure 1: Percentage of inpatients experiencing one or more episodes of hypoglycaemia (<3.0mmol/L)**



# Clinical Features

The symptoms of hypoglycaemia warn an individual of its onset and vary considerably between individuals. Autonomic symptoms are generated by the activation of the sympatho-adrenal system and neuroglycopenic symptoms are the result of cerebral glucose deprivation. The brain is dependent on a continuous supply of circulating glucose as the substrate to fuel cerebral metabolism and to support cognitive performance. If blood glucose levels fall sufficiently, cognitive dysfunction is inevitable (Inkster and Frier, 2012). The 11 most commonly reported symptoms were used to form the Edinburgh Hypoglycaemia Scale and are reproduced in the below table (Deary et al., 1993).

Autonomic	Neuroglycopenic	General malaise
<ul style="list-style-type: none"><li>• Sweating</li></ul>	<ul style="list-style-type: none"><li>• Confusion</li></ul>	<ul style="list-style-type: none"><li>• Headache</li></ul>
<ul style="list-style-type: none"><li>• Palpitations</li></ul>	<ul style="list-style-type: none"><li>• Drowsiness</li></ul>	<ul style="list-style-type: none"><li>• Nausea</li></ul>
<ul style="list-style-type: none"><li>• Shaking</li></ul>	<ul style="list-style-type: none"><li>• Odd behaviour</li></ul>	
<ul style="list-style-type: none"><li>• Hunger</li></ul>	<ul style="list-style-type: none"><li>• Speech difficulty</li></ul>	
	<ul style="list-style-type: none"><li>• Incoordination</li></ul>	

# Risk Factors for Hypoglycaemia

**Table 2: Risk Factors for Hypoglycaemia**

<b>Medical issues</b>	<b>Lifestyle Issues</b>
<ul style="list-style-type: none"><li>• Strict glycaemic control</li><li>• Previous history of severe hypoglycaemia</li><li>• Long duration of type 1 diabetes</li><li>• Duration of insulin therapy in type 2 diabetes</li><li>• Lipohypertrophy at injection sites</li><li>• Impaired awareness of hypoglycaemia</li><li>• Severe hepatic dysfunction</li><li>• Impaired renal function (including those patients requiring renal replacement therapy)</li><li>• Sepsis</li><li>• Inadequate treatment of previous hypoglycaemia</li><li>• Terminal illness</li><li>• Cognitive dysfunction/dementia</li></ul>	<ul style="list-style-type: none"><li>• Increased exercise (relative to usual)</li><li>• Irregular lifestyle</li><li>• Alcohol</li><li>• Increasing age</li><li>• Early pregnancy</li><li>• Breast feeding</li><li>• No or inadequate blood glucose monitoring</li></ul>
	<b>Reduced Carbohydrate intake/absorption</b>
	<ul style="list-style-type: none"><li>• Food malabsorption e.g.gastroenteritis, coeliac disease</li><li>• Bariatric surgery involving bowel resection</li></ul>

Multivariable logistic regression analysis showed that age > 70 years, cognitive dysfunction and nephropathy were independently associated with hypoglycaemia (Borzi et al., 2016). Be aware that the following can also precipitate hypoglycaemia:

- Concurrent use of medicines with hypoglycaemic agents e.g. warfarin, quinine, salicylates, fibrates, sulphonamides (including cotrimoxazole), monoamine oxidase inhibitors, NSAIDs, probenecid, somatostatin analogues, SSRIs. Do not stop or withhold medication, discuss with the medical team or pharmacist
- Loss of counterregulatory hormonal function (e.g. Addison's disease, growth hormone deficiency, hypothyroidism, hypopituitarism)

# Potential causes of inpatient hypoglycaemia

Common causes of inpatient hypoglycaemia are listed in Table 3. One of the most serious and common causes of inpatient hypoglycaemia are insulin prescription errors including:

- Misreading poorly written prescriptions – when 'U' is used for units (i.e. 4U becoming 40 units)
- Confusing the insulin name with the dose (e.g. Humalog Mix25 becoming Humalog 25 units)
- Confusing the insulin strength with the dose (e.g. 100 unit dose inadvertently prescribed)
- Transcription errors (e.g. where patient on animal insulin is inadvertently prescribed human insulin or where handwriting is unclear)
- Inappropriately withdrawing insulin using a standard insulin syringe (100units/ml) from prefilled insulin pens containing higher insulin concentrations (e.g. 200 units/ml, 300 units/ml or 500 units/ml)
- Confusion between the prescription of a glucose and insulin infusion for hyperkalaemia and glucose and insulin infusion to control blood glucose (i.e. 10units of insulin in 50ml 50% dextrose prescribed instead of 50 units in 50ml sodium chloride 0.9%)

**Table 3: Potential causes of inpatient hypoglycaemia**

## Medical issues

- Inappropriate use of 'stat' or 'PRN' rapid/short acting insulin
- Acute discontinuation of long term corticosteroid therapy
- Recovery from acute illness/stress
- Mobilisation after illness
- Major amputation of a limb
- Incorrect type of insulin or oral hypoglycaemic therapy prescribed and administered
- Inappropriately timed insulin or oral hypoglycaemic therapy in relation to meal or enteral feed
- Change of insulin injection site
- IV insulin infusion with or without glucose infusion
- Inadequate mixing of intermediate acting or mixed insulins
- Regular insulin doses or oral hypoglycaemia therapy being given in hospital when these are not routinely taken at home
- Failure to monitor blood glucose adequately whilst on IV insulin infusion

## Carbohydrate intake issues

- Missed or delayed meals
- Less carbohydrate than normal
- Change of the timing of the biggest meal of the day (i.e. main meal at midday rather than evening)
- Lack of access to usual between meal or before bed snacks
- Prolonged starvation time e.g. 'Nil by Mouth'
- Vomiting
- Reduced appetite
- Reduced carbohydrate intake
- Omitting glucose whilst on IV insulin infusion

## Morbidity and Mortality

Hypoglycaemia can cause coma, hemiparesis and seizures. If the hypoglycaemia is prolonged the neurological deficits may become permanent. Acute hypoglycaemia impairs many aspects of cognitive function, particularly those involving planning and multitasking. The long-term effect of repeated exposure to severe hypoglycaemia is less clear.

The ACCORD study highlighted a potential risk of intensive glycaemic control. Recognised and unrecognised hypoglycaemia was more common in the intensive group than in the standard group. In the intensive group, a small but statistically significant inverse relationship of uncertain clinical importance was identified between the number of hypoglycaemic episodes and the risk of death among participants (Action to Control Cardiovascular Risk in Diabetes Study et al., 2008, Seaquist et al., 2012).

Patients on insulin therapy remain in hospital for longer if they experience hypoglycaemia (7 days compared with 4 days). Patients on insulin therapy also had greater inpatient mortality if they experienced hypoglycaemia compared to those who didn't (12.9% and 11.0% respectively); the inpatient mortality rate increased to 24.9% in those with hypoglycaemia defined as  $<2.2\text{mmol/L}$  (Akirov et al., 2017). Turchin et al (2009) examined data from 4368 admission episodes for people with diabetes of which one third were on regular insulin therapy. Patients experiencing inpatient hypoglycaemia experienced a 66% increased risk of death within one year and spent 2.8 days longer in hospital compared to those not experiencing hypoglycaemia (Turchin et al., 2009). Increased mortality rates were reported for inpatients on insulin therapy who experienced hypoglycaemia (blood glucose  $<2.8\text{mmol/L}$ ) compared to those with no hypoglycaemia (20.3% versus 4.5%). However, only 41-51% of these participants had diabetes and subgroup analysis of those with diabetes would have been useful (Garg et al., 2013).

## Impaired awareness of hypoglycaemia

Impaired awareness of hypoglycaemia (IAH) is an acquired syndrome associated with insulin treatment. IAH results in the warning symptoms of hypoglycaemia becoming diminished in intensity, altered in nature or lost altogether. This increases the vulnerability of affected individuals of progression to severe hypoglycaemia. The prevalence of IAH increases with duration of diabetes and is much more common in type 1 than in type 2 diabetes (Graveling and Frier, 2010).

# Management of Hypoglycaemia

## Introduction

People experiencing hypoglycaemia require quick acting carbohydrate to return their blood glucose levels to the normal range. The quick acting carbohydrate should be followed up by giving long acting carbohydrate either as a snack or as part of a planned meal. All patients experiencing hypoglycaemia should be treated without delay. Where it is safe to do so, a blood glucose measurement should be taken to confirm hypoglycaemia (especially if there is any suspicion that the person may also be under the influence of alcohol). If measurement is difficult (e.g. in a patient undergoing a seizure) then treatment should not be delayed.

After acute treatment, consideration should be given to whether the hypoglycaemia is likely to be prolonged, i.e. as a result of long acting insulin or sulfonylurea therapy; these patients may require a continuous infusion of glucose to maintain blood glucose levels. Normal blood glucose levels in a person without diabetes are 3.5-7.0mmol/L. To avoid potential hypoglycaemia, Diabetes UK recommends a practical policy of “make four the floor”, i.e. 4.0mmol/L the lowest acceptable blood glucose level in people with diabetes. Regular blood glucose monitoring enables detection of asymptomatic biochemical hypoglycaemia.

## Evidence for treatment options

There is limited evidence regarding the quantity of quick acting carbohydrate required to successfully treat an episode of hypoglycaemia. The initial quantities chosen were the result of expert consensus subsequently backed up with glucose clamp studies (Brodows et al., 1984, Slama et al., 1990). Vindedzis et al compared 15g versus 20g and found that 32-63% of episodes resolved after one treatment with 15g carbohydrate compared with 55-89% of episodes with 20g carbohydrate (Vindedzis et al., 2012). Larsen et al used continuous glucose monitoring (CGM) to monitor 125 adult patients with T1DM over 6 days; they defined adequate treatment as ingesting 10-20g of quick acting carbohydrate (Larsen et al., 2006). They reported that 30% of hypoglycaemic episodes were under-treated (i.e. less than 10g carbohydrate consumed) and 38% were over-treated (i.e. more than 20g carbohydrate consumed). Participants who were under-treated had a 57% chance of remaining hypoglycaemic at the repeat test, this compares with 30% for those adequately treated and 26% for those over treated. This reinforces the suggestion that treatment of hypoglycaemia with less than 10g of quick acting carbohydrate is likely to be inadequate. Anecdotally, over-treatment of hypoglycaemic episodes is often seen both in the community and hospital. Seventy-three percent of hypoglycaemic episodes were over-treated (i.e. more than 20g of rapid acting carbohydrate consumed) in adults with T1DM; the mean amount of carbohydrate used to treat was 32g (Savard et al., 2016).

Chocolate is no longer recommended for the treatment of hypoglycaemia. Chocolate contains quick acting carbohydrate and fat; the addition of fat has been shown to slow the absorption of quick acting carbohydrate (Cedermark et al., 1993, Shively et al., 1986). Orange juice (which contains fructose) remains a popular treatment for hypoglycaemia. The results of two studies using a modified glucose clamp technique have suggested that orange juice may not be the most effective treatment in adults with T1DM (Slama et al., 1990, Brodows et al., 1984). Brodows et al reported that almost double the amount of orange juice was required to produce a similar increment compared with glucose tablets. The total sugar content of any fruit juice varies according to the ripeness of the fruit, the season it is picked and the addition of any sugar when packaged (Slama et al., 1990). A more recent study showed that fructose (in the form of a fruit bar) was less effective than sucrose in successfully treating hypoglycaemia in children with type 1 diabetes. The fibre in the bar may

have slowed down the absorption of the fructose, reducing its efficacy as a treatment for hypoglycaemia (Husband et al., 2010). By contrast, a recent “real-world” study of children with type 1 diabetes attending a diabetes camp found orange juice to be as effective as other treatments (McTavish and Wiltshire, 2011).

Several studies have examined the time interval between treatment and re-testing to confirm resolution of hypoglycaemia. All are supportive of a minimum interval of at least 10 minutes before retesting to ensure resolution of hypoglycaemia (McTavish and Wiltshire, 2011). Slama et al concluded that repeating carbohydrate intake every 5-10 minutes would not allow adequate time for the treatment to take effect thus leading to over treatment (Slama et al., 1990). Vindedzis et al reported that when hypoglycaemia was treated with 20g of carbohydrate, 55% were adequately treated after a 5 minute wait, compared with 89% after a 10 minute wait (Vindedzis et al., 2012).

## “Sugar tax”

Since the government have announced The Soft Drinks Industry Levy (SDIL) which comes into effect from April 2018, many soft drinks companies are likely to change the formulation of their products to ensure they contain reduced sugar. Many companies will change the formulation before 2018 and some already have. Therefore Lucozade®, which was commonly used to treat hypoglycaemia, is no longer recommended due to the quantities required to achieve 15-20 g carbohydrate (and variation in carbohydrate content between different types of Lucozade®. Similarly, Ribena® is no longer recommended as a treatment in patients requiring enteral nutrition.). Fruit juices and products specifically designed for the treatment of hypoglycaemia only, will be exempt from this sugar tax and are therefore recommended in this guideline. However, if hospital Trusts or patients continue to use generally available soft drinks to treat hypoglycaemia, staff giving these treatments will need to check the carbohydrate content before administration.

## Evidence for parenteral treatment options

Intramuscular glucagon and intravenous glucose in varying concentrations are the main treatment options. A randomised trial of people attending the Emergency Department with hypoglycaemia found glucagon almost as effective as intravenous dextrose with no difference in adverse events (e.g. vomiting) although recovery of blood glucose levels was slower with glucagon (Collier et al., 1987, Patrick et al., 1990). Faster recovery of blood glucose levels using intravenous glucose compared with intramuscular glucagon was shown in two subsequent studies into the pre-hospital treatment of hypoglycaemia (Howell and Guly, 1997, Carstens and Sprehn, 1998). Repeated administration of glucagon is not advised, only 1% of people responded to a second injection of glucagon who had not responded to the first injection (MacCuish et al., 1970). Glucagon will be less effective in those people with depleted glycogen reserves such as those with impaired hepatic function (i.e. people with an excessive alcohol consumption). In summary glucagon is effective and can be a useful treatment option, especially outside the hospital setting when intravenous access may not be available. However, it can only be used once with the slower recovery and higher treatment failure rate making intravenous glucose the preferred option.

The increment in blood glucose after administration of 50% glucose varies widely between individuals with hypoglycaemia. The mean increment in participants with diabetes was 9.8 mmol/L with a large standard deviation of 4.4mmol/L (Adler, 1986). There is a paucity of evidence comparing 10% or 20% dextrose with 50% dextrose. Moore and Wollard administered 5g aliquots of either 10% or 50% glucose at 1-minute intervals to people with hypoglycaemia until recovery of consciousness level had occurred. Participants were selected on the basis of confusion or impaired consciousness level sufficient to make treatment with oral carbohydrate inadvisable. Using 10% glucose resulted in lower post treatment glucose levels (6.2 versus 9.4 mmol/L) (Moore and Woollard, 2005). Ten grams of carbohydrate delivered as 10% dextrose in the pre-hospital setting resulted in adequate treatment of hypoglycaemia for most patients with only 18% requiring an additional 100ml of 10% dextrose (Kiefer et al., 2014).

The risk of extravasation injury with any hypertonic solution may make 10% dextrose safer than 50% glucose (Wood, 2007). Glucose 10% preparations are considerably less hypertonic than the 50% preparation and therefore less destructive to the venous endothelium (Nolan, 2005). A Japanese study using rabbit ears found that increasing the duration of infusion decreased the tolerance of peripheral veins to solutions of increased osmolality (Kuwahara et al., 1998). Ten percent glucose has an osmolality of 506mOsm/L compared with 2522mOsm/L for 50% dextrose (Nehme and Cudini, 2009). For these reasons 10% or 20% glucose solutions are preferred.

## “Hypo” boxes

These boxes are often in a prominent place e.g. on resuscitation trolleys and are brightly coloured for instant recognition. They contain all the equipment required to treat hypoglycaemia from cartons of fruit juice to IV cannulas. Suggested contents of a typical “hypo box” can be found in Appendix 2. Areas of good practice have successfully used “hypo boxes” for the management of hypoglycaemia (Baker, 2007). There are now commercially available hypo boxes.

## Alterations to treatment regimens with the aim of reducing hypoglycaemia

Therapeutic inertia can make healthcare professionals slow to respond to hypoglycaemic events or to proactively reduce insulin doses in those identified as at risk of hypoglycaemia; Mathioudakis et al found that only 44% of patients had their insulin doses reduced by a suitable amount following an episode of hypoglycaemia (Mathioudakis et al., 2016). There is evidence that implementation of a hypoglycaemia reduction bundle in a hospital environment can reduce rates of hypoglycaemia (Maynard et al., 2015).

## Treatment of Hypoglycaemia

In patients who are conscious and able to swallow, 15-20g of fast acting carbohydrate is the treatment of choice (see algorithm A). Subsequent treatment algorithms discuss treatment options for those unable to consume oral carbohydrate.

Adults who have poor glycaemic control may start to experience symptoms of hypoglycaemia above 4.0mmol/L. There is no evidence that the thresholds for cognitive dysfunction are reset upwards; therefore the only reason for treatment is symptomatic relief. **So adults who are experiencing hypoglycaemia symptoms but have a blood glucose level greater than 4.0mmol/L – treat with a small carbohydrate snack only** e.g. 1 medium banana, a slice of bread or normal meal if due. All adults with a blood glucose level less than 4.0mmol/L with or without symptoms of hypoglycaemia should be treated as outlined in this guideline.

DAFNE (dose adjustment for normal eating) is a course for people with type 1 diabetes designed to teach patients how to adjust their insulin doses according to their carbohydrate consumption (carbohydrate counting). DAFNE principles suggest that hypoglycaemia is treated at the level of 3.5mmol/L and that long acting carbohydrate is not always required (DAFNE). However, in hospitalised patients the Joint British Diabetes Societies for Inpatient care (JBDS) suggest a target blood glucose of 6-10mmol/L, therefore this guidance recommends that in the hospital environment, a blood glucose of less than 4.0mmol/L is treated as hypoglycaemia in all patients with diabetes.



Continuous subcutaneous insulin infusions (CSII) or “insulin pumps” administer rapid acting insulin on a continuous basis via a subcutaneous cannula. CSII is used by some people with type 1 diabetes and some patients are taught that long-acting carbohydrate may not always be required. However, if hypoglycaemia recurs then long-acting carbohydrate must be given after initial treatment, and the patient referred to the diabetes inpatient specialist team.

## Conclusion

Although most patients with diabetes are admitted for reasons not directly related to their diabetes, adequate management of their diabetes while an inpatient, including timely recognition, treatment and prevention of hypoglycaemia, will help reduce morbidity and prevent lengthy inpatient stays.

These guidelines are intended to guide the assessment and management of a hospital inpatient with diabetes; each patient should be individually assessed and management altered where necessary. You may want to agree local guidance for the self-management of hypoglycaemia in conjunction with certain other medical conditions (e.g. renal impairment, congestive cardiac failure). Many people with diabetes carry their own supplies of oral carbohydrate and should be supported to self-manage when capable and appropriate; this decision should be recorded in their hospital care plan. Patients capable of self-care should alert nursing staff that an episode of hypoglycaemia has occurred so that their management plan can be altered if necessary. Many episodes of hypoglycaemia are avoidable so every preventable measure should be taken.

Easily accessible quick- and long-acting carbohydrate must be available in your clinical area and all staff should be aware of its location.

## A. Adults who are conscious, orientated and able to swallow

1) Give 15-20g quick acting carbohydrate of the patient's choice where possible. Some examples are:

- 5-7 Dextrosol® tablets (or 4-5 Glucotabs®)
- 1 bottle (60ml) Glucojuice®
- 150-200ml pure fruit juice e.g. orange
- 3-4 heaped teaspoons of sugar dissolved in water

N.B. Patients following a low potassium diet (due to chronic kidney disease) should not use orange juice to treat hypoglycaemia due to its potassium content.

N.B. Sugar dissolved in water is not an effective treatment for patients taking acarbose as it prevents the breakdown of sucrose to glucose. It should also only be considered if no other treatment options are readily available.

2) Repeat capillary blood glucose measurement 10-15 minutes later. If it is still less than 4.0mmol/L, repeat step 1 (no more than 3 treatments in total).

3) If blood glucose remains less than 4.0mmol/L after 30-45 minutes or 3 cycles, **contact a doctor**. Consider:

- 1mg of glucagon IM (may be less effective in patients prescribed sulfonylurea therapy or under the influence of alcohol)
- 150-200ml of 10% glucose over 15 minutes (e.g. 600-800ml/hr). Care should be taken with infusion pump settings if larger volume bags are used to ensure that the whole bag is not inadvertently administered. Volume should be determined by clinical circumstances (refer to Appendix 5 for administration details).

4) Once blood glucose is above 4.0mmol/L and the patient has recovered, give a long acting carbohydrate of the patient's choice where possible, taking into consideration any specific dietary requirements.

Examples include:

- Two biscuits
- One slice of bread/toast
- 200-300ml glass of milk (not soya or other forms of 'alternative' milk, e.g. almond or coconut)
- Normal meal if due (must contain carbohydrate)

N.B. Patients given glucagon require a larger portion of long acting carbohydrate to replenish glycogen stores (double the suggested amount above) although nausea associated with glucagon injections may be an issue.

5) **DO NOT omit insulin injection if due** (However, insulin regimen review may be required).

6) Patients who self-manage their insulin pumps (CSII) may not need a long acting carbohydrate but should take initial treatment as outlined and adjust their pump settings appropriately. Many patients will have a locally devised hypoglycaemia protocol that should be checked to ensure that it remains appropriate for use in the inpatient setting.

7) If the hypoglycaemia was due to sulfonylurea or long acting insulin therapy then be aware that the risk of hypoglycaemia may persist for up to 24-36 hours following the last dose, especially if there is concurrent renal impairment.

8) Document event in patient's notes. Ensure regular capillary blood glucose monitoring is continued for at least 24 to 48 hours. Ask the patient to continue this at home if they are to be discharged. Give hypoglycaemia education or refer to local Diabetes Inpatient Team.

## B. Adults who are conscious but confused, disorientated, unable to cooperate or aggressive but are able to swallow

- 1) If the patient is capable and cooperative, follow **section A** in its entirety.
  - 2) If the patient is not capable and/or uncooperative, but is able to swallow give **either** 2 tubes 40% glucose gel (e.g. Glucogel®) squeezed into the mouth between the teeth and gums **or** (if this is ineffective) give glucagon 1mg IM (may be less effective in patients prescribed sulfonylurea therapy/ patients currently under the influence of alcohol).
  - 3) Repeat capillary blood glucose levels after 10-15 minutes. If it is still less than 4.0mmol/L repeat steps 1 and/or 2 (no more than 3 treatments in total and only give IM glucagon once).
  - 4) If blood glucose level remains less than 4.0mmol/L after 30-45 minutes, **contact a doctor**. Consider intravenous glucose (i.e. 150-200ml of 10% glucose over 15 minutes delivered at an infusion rate of 600-800ml/hr). Care should be taken with infusion pump settings if larger volume bags are used to ensure that the whole bag is not inadvertently administered. Volume should be determined by clinical circumstances (refer to Appendix 5 for administration details).
  - 5) Once blood glucose is above 4.0mmol/L and the patient has recovered, give a long acting carbohydrate of the patient's choice where possible, taking into consideration any specific dietary requirements. Examples include:
    - Two biscuits
    - One slice of bread/toast
    - 200-300ml glass of milk (not soya)
    - Normal meal if due (must contain carbohydrate)
- N.B. Patients given glucagon require a larger portion of long acting carbohydrate to replenish glycogen stores (double the suggested amount above).
- N.B. Patients who self-manage their insulin pumps (CSII) may not need a long acting carbohydrate but should take initial treatment, continue their pump and assess for the cause of the episode.
- 6) **DO NOT omit insulin injection if due** (however, insulin regimen review may be required).
  - 7) Patients who self-manage their insulin pumps (CSII) may not need a long acting carbohydrate but should take initial treatment as outlined and adjust their pump settings appropriately. Many patients will have a locally devised hypoglycaemia protocol that should be checked to ensure that it remains appropriate for use in the inpatient setting.
  - 8) If the hypoglycaemia was due to sulfonylurea or long acting insulin therapy then be aware that the risk of hypoglycaemia may persist for up to 24-36 hours following the last dose, especially if there is concurrent renal impairment.
  - 9) Document event in patient's notes. Ensure regular capillary blood glucose monitoring is continued for at least 24 to 48 hours. Ask the patient to continue this at home if they are to be discharged. Give hypoglycaemia education or refer to Diabetes Inpatient Team.

## C. Adults who are unconscious and/or having seizures and/or are very aggressive

- 1) Check: **Airway (and give oxygen)**
  - i. **Breathing**
  - ii. **Circulation**
  - iii. **Disability (including GCS and blood glucose)**
  - iv. **Exposure (including temperature)**
- 2) If the patient has an insulin infusion in situ, **stop immediately**
- 3) **Request immediate assistance from medical staff (e.g. "fast bleep" a doctor)**
- 4) The following three options (i-iii) are all appropriate; local agreement should be sought:
  - i) If IV access available, give 75-100ml of 20% glucose over 15 minutes, (e.g. 300-400ml/hr). A 100ml preparation of 20% glucose is now available that will deliver the required amount after being run through a standard giving set. If an infusion pump is available use this, but if not readily available the infusion should not be delayed (see Appendix 5 for administration details). Repeat capillary blood glucose measurement 10 minutes later. If it is still less than 4.0mmol/L, repeat.
  - ii) If IV access available, give 150-200ml of 10% glucose (over 15 minutes, e.g. 600-800ml/hr). If an infusion pump is available use this, but if not readily available the infusion should not be delayed. Care should be taken if larger volume bags are used to ensure that the whole infusion is not inadvertently administered. Repeat capillary blood glucose measurement 10 minutes later. If it is still less than 4.0mmol/L, repeat (refer to Appendix 5 for administration details).
  - iii) If no IV access is available then give 1mg glucagon IM. Glucagon 1mg IM may be less effective in patients prescribed sulfonylurea therapy and may take up to 15 minutes to take effect. Glucagon mobilises glycogen from the liver and will be less effective in those who are chronically malnourished (including those who have had a prolonged period of starvation), abuse alcohol or have severe liver disease. In this situation IV glucose is the preferred option.
- 5) Once the blood glucose is greater than 4.0mmol/L and the patient has recovered give a long acting carbohydrate of the patient's choice where possible, taking into consideration any specific dietary requirements. Some examples are:
  - a. Two biscuits
  - b. One slice of bread/toast
  - c. 200-300ml glass of milk (not soya)
  - d. Normal meal if due (must contain carbohydrate)

N.B. Patients given glucagon require a larger portion of long acting carbohydrate to replenish glycogen stores (double the suggested amount above).

N.B. Patients who self-manage their insulin pumps (CSII) may not need a long acting carbohydrate.



**6) DO NOT omit insulin injection if due** (However, insulin regimen review may be required).

- 7) If the patient was on IV insulin, continue to check blood glucose every 15 minutes until above 3.5mmol/L, then re-start IV insulin after review of dose regimen to try and prevent hypoglycaemia recurrence. Consider concurrent IV 10% glucose infusion at 100ml/hr and/or stepping down the insulin increments on the variable scale if appropriate (check local Trust guidance)
- 8) If the hypoglycaemia was due to sulfonylurea or long acting insulin therapy then be aware that the risk of hypoglycaemia may persist for up to 24-36 hours following the last dose, especially if there is concurrent renal impairment.
- 9) Document event in patient's notes. Ensure regular capillary blood glucose monitoring is continued for at least 24 to 48 hours. Ask the patient to continue this at home if they are to be discharged. Give hypoglycaemia education or refer to DISN or Diabetes Inpatient Team.

## D. Adults who are 'Nil by Mouth'

- 1) If the patient has a variable rate intravenous insulin infusion, adjust as per prescribed regimen, and seek medical advice. Most variable rate intravenous insulin infusions should be restarted once blood glucose is above 4.0mmol/L although an infusion rate adjustment may be indicated.
- 2) Options i and ii (intravenous glucose) as above in section C (4) are both appropriate treatment options. Again local agreement should be sought.
- 3) Once blood glucose is greater than 4.0mmol/L and the patient has recovered consider intravenous infusion of 10% glucose at a rate of 100ml/hr (refer to Appendix 5 for administration details) until patient is no longer 'Nil by Mouth' or has been reviewed by a doctor.
- 4) If the hypoglycaemia was due to sulfonylurea or long acting insulin therapy then be aware that the risk of hypoglycaemia may persist for up to 24-36 hours following the last dose, especially if there is concurrent renal impairment.
- 5) Document event in patient's notes. Ensure regular capillary blood glucose monitoring is continued for at least 24 to 48 hours. Ask the patient to continue this at home if they are to be discharged. Give hypoglycaemia education or refer to DISN.

## E. Adults requiring enteral/parenteral feeding

Patients requiring total parenteral nutrition (TPN) should be referred to a dietitian/nutrition team and diabetes team for individual assessment

### Risk factors for hypoglycaemia

- Blocked/displaced tube
- Change in feed regimen
- Enteral feed discontinued
- TPN or IV glucose discontinued
- Diabetes medication administered at an inappropriate time to feed
- Changes in medication that cause hyperglycaemia e.g. steroid therapy reduced/stopped
- Feed intolerance
- Vomiting
- Deterioration in renal function
- Severe hepatic dysfunction

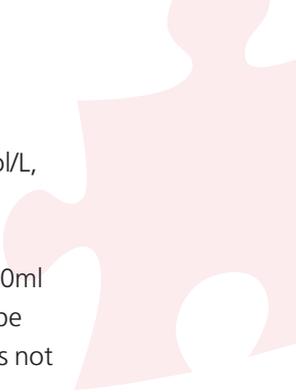
### Treatment – To be administered via feed tube:

*Do not administer these treatments via a TPN line*

*In patients receiving TPN, treatment should be administered orally or intravenously as appropriate.*

- 1) Give 15-20g quick acting carbohydrate of the patient's choice where possible. Some examples are:
  - 2 tubes 40% glucose gel ( e.g. Glucogel®) - not for use with fine bore NGT
  - 1 bottle (60ml) Glucojuice®
  - 150-200ml orange juice
  - 50-70ml Fortijuice® (NOT Fortisip) to give 15-20g carbohydrate
  - Re-start feed to rapidly deliver 15 – 20g carbohydrate

N.B. All treatments should be followed by a 40-50ml water flush of the feeding tube to prevent tube blockage (Dandelees and Lodolce, 2011).

- 
- 2) Repeat capillary blood glucose measurement 10 to 15 minutes later. If it is still less than 4.0mmol/L, repeat step 1 (no more than 3 treatments in total).
  - 3) If blood glucose remains less than 4.0mmol/L after 30-45 minutes (or 3 cycles), consider 150-200ml of 10% glucose administered intravenously over 15 minutes, (e.g. 600-800ml/hr). Care should be taken with infusion pump settings if larger volume bags are used to ensure that the whole bag is not inadvertently administered.
  - 4) Once blood glucose is above 4.0mmol/L and the patient has recovered:
    - Restart feed
    - If bolus feeding, give additional bolus feed (read nutritional information and calculate amount required to give 20g of carbohydrate)
    - 10% IV glucose at 100ml/hr. Volume should be determined by clinical circumstances (refer to Appendix 5 for administration details)
  - 5) **DO NOT omit insulin injection if due** (However, insulin regime review may be required).
  - 6) If the hypoglycaemia was due to sulfonylurea or long acting insulin therapy then be aware that the risk of hypoglycaemia may persist for up to 24-36 hours following the last dose, especially if there is concurrent renal impairment.
  - 7) Document event in patient's notes. Ensure regular capillary blood glucose monitoring is continued for at least 24 to 48 hours. Ask the patient to continue this at home if they are to be discharged. Give hypoglycaemia education or refer to DISN. Ensure patient has been referred to a dietician for individualised hypoglycaemia treatment advice.

# When hypoglycaemia has been successfully treated

- Complete an audit form, and send it to the DISN (see Appendix 3 for Audit form). Some Trusts have utilised pre-printed stickers in patients' notes both for documentation and audit purposes. For an example see Appendix 4. Consider completing an incident form if appropriate. If "hypo boxes" have been used restock as appropriate.
- Identify the risk factor or cause resulting in hypoglycaemia (see Tables 2 and 3).
- Take measures to avoid hypoglycaemia in the future. The DISN or Inpatient Diabetes Team can be contacted to discuss this.
- Unless the cause is easily identifiable and both the nursing staff and patient are confident that steps can be taken to avoid future events, a medical or DISN review should be considered. If the hypoglycaemia event was severe or recurrent, or if the patient voices concerns then a review is indicated.
- Please **DO NOT** omit the next insulin injection or start variable rate intravenous insulin infusion to 'stabilise' blood glucose. If unsure of subsequent diabetes treatment, discuss with the diabetes team/ DISN e.g. it may be safe to omit a meal time bolus dose of rapid acting insulin if the patient is declining food and has taken their usual basal insulin.
- Medical team (or DISN if referred) to consider reducing the dose of insulin prior to the time of previous hypoglycaemia events. This is to prevent further hypoglycaemia episodes occurring.
- Please **DO NOT** treat isolated spikes of hyperglycaemia with 'stat' doses of rapid acting insulin. Instead maintain regular capillary blood glucose monitoring and adjust normal insulin regimen only if a particular pattern emerges.

# Audit Standards

## Processes

<b>Protocol</b>	Availability of diabetes management guidelines based on national examples of good practice including management of patients who are nil-by-mouth or enterally fed
<b>Implementation</b>	Availability of hospital-wide pathway agreed with diabetes speciality team Defined rolling education programme for ward staff and regular audit of key components including staff knowledge of correct treatment targets, blood glucose meter calibration, and quality assurance Percentage of wards with “hypo boxes” (or equivalent) Percentage of people with diabetes able to access treatments to manage their own hypos
<b>Specialist review</b>	People with diabetes who are admitted to hospital with hypoglycaemia are reviewed by a specialist diabetes physician or nurse prior to discharge

## Outcome measures

<b>Incidence</b>	Benchmark incidence of severe hypoglycaemia against equivalent national and regional data for admissions using widely available local and national datasets
<b>Income</b>	Percentage of hospital discharges delayed by inpatient hypoglycaemia episode
<b>Identification &amp; prevention</b>	Cause of hypoglycaemia identified and recorded Percentage of appropriate insulin/ anti-hyperglycaemic medication dose adjustment regarding prevention of hypoglycaemia (snap shot audit of different areas of Trust on monthly basis)
<b>Resolution</b>	Time to recovery

We would like to thank Dr Rifat Malik for producing the Audit Standards for hypoglycaemia.

## Guideline update

This guideline should be updated regularly.

# References

- Action to Control Cardiovascular Risk in Diabetes Study, G., Gerstein, H. C., Miller, M. E., Byington, R. P., Goff, D. C., Jr., Bigger, J. T., Buse, J. B., Cushman, W. C., Genuth, S., Ismail-Beigi, F., Grimm, R. H., Jr., Probstfield, J. L., Simons-Morton, D. G. & Friedewald, W. T. 2008. Effects of intensive glucose lowering in type 2 diabetes. *N Engl J Med*, 358, 2545-59.
- Adler, P. M. 1986. Serum glucose changes after administration of 50% dextrose solution: pre- and in-hospital calculations. *Am J Emerg Med*, 4, 504-6.
- Akirov, A., Grossman, A., Shochat, T. & Shimon, I. 2017. Mortality Among Hospitalized Patients With Hypoglycemia: Insulin Related and Noninsulin Related. *J Clin Endocrinol Metab*, 102, 416-424.
- Baker, H. H., M. Stephenson, S. Sumner, J 2007. Managing hypoglycaemia in hospital. *Journal of Diabetes Nursing*, 11, 108-111.
- Borzi, V., Frasson, S., Gussoni, G., Di Lillo, M., Gerloni, R., Augello, G., Gulli, G., Ceriello, A., Solerte, B., Bonizzoni, E., Fontanella, A. & Research Department of FADOI 2016. Risk factors for hypoglycemia in patients with type 2 diabetes, hospitalized in internal medicine wards: Findings from the FADOI-DIAMOND study. *Diabetes Res Clin Pract*, 115, 24-30.
- Brodows, R. G., Williams, C. & Amatruda, J. M. 1984. Treatment of insulin reactions in diabetics. *JAMA*, 252, 3378-81.
- Carstens, S. & Sprehn, M. 1998. Prehospital treatment of severe hypoglycaemia: a comparison of intramuscular glucagon and intravenous glucose. *Prehosp Disaster Med*, 13, 44-50.
- Cedermark, G., Selenius, M. & Tullus, K. 1993. Glycaemic effect and satiating capacity of potato chips and milk chocolate bar as snacks in teenagers with diabetes. *Eur J Pediatr*, 152, 635-9.
- Collier, A., Steedman, D. J., Patrick, A. W., Nimmo, G. R., Matthews, D. M., MacIntyre, C. C., Little, K. & Clarke, B. F. 1987. Comparison of intravenous glucagon and dextrose in treatment of severe hypoglycemia in an accident and emergency department. *Diabetes Care*, 10, 712-5.
- DAFNE. 10.0 Hypoglycaemia Resources Session [Online]. Available: <http://www.dafne.uk.com/uploads/223/documents/DEP%20Training%20DVD%20-%20Sample%20Hypoglycaemia%20session%20of%20DAFNE%20curriculum%20-%20T07.003%20p12-14.pdf> [Accessed December 2019].
- Dandele, L. M. & Lodolce, A. E. 2011. Efficacy of agents to prevent and treat enteral feeding tube clogs. *Ann Pharmacother*, 45, 676-80.
- DCCT 1993. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. The Diabetes Control and Complications Trial Research Group. *N Engl J Med*, 329, 977-86.
- Deary, I. J., Hepburn, D. A., MacLeod, K. M. & Frier, B. M. 1993. Partitioning the symptoms of hypoglycaemia using multi-sample confirmatory factor analysis. *Diabetologia*, 36, 771-7.
- Donnelly, L. A., Morris, A. D., Frier, B. M., Ellis, J. D., Donnan, P. T., Durrant, R., Band, M. M., Reekie, G., Leese, G. P. & Collaboration, D. M. 2005. Frequency and predictors of hypoglycaemia in Type 1 and insulin-treated Type 2 diabetes: a population-based study. *Diabet Med*, 22, 749-55.
- Farrokhi, F., Umpierrez, G. & Smiley, D. 2012. Hypoglycemia in the hospital inpatient setting. *Diabetic Hypoglycemia* (<http://www.hypodiab.com/>), 5, 3-8.
- Garg, R., Hurwitz, S., Turchin, A. & Trivedi, A. 2013. Hypoglycemia, with or without insulin therapy, is associated with increased mortality among hospitalized patients. *Diabetes Care*, 36, 1107-10.
- Graveling, A. J. & Frier, B. M. 2010. Impaired awareness of hypoglycaemia: a review. *Diabetes Metab*, 36 Suppl 3, S64-74.
- Howell, M. A. & Guly, H. R. 1997. A comparison of glucagon and glucose in prehospital hypoglycaemia. *J Accid Emerg Med*, 14, 30-2.
- Husband, A. C., Crawford, S., McCoy, L. A. & Pacaud, D. 2010. The effectiveness of glucose, sucrose, and fructose in treating hypoglycemia in children with type 1 diabetes. *Pediatr Diabetes*, 11, 154-8.
- Inkster, B. & Frier, B. M. 2012. The effects of acute hypoglycaemia on cognitive function in type 1 diabetes. *The British Journal of Diabetes & Vascular Disease*, 12, 221-226.
- Kiefer, M. V., Hern, H. G., Alter, H. J. & Barger, J. B. 2014. Dextrose 10% in the treatment of out-of-hospital hypoglycemia. *Prehosp Disaster Med*, 29, 190-194.
- Kuwahara, T., Asanami, S. & Kubo, S. 1998. Experimental infusion phlebitis: tolerance osmolality of peripheral venous endothelial cells. *Nutrition*, 14, 496-501.
- Larsen, T., Banck-Petersen, P., Due-Andersen, R., Hoi-Hansen, T., Pedersen-Bjergaard, U. & Thorsteinsson, B. 2006. Effect of carbohydrate treatment on mild symptomatic hypoglycaemia, assessed by continuous glucose monitoring. *European Diabetes Nursing*, 3, 143-6.

- MacCuish, A. C., Munro, J. F. & Duncan, L. J. 1970. Treatment of hypoglycaemic coma with glucagon, intravenous dextrose, and mannitol infusion in a hundred diabetics. *Lancet*, 2, 946-9.
- Mathioudakis, N., Everett, E. & Golden, S. H. 2016. Prevention and Management of Insulin-Associated Hypoglycemia in Hospitalized Patients. *Endocr Pract*, 22, 959-69.
- Maynard, G., Kulasa, K., Ramos, P., Childers, D., Clay, B., Sebasky, M., Fink, E., Field, A., Renvall, M., Juang, P. S., Choe, C., Pearson, D., Serences, B. & Lohnes, S. 2015. Impact of a hypoglycemia reduction bundle and a systems approach to inpatient glycemic management. *Endocr Pract*, 21, 355-67.
- McTavish, L. & Wiltshire, E. 2011. Effective treatment of hypoglycemia in children with type 1 diabetes: a randomized controlled clinical trial. *Pediatr Diabetes*, 12, 381-7.
- Moore, C. & Woollard, M. 2005. Dextrose 10% or 50% in the treatment of hypoglycaemia out of hospital? A randomised controlled trial. *Emerg Med J*, 22, 512-5.
- NaDIA 2016. National Diabetes Inpatient Audit. NHS Digital.
- Nehme, Z. & Cudini, D. 2009. A review of the efficacy of 10% dextrose as an alternative to high concentration glucose in the treatment of out-of-hospital hypoglycaemia. *Australasian Journal of Paramedicine*, 7.
- Nolan, J. J. 2005. Emergency management of hypoglycaemia: quantitative considerations. *Eur J Emerg Med*, 12, 213-5.
- Patrick, A. W., Collier, A., Hepburn, D. A., Steedman, D. J., Clarke, B. F. & Robertson, C. 1990. Comparison of intramuscular glucagon and intravenous dextrose in the treatment of hypoglycaemic coma in an accident and emergency department. *Arch Emerg Med*, 7, 73-7.
- Rajendran, R., Kerry, C., Rayman, G. & Ma, G. I. C. s. g. 2014. Temporal patterns of hypoglycaemia and burden of sulfonylurea-related hypoglycaemia in UK hospitals: a retrospective multicentre audit of hospitalised patients with diabetes. *BMJ Open*, 4, e005165.
- Royal Pharmaceutical Society 2016. *Medicines, Ethics and Practice*, Pharmaceutical Press.
- Sampson, M., Bailey, M., Clark, J., Evans, M. L., Fong, R., Hall, H., Hambling, C., Hadley-Brown, M., Morrish, N., Murphy, H., Rayman, G. A., Vithian, K., Winocour, P. & Harries, A. 2017. A new integrated care pathway for ambulance attended severe hypoglycaemia in the East of England: The Eastern Academic Health Science Network (EAHSN) model. *Diabetes Res Clin Pract*, 133, 50-59.
- Savard, V., Gingras, V., Leroux, C., Bertrand, A., Desjardins, K., Mircescu, H. & Rabasa-Lhoret, R. 2016. Treatment of Hypoglycemia in Adult Patients with Type 1 Diabetes: An Observational Study. *Can J Diabetes*, 40, 318-23.
- Seaquist, E. R., Miller, M. E., Bonds, D. E., Feinglos, M., Goff, D. C., Jr., Peterson, K., Senior, P. & Investigators, A. 2012. The impact of frequent and unrecognized hypoglycemia on mortality in the ACCORD study. *Diabetes Care*, 35, 409-14.
- Shively, C. A., Apgar, J. L. & Tarka, S. M., Jr. 1986. Postprandial glucose and insulin responses to various snacks of equivalent carbohydrate content in normal subjects. *Am J Clin Nutr*, 43, 335-42.
- Slama, G., Traynard, P. Y., Desplanque, N., Pudar, H., Dhunpath, I., Letanoux, M., Bornet, F. R. & Tchobroutsky, G. 1990. The search for an optimized treatment of hypoglycemia. Carbohydrates in tablets, solution, or gel for the correction of insulin reactions. *Arch Intern Med*, 150, 589-93.
- Strachan, M. W. J. 2014. Frequency, causes and risk factors for hypoglycaemia in type 1 diabetes. In: Frier, B. M., Heller, S. R. & Mccrimmon, R. J. (eds.) *Hypoglycaemia in clinical diabetes*. 3rd ed. Chichester: John Wiley & Sons Ltd.
- Turchin, A., Matheny, M. E., Shubina, M., Scanlon, J. V., Greenwood, B. & Pendergrass, M. L. 2009. Hypoglycemia and clinical outcomes in patients with diabetes hospitalized in the general ward. *Diabetes Care*, 32, 1153-7.
- UK Hypoglycaemia Study Group 2007. Risk of hypoglycaemia in types 1 and 2 diabetes: effects of treatment modalities and their duration. *Diabetologia*, 50, 1140-7.
- Ulmer, B. J., Kara, A. & Mariash, C. N. 2015. Temporal occurrences and recurrence patterns of hypoglycemia during hospitalization. *Endocr Pract*, 21, 501-7.
- Vindedzis, S., Marsh, B., Sherriff, J., Dhaliwal, S. & Stanton, K. 2012. Dietary treatment of hypoglycaemia: should the Australian recommendation be increased? *Intern Med J*, 42, 830-3.
- Wexler, D. J., Meigs, J. B., Cagliero, E., Nathan, D. M. & Grant, R. W. 2007. Prevalence of hyper- and hypoglycemia among inpatients with diabetes: a national survey of 44 U.S. hospitals. *Diabetes Care*, 30, 367-9.
- Wood, S. P. 2007. Is D50 too much of a good thing? A reappraisal of the safety of 50% dextrose administration in patients with hypoglycemia. *JEMS*, 32, 103-6, 108, 110.

# Further reading

**The Code for Nurses and Midwives.** <https://www.nmc.org.uk/standards/code/>  
Accessed December 2019

**The Soft Drinks Industry Levy (SDIL).** <https://www.gov.uk/government/publications/soft-drinks-industry-levy/soft-drinks-industry-levy> accessed December 2019

Blumenstein I, Shastri YM Stein J (2014). **Gastroenteric tube feeding: techniques, problems and solutions.** World J Gastroenterol. July 14 20(26): 8505-8524

Cryer PE (2008). **The barrier of hypoglycaemia in diabetes,** Diabetes 57: 3169-3176

Watson J (2008). **Hypoglycaemia Management in Hospital: Milk and Biscuits Syndrome,** Journal of Diabetes Nursing 12(6): 206

## Algorithm for the Treatment and Management of Hypoglycaemia in Adults with Diabetes Mellitus in Hospital

Hypoglycaemia is a serious condition and should be treated as an emergency regardless of level of consciousness. Hypoglycaemia is defined as blood glucose of less than 4.0mmol/L (if not less than 4.0mmol/L but symptomatic give a small carbohydrate snack for symptom relief).

For further information see the full guideline “The Hospital Management of Hypoglycaemia in Adults with Diabetes Mellitus” at [www.diabetes.org.uk/joint-british-diabetes-society](http://www.diabetes.org.uk/joint-british-diabetes-society)

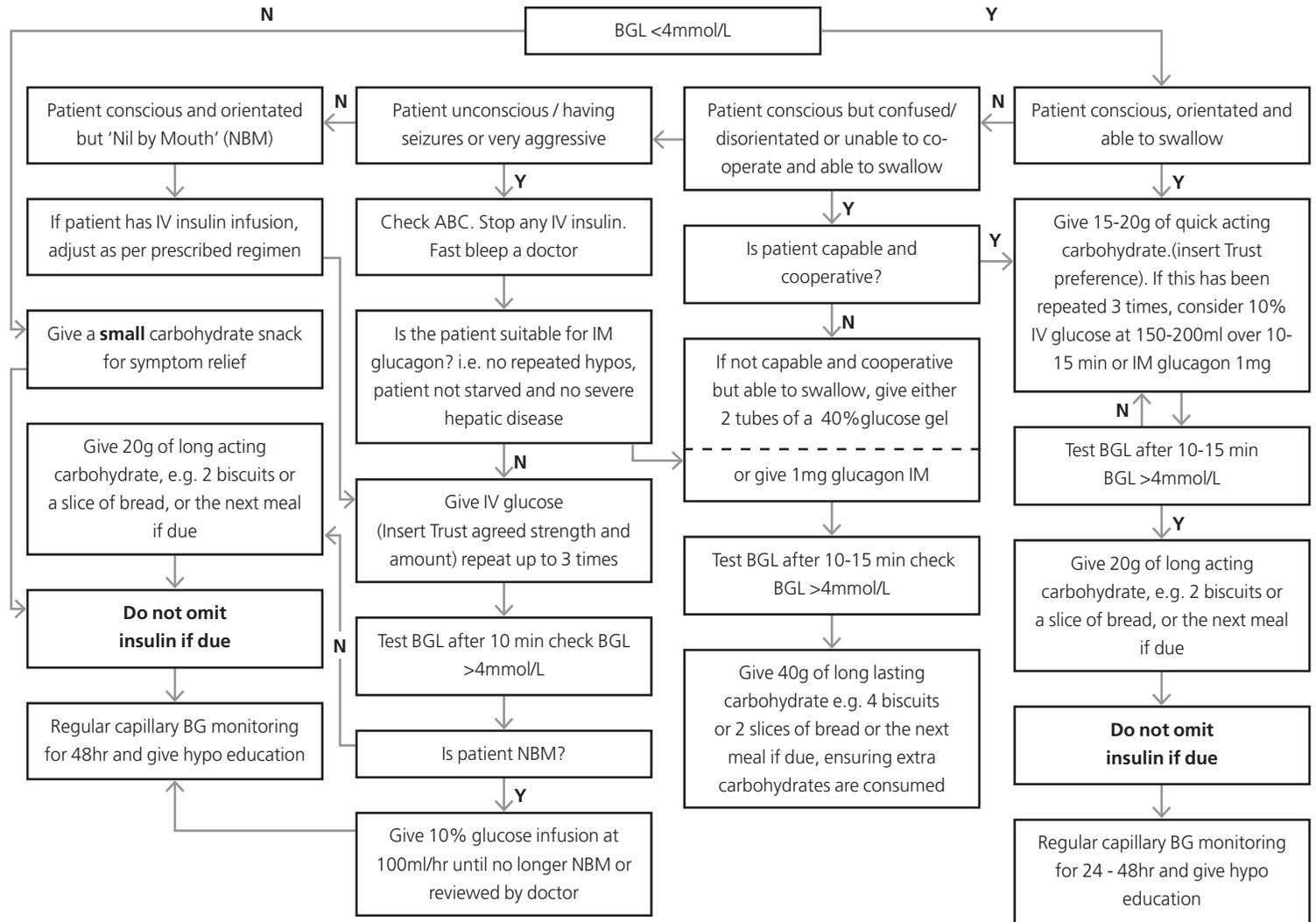


## Flow chart

BG = blood glucose

BGL = blood glucose level

### Treatment of Hypoglycaemia in Adults with Diabetes in Hospital



\*\*For enterally fed patients please see [Section E](#) of Hypoglycaemia Guideline.

© 2009 East and North Hertfordshire NHS Trust Medical Photography and Illustration

# Appendix 1: Insulin action table



Name	Manufacturer	Source	Delivery system	Taken	Onset, peak and duration (approximate hours)
<b>Rapid-acting analogue</b>					
Fiasp	Novo Nordisk	Analogue	Vial, cartridge, FlexTouch prefilled pen	2 mins before or up to 20 mins after	0 2 4 6 8 10 12 14 18 17 20 22 24 28 29 30 32 34 38
NovoRapid	Novo Nordisk	Analogue	Vial, cartridge, FlexTouch and FlexPen prefilled pen	Just before/with/just after food	
Humalog	Lilly	Analogue	Vial, cartridge, KwikPen (prefilled pen)	Just before/with/just after food	
Apidra	Sanofi	Analogue	Vial, cartridge, prefilled pen	0–15mins before, or soon after, a meal	
Humalog 200U/ml KwikPen	Lilly	Analogue	3ml KwikPen (600U)	Just before/soon after a meal	
<b>Short-acting/neutral</b>					
Actrapid	Novo Nordisk	Human	Vial	30 mins before food	
Humulin S	Lilly	Human	Vial, cartridge	20–45 mins before food	
Hypurin Bovine Neutral	Wockhardt UK	Bovine	Vial, cartridge	As advised by your healthcare team	
Hypurin Porcine Neutral	Wockhardt UK	Porcine	Vial, cartridge	As advised by your healthcare team	
Insuman Rapid	Sanofi	Human	Cartridge	15–20 mins before food	
<b>Medium- and long-acting</b>					
Insulatard	Novo Nordisk	Human	Vial, cartridge, prefilled insulin doser	As advised by your healthcare team	
Humulin I	Lilly	Human	Vial, cartridge, KwikPen (prefilled pen)	As advised by your healthcare team	
Hypurin Bovine Isophane	Wockhardt UK	Bovine	Vial, cartridge	As advised by your healthcare team	
Hypurin Porcine Isophane	Wockhardt UK	Porcine	Vial, cartridge	As advised by your healthcare team	
Hypurin Bovine Protamine Zinc	Wockhardt UK	Bovine	Vial	As advised by your healthcare team	
Hypurin Bovine Lente	Wockhardt UK	Bovine	Vial	As advised by your healthcare team	
Insuman Basal	Sanofi	Human	Vial, cartridge, prefilled pen	40–60 mins before food	
<b>Mixed</b>					
Humulin M3	Lilly	Human	Vial, cartridge, KwikPen (prefilled pen)	25–45 mins before food	
Hypurin Porcine 30/70 Mix	Wockhardt UK	Porcine	Vial, cartridge	As advised by your healthcare team	
Insuman Comb 15	Sanofi	Human	Cartridge	35–45 mins before food	
Insuman Comb 25	Sanofi	Human	Vial, cartridge, prefilled pen	35–45 mins before food	
Insuman Comb 50	Sanofi	Human	Cartridge	20–30 mins before food	
Humalog Mix 25	Lilly	Analogue	Vial, cartridge, KwikPen (prefilled pen)	Just before/with/just after food	
Humalog Mix 50	Lilly	Analogue	Cartridge, KwikPen (prefilled pen)	Just before/with/just after food	
NovoMix 30	Novo Nordisk	Analogue	Cartridge, prefilled pen	Just before/with/just after food	
<b>Long-acting analogue</b>					
Lantus	Sanofi	Analogue	Vial, cartridge, prefilled pen	Once a day, anytime (preferably at same time each day)	
Levemir	Novo Nordisk	Analogue	Cartridge, FlexPen prefilled pen, prefilled insulin doser	Once or twice a day, anytime (preferably at same time each day)	
Tresiba	Novo Nordisk	Analogue	Tresiba Penfill 100units/ml, Tresiba Flex Touch 100units/ml, Tresiba FlexTouch 200units/ml (NB the 3ml FlexTouch pen for 200units/ml contains 600 units)	Once a day, anytime (preferably at same time each day)	Tresiba, beyond 42 hours
Abasaglar	Lilly	Analogue	Cartridge, KwikPen (prefilled pen)	Once a day, anytime (preferably at same time each day)	
Toujeo	Sanofi	Analogue	SoloStar prefilled pen only	Once a day, anytime (preferably at same time each day)	



## Appendix 2: Example of contents of hypo box

- Copy of hypoglycaemia algorithm (laminated and attached to inside of lid)
- 2x 200ml cartons of pure fruit juice
- 2x packets of dextrose tablets
- 1x mini pack of biscuits (source of long acting carbohydrate)
- 3 x tubes (1 box) 40% glucose gel
- 20% glucose IV solution (100ml vial)
- 1x green cannula 18G
- 1x grey cannula 16G
- 1x 10ml sterile syringe
- 3 x 10ml sodium chloride 0.9% ampoules for flush
- 1x green sterile needle 21G
- Chlorhexidine spray/alcohol wipes
- 1x IV dressing (cannula cover)
- 10% glucose for IV infusion (500ml bag)
- Audit form
- Instructions on where to send audit form and replenish supplies
- 1x Glucagon pack – to be kept in the nearest drug fridge or labelled with reduced expiry date of 18 months if stored at room temperature



“Hypo box” contents should be checked on a daily basis to ensure it is complete and in date. It is the responsibility of the member of staff who uses any contents to replenish them after use.

N.B. Chosen preparation of IV glucose should also be included or kept nearby with appropriate giving set.

N.B. Appropriate portable sharps disposal equipment should also be kept nearby.

## Appendix 3

# Hypoglycaemia Audit Form

To be completed by a Healthcare Professional after each hypoglycaemic episode

### Patient Details/Sticker:

Hosp No: _____	DoB: _____
Surname: _____	
Forename(s): _____	
Male <input type="checkbox"/>	Female <input type="checkbox"/>
NHS No _____	

### Healthcare Professional Details:

Name: \_\_\_\_\_

Grade/Band: \_\_\_\_\_

Ward: \_\_\_\_\_

Consultant: \_\_\_\_\_

Date of Event: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Time of Event: \_\_\_\_ : \_\_\_\_ hrs (24 hr clock)

Hypoglycaemic episode type please insert letter from key below:

### Key:

- A. Patient was conscious, orientated and able to swallow
- B. Patient was conscious but confused, disorientated, aggressive or had an unsteady gait but was able to swallow
- C. Patient was unconscious and/or having seizures and/or was very aggressive
- D. Patient was conscious, orientated but 'Nil by Mouth'
- E. Patient requiring enteral feeding

### Treatment administered

Blood Glucose (BG) at time of event:

<input type="text"/>	<input type="text"/>
----------------------	----------------------

BG – 10-15 minutes after treatment:

<input type="text"/>	<input type="text"/>
----------------------	----------------------

BG – 10-15 minutes after further Treatment (if required):

<input type="text"/>	<input type="text"/>
----------------------	----------------------

Was Hypoglycaemia Treatment Guideline followed? Yes  No\*  (Please tick appropriate box)

\*If No, please give details:

----------------------



## Hypoglycaemia Audit Form (Cont'd)

Did the patient self-manage? Yes  No\*  (Please tick appropriate box)

Patient recovered? Yes  No\*  (Please tick appropriate box)

\*If No, please give details:

What steps were taken to identify the reason for the hypoglycaemia?

Please give details:

What steps were taken to prevent a recurrence?

Please give details:

Please comment on the ease and effectiveness of the Hypoglycaemia Guideline and make any suggestions on how it could be improved.

**Thank you**

**Please return completed form to the Diabetes Inpatient Team**

## Appendix 4: Example of a Hypoglycaemic Episode Label

**Hypoglycaemic Episode** Based on the original from Harrogate and District NHS Foundation Trust

Ward: \_\_\_\_\_  
 Consultant: \_\_\_\_\_  
 Completed by: \_\_\_\_\_  
 Name: \_\_\_\_\_  
 Sign: \_\_\_\_\_  
 Date: \_\_\_\_/\_\_\_\_/\_\_\_\_

**Affix Patient Label**

Hypoglycaemic episode code (from key below):

**Key:**  
 A. Patient was conscious, orientated and able to swallow  
 B. Patient was conscious but confused, disorientated, aggressive and had an unsteady gait but was able to swallow  
 C. Patient was unconscious and/or having seizures and/or was very aggressive  
 D. Patient was conscious, orientated, but 'Nil by Mouth'  
 E. Patients requiring enteral feeding

	Blood Glucose (BG)(mmol/L)	Treatment Administered (see options inside hypo kit)
Starting BG Time: ____:____ (24hr clock)		
BG after 10/15 mins Time: ____:____		
Further BG after further 10/15 mins (if required) Time: ____:____		

PLEASE STICK IN MEDICAL NOTES AFTER HYPOGLYCAEMIC EPISODE HAS BEEN TREATED.  
 CONSIDER REFERRAL TO DISN (DIABETES INPATIENT SPECIALIST NURSE) X5345 / BLEEP 5345 FOR:  
 REPEATED EPISODES; HYPO - RELATED ADMISSIONS; SEVERE HYPO; PATIENTS ON ENTERAL FEEDS

Cause of Hypoglycaemic episode	Action taken to prevent recurrence

**Hypoglycaemic Episode** Based on the original from Harrogate and District NHS Foundation Trust

Ward: \_\_\_\_\_  
 Consultant: \_\_\_\_\_  
 Completed by: \_\_\_\_\_  
 Name: \_\_\_\_\_  
 Sign: \_\_\_\_\_  
 Date: \_\_\_\_/\_\_\_\_/\_\_\_\_

**Affix Patient Label**

Hypoglycaemic episode code (from key below):

**Key:**  
 A. Patient was conscious, orientated and able to swallow  
 B. Patient was conscious but confused, disorientated, aggressive and had an unsteady gait but was able to swallow  
 C. Patient was unconscious and/or having seizures and/or was very aggressive  
 D. Patient was conscious, orientated, but 'Nil by Mouth'  
 E. Patients requiring enteral feeding

	Blood Glucose (BG)(mmol/L)	Treatment Administered (see options inside hypo kit)
Starting BG Time: ____:____ (24hr clock)		
BG after 10/15 mins Time: ____:____		
Further BG after further 10/15 mins (if required) Time: ____:____		

PLEASE STICK IN MEDICAL NOTES AFTER HYPOGLYCAEMIC EPISODE HAS BEEN TREATED.  
 CONSIDER REFERRAL TO DISN (DIABETES INPATIENT SPECIALIST NURSE) X5345 / BLEEP 5345 FOR:  
 REPEATED EPISODES; HYPO - RELATED ADMISSIONS; SEVERE HYPO; PATIENTS ON ENTERAL FEEDS

Cause of Hypoglycaemic episode	Action taken to prevent recurrence

With kind permission from Laura Dinning, Harrogate and District NHS Foundation Trust

## Appendix 5

Written by Dr Clare Crowley, Consultant Medicines Safety Pharmacist, Oxford University Hospitals  
NHS Foundation Trust

### Sample injectable monograph

To provide healthcare staff with essential technical information in clinical area at point of use, in accordance with NPSA Patient Safety Alert 20 'Promoting safer use of injectable medicines'

### MEDICINE: GLUCOSE 10% & 20% INFUSION

**Indication:** Management of adult hypoglycaemia, where dose should be prescribed by volume and concentration to minimise confusion.

**Available as:** 10% glucose 500ml solution for IV infusion (0.1g/ml)  
20% glucose 100ml solution for IV infusion (0.2g/ml)

### Example calculations

Should not be required if prescribed via concentration and volume as advised

**Usual adult dose:** see guidelines

### Administration:

IV injection: Not recommended

IV infusion:

20% glucose - short term peripheral use via a secure cannula into a large vein is acceptable for the emergency management of hypoglycaemia with close monitoring of the infusion site for thrombophlebitis. Central access is preferred where available and is desirable if 20% infusion has to be continued after the initial dose.

10% glucose - peripherally via a secure cannula into a large vein or central access (preferred where available). If peripheral infusion continues for more than 24 hours change infusion site to minimise thrombophlebitis. Care should be taken to ensure that the whole 500ml infusion is not inadvertently administered.

IM injection: Contraindicated

Subcutaneous injection: Contraindicated

### Preparation & final concentration

Ready to use infusion. If only part of the infusion is needed discard any unused portion.

### Rate of administration

Give 75\*-100ml of 20% glucose (or 150-200ml 10% glucose) over 10-15 minutes. For the initial emergency management of hypoglycaemia this may be administered via a giving set alone.

In all other situations, an infusion pump is required. With 10% glucose, care should be taken to ensure that the whole 500ml infusion is not inadvertently administered. \* *The entire 100ml infusion bottle should be hung to get this dose due to the deadspace in the infusion set*

For persistent hypoglycaemia despite appropriate initial treatment, an infusion of 10% glucose at 100ml/hr may be required.

## Flush

Sodium chloride 0.9%, glucose 5% - flush well to reduce vein irritation  
Remove infusion set and discard once hypoglycaemia corrected

## Compatible infusions

Not applicable

## Storage and handling

Do not use unless solution is clear, without visible particles and container undamaged.

Discard any unused portion. Do not reconnect any partially used bags.

Do not remove the infusion bag from overwrap until ready to use (inner bag maintains the sterility of the product).

High strength solution – packaging looks similar to other infusion fluids take care to confirm correct strength selected.

## Cautions and side effects

- Hyperglycaemia, monitor blood glucose
- Avoid extravasation – may cause tissue damage
- Pain, phlebitis and vein irritation may occur during administration as the solution is hypertonic. This is a particular risk if infused too quickly. Monitor the infusion site, if any signs of phlebitis, stop infusion, remove cannula and resite
- Hypersensitivity/infusion reactions including anaphylactic/anaphylactoid reactions have been reported with glucose infusions, thought to be from corn allergy. Caution in patients with suspected or know allergy to corn or corn products. Stop the infusion immediately if any signs or symptoms of a suspected hypersensitivity reaction develop. Treat reaction and seek urgent medical advice regarding hypoglycaemia treatment
- Fluid and electrolyte disturbances including oedema, hypokalaemia and hypomagnesaemia
- Monitor patients with or at risk of fluid overload

## References

1. Baxter Healthcare Ltd. Summary of Product Characteristics (SPC) Glucose 10% w/v Solution for Infusion Revised March 2016. Available at <http://www.medicines.org.uk/emc/medicine/30172>  
Accessed 7 July 2017
2. Hameln Pharmaceuticals Ltd. Summary of Product Characteristics (SPC) Glucose 20% w/v Solution for Infusion. 12/05/2013. Available at <http://www.medicines.org.uk/emc/medicine/27875/spc>  
Accessed 7 July 2017
3. Injectable Medicines Guide. Monograph for Intravenous Glucose (treatment of hypoglycaemia in adults), version 2. 17.05.2012. Available at <http://medusa.wales.nhs.uk/IVGuidePrint.asp?Drugno=1860&format=3>  
Accessed 7 July 2017
4. University College London Hospitals NHS Foundation Trust. Injectable Medicines Administration Guide. 3rd Ed. 2010. Wiley-Blackwell: Chichester.

