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Diabetes UK Position Statements

Diabetes at the front door. A guideline for dealing with glucose related emergencies at the time of acute hospital admission from the Joint British Diabetes Society (JBDS) for Inpatient Care Group*

K. Dhatariya[1,2], J. James[3], M.-F. Kong[3] and R. Berrington[3] on behalf of the Joint British Diabetes Society (JBDS) for Inpatient Care Group and guidelines writing group

[1]Elsie Bertram Diabetes Centre, Norfolk and Norwich University Hospitals NHS Foundation Trust, [2]Norwich Medical School, University of East Anglia, Norwich and [3]Department of Diabetes, University Hospitals Leicester NHS Trust, Leicester, UK

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Abstract

People with diabetes account for nearly one-fifth of all inpatients in English and Welsh hospitals; of these, up to 90% are admitted as an emergency. Most are admitted for a reason other than diabetes with only 8% requiring admission for a diabetes-specific cause. Healthcare professionals working in emergency departments experience numerous clinical challenges, notwithstanding the need to know whether each individual with diabetes requires urgent admission. This document has been developed and written by experts in the field, and reviewed by the parent organizations of the Joint British Diabetes Societies for Inpatient Care—Diabetes UK, the Diabetes Inpatient Specialist Nurse Group and the Association of British Clinical Diabetologists. The document aims to support staff working in emergency departments and elsewhere by offering practical advice and tools for effective, appropriate and safe triage. Each section relates to the commonest diabetic specific emergencies and algorithms can be printed off to enable ease of access and use.

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Introduction

In the UK, diabetes accounts for around 18% of inpatients, with one in six acute hospital beds occupied by a person with diabetes. People with diabetes in hospital tend to be older, with an average age of 75 years [1]. The National Diabetes Inpatient Audit (NaDIA) measures provide a snapshot of the quality of diabetes care provided to people with diabetes while they are admitted to hospital whatever the cause, and aim to support quality improvement.

According to NaDIA, 83–90% of people with diabetes are admitted as an emergency; however, the majority are not admitted for their diabetes per se [1]. In 2017, diabetes-specific emergencies accounted for only 8% of the total number of admissions (16 010) audited on a single day in England and Wales.

The commonest reasons for diabetes-specific admissions are: foot ulceration, hypoglycaemia, hyperglycaemia, diabetic ketoacidosis and hyperosmolar hyperglycaemic state [1]. Other reasons for admissions to hospital in the diabetes population include: newly diagnosed diabetes, cardiovascular disease, stroke and end of life care.

This short guide is for healthcare professionals working in acute emergency departments and emergency decision units. It aims to give a quick guide to triage when adults with diabetes attend these departments for diabetes-specific problems.

All guidance is aligned to the Joint British Diabetes Societies and Diabetes UK recommendations.

Each section of this document includes condition specific algorithms and links to JBDS guidelines and other resources.

Hypoglycaemia

Hypoglycaemia is common in people with diabetes and mainly affects those taking insulin and/or sulfonylurea agents or prandial regulators. There are 4.7 million people in the UK with diabetes and ~ 30% of them use insulin (in type 1 and type 2 diabetes) [2].

The 2016 NaDIA reported that hypoglycaemia accounted for 15% of hospital admissions in the 15 774 people audited that year [3].

Correspondence to: Ketan Dhatariya. Email: ketan.dhatariya@nnuh.nhs.uk

What's new?

- About one in six acute hospital beds in the UK is occupied by someone with diabetes, over 80% of whom are admitted as an emergency not related to their diabetes.
- This guideline is aimed at teams working in areas where acute admissions occur to help them appropriately manage glucose-related emergencies.
- It looks at the acute management of those known to have diabetes and those at risk of developing dysglycaemia.
- Areas covered are hypoglycaemia, hyperglycaemia, diabetic ketoacidosis, hyperosmolar hyperglycaemic state, the diabetic foot, end of life care and how to deal with an unknown insulin regimen in an acutely unwell individual.

Hypoglycaemia can be defined as 'mild' if the episode is self-treated and 'severe' if assistance by a third party is required [4]. For the purposes of people with diabetes who are hospital inpatients, any blood glucose < 4.0 mmol/l should be treated. The majority attending emergency units will have experienced a 'severe' hypoglycaemic event. The 2019 NaDIA report showed that 1.4% of people with diabetes in hospital required hypoglycaemic rescue during the previous 7 days of their hospital stay [5]. In type 2 diabetes, the prevalence is lower than in type 1 diabetes, but increases in those with long duration of diabetes and those who are insulin-treated [4].

Hypoglycaemia can cause coma, hemiparesis and seizures. If the hypoglycaemia is prolonged, neurological deficits may become permanent. Severe hypoglycaemia is associated with increased mortality [6].

The risk factors associated with hypoglycaemia are shown in Table 1. An example pathway to decide whether someone presenting with hypoglycaemia needs acute hospital admission or not is shown in Fig. 1. The recommended treatment of hypoglycaemia is shown in Fig. 2.

Table 1 Risk factors for hypoglycaemia

Medical issues	Lifestyle issues
Strict glycaemic control	Increased exercise (relative to usual)
Previous history of severe hypoglycaemia	Irregular lifestyle
Long duration of type 1 diabetes	Alcohol
Duration of insulin therapy in type 2 diabetes	Increasing age
Lipohypertrophy	Early pregnancy
Impaired hypoglycaemic awareness	Breast feeding
Severe hepatic dysfunction	No or inadequate monitoring
Impaired renal function including those on renal replacement therapy	Reduced carbohydrate intake/absorption
Sepsis	Anorexia, poor appetite/ interruption of enteral feeding
Inadequate treatment of previous hypoglycaemia	Irregular meals
Terminal illness	Food malabsorption, e.g. gastroenteritis pancreatic enzyme insufficiency, coeliac diabetes
Cognitive dysfunction/ dementia	Bariatric surgery involving bowel resection
Frailty	Reduction in steroids

Adapted from Stanisstreet *et al.* [7].

Recommendations

- Not everyone reviewed and treated for hypoglycaemia will require hospital admission.
- All should be reviewed for the cause of the hypoglycaemic event and HbA_{1c} checked if it has been longer than 3 months since the last test. Because results may not be available quickly, it should be clearly documented that the results should be followed up and acted upon.
- Ask about recent or recurrent hypoglycaemic events. If these are found, then the specialist diabetes team should be asked to review the person either in the ambulatory care setting (where admission may or may not be necessary), or urgently as an outpatient.
- Beware the low HbA_{1c} and ensure that sulfonylureas are not used in frail, older people and those who have pre-filled medicine trays/pill organizers. They and/or their carers will be unable to detect which drug is the sulfonylurea if they are unable or unwilling to eat. Sulfonylureas must be given with food.
- If in doubt whether sulfonylureas or other oral hypoglycaemic agents should be continued or the dose adjusted, consult the British National Formulary and/or ask the specialist diabetes team for advice.
- People with type 1 and those with insulin-treated type 2 diabetes who are usually well, and can self-manage their condition and medication, can usually be discharged following insulin dose advice and possible reduction. They and/or their carers should receive education and a leaflet on the prevention and treatment of hypoglycaemia. Those who are discharged from the emergency department should be strongly encouraged to inform their diabetes team at the earliest opportunity that they have had an episode of severe hypoglycaemia. If in doubt whether the insulin dose should be adjusted, ask the specialist diabetes team for advice.

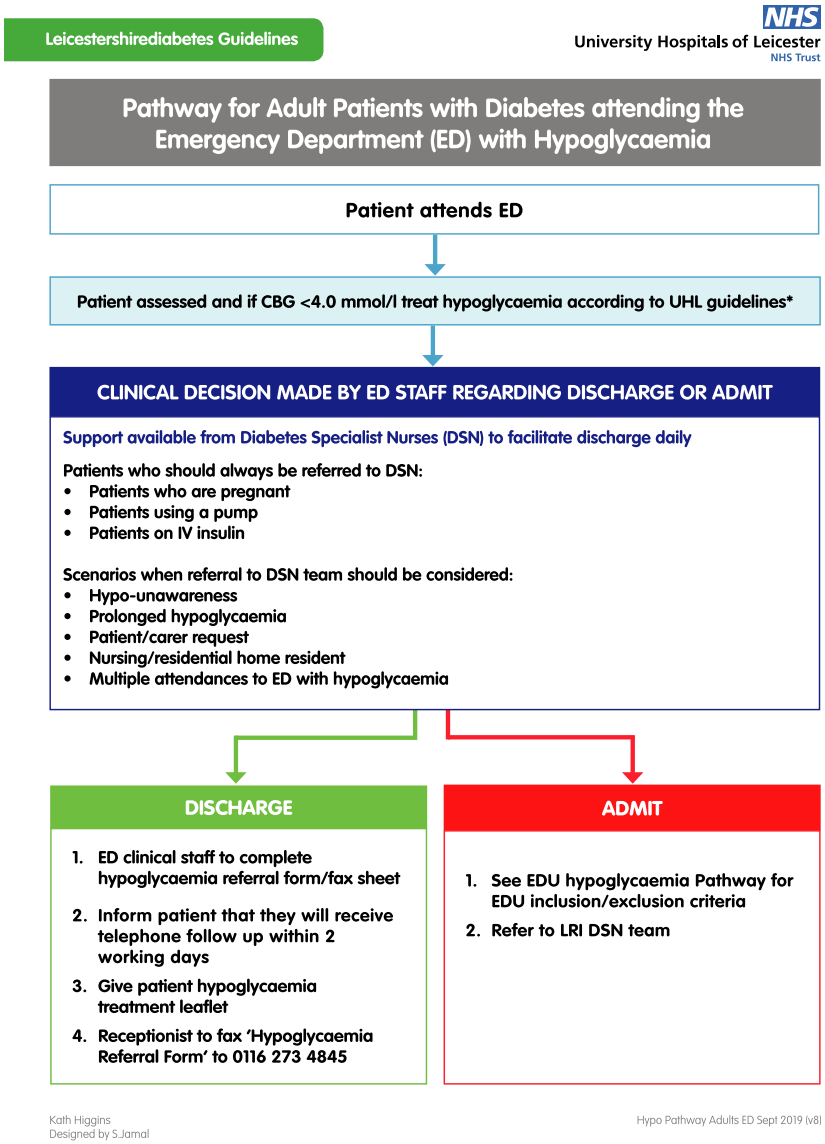

FIGURE 1 An example pathway to decide whether or not someone presenting with hypoglycaemia needs acute hospital admission. Reproduced with kind permission from Dr Kath Higgins University Hospitals of Leicester.

- People with type 2 diabetes on sulfonylureas, and in particular the frail, older person, those with other exacerbation of co-morbidities, those who live alone or people who have sustained an injury, e.g. fracture, should be admitted to hospital as they are at high risk of further hypoglycaemic episode in the next 48 h because sulfonylureas, even when discontinued, are slow to be excreted.
- Ensure the discharge letter states the treatment given, the drugs changed and the follow-up plan—and where appropriate, that an HbA_{1c} was taken should also be recorded, and where necessary followed up by the primary care team.
- If the person drives, they must be informed of the appropriate Driver and Vehicle Licensing Agency regulations regarding severe hypoglycaemia. This advice can be found at https://www.gov.uk/diabetes-driving. If in doubt call the specialist diabetes team.

Hyperglycaemic emergencies: hyperglycaemia, diabetic ketoacidosis and hyperosmolar hyperglycaemic state

Any individual with diabetes who presents acutely unwell should have a capillary glucose measurement and blood/urine ketone measurement taken.

If an individual is not known to have diabetes

If, in these individuals, random capillary glucose is ≤ 7.8 mmol/l and they have no additional risk factors for

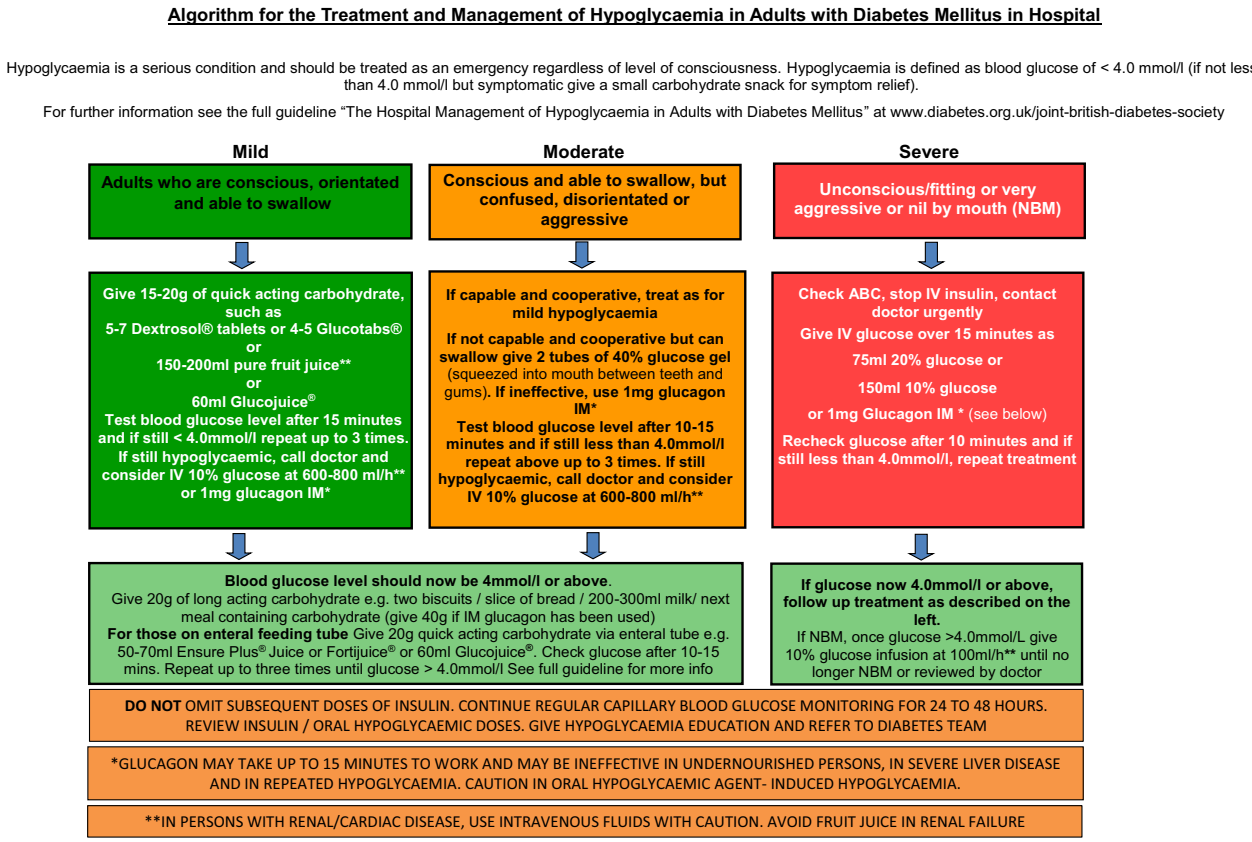

FIGURE 2 Treatment of hypoglycaemia—separated into three sections depending of the severity of symptoms.

the development of hyperglycaemia (Table 2), no further capillary glucose testing is necessary, unless circumstances change and the clinical team feel it appropriate (e.g. the use of high-dose glucocorticoids) [8].

If they have an initial capillary glucose concentration of ≥ 7.8 mmol/l at presentation, or if they have any risk factor for developing hyperglycaemia (Table 2), venous blood gases should be taken to exclude a metabolic acidosis; if these are abnormal then ketone concentrations should be checked to exclude diabetic ketoacidosis [9]. Consider requesting antibodies (e.g. anti-glutamic decarboxylase autoantibodies and anti-islet cell autoantibodies, if available) if the clinical picture is suggestive of new-onset type 1 diabetes, and to help exclude ketosis-prone type 2 diabetes.

Table 2 Risk factors for developing hyperglycaemia

Aged > 40 years (> 30 years in people of South Asian origin)
Family history of diabetes
Personal history of gestational diabetes
Personal history of hypertension
Personal history of dyslipidaemia
Personal history of prediabetes
BMI > 25 kg m^{-2} (23 kg m^{-2} in those of South Asian origin)
Those on long-term glucocorticoid treatment

Adapted from Savage *et al.* [9].

The feet should be examined for any signs of infection, ischaemia or injury. If ketoacidosis is excluded and the feet are fine, then capillary glucose concentrations should be measured every 4-6 h for the first 24 h depending on clinical need.

If the glucose is > 30.0 mmol/l, and ketones are either negative or positive on urine, or < 3.0mmol/l, the plasma osmolality should be calculated ($2[Na^+]$ + glucose + urea). If this is > 320 mOsmol/kg, hyperosmolar hyperglycaemic syndrome should be diagnosed (see Table 3), and treated accordingly.

Be aware that a mixed picture of hyperosmolar hyperglycaemic state and diabetic ketoacidosis can occur [10].

If all of the capillary glucose concentrations during those 24 h are ≤ 7.8 mmol/l, testing can be stopped unless circumstances change and the clinical team feel it appropriate

Table 3 Diagnostic criteria for hyperosmolar hyperglycaemic state

Plasma glucose > 30.0 mmol/l
pH > 7.3
Serum bicarbonate > 15.0 mmol/l
Plasma ketones < 3.0 mmol/l
Serum osmolality > 320 mOmol/kg

Adapted from Scott [10].

to continue. The discharge summary should include the fact that admission glucose was raised, but subsequent readings were normal. This is consistent with a diagnosis of 'stress hyperglycaemia' [11] and it is recommended that the individual should have a yearly fasting glucose or HbA_{1c} because they are at increased risk of developing type 2 diabetes over time.

During the first 24 h after admission, if any of the capillary glucose measurements are ≥ 7.8 mmol/l, then an HbA_{1c} measurement should be requested. If the HbA_{1c} is ≥ 48 mmol/mol (6.5%), then the patient probably has type 2 diabetes and should be informed of this. The diagnosis of diabetes should be clearly documented in the hospital notes and in the discharge summary. In addition, it should be remembered that people with newly diagnosed diabetes may present with other primary pathologies and the diabetes is picked up incidentally. The individual should be treated appropriately according to local guidelines and the diabetes specialist team should be informed as necessary.

If an individual is known to have diabetes

If an individual is known to have diabetes and the random capillary glucose concentration is < 4.0 mmol/l, then they need to be treated appropriately for hypoglycaemia [7].

In individuals who are acutely unwell, a venous blood gas measurement should be taken and capillary blood tested for plasma ketones. Table 4 shows the diagnostic criteria for ketoacidosis [9]—be aware that ketoacidosis can occur with a normal glucose concentration, in particular with sodium–glucose co-transporter 2 (SGLT-2) use [12].

In addition, the feet should be examined at the time of admission and then daily during admission in all inpatients known to have diabetes.

If HbA_{1c} has not been measured within the 3 months prior to admission, this should be done. The result should be approached with the individual in mind, i.e. is it appropriate for the person when considering their age and co-morbidities? If in doubt, the specialist diabetes team should be consulted. If the HbA_{1c} is not appropriate for the person's age and comorbidities, then capillary glucose concentrations should be measured hourly until a pattern is established and the medication can be adjusted to achieve 'safe' glucose concentrations between 6.0 and 10.0 mmol/l with an acceptable range of 4.0–12.0 mmol/l for most people.

If the glucose is > 30.0 mmol/l, and ketones are negative then the plasma osmolality should be calculated (2 [Na^+] + glucose + urea). If this is > 320 mOsmol/kg, hyperosmolar hyperglycaemic syndrome should be diagnosed, and treated accordingly [10]. Be aware that a mixed picture of hyperosmolar hyperglycaemic state and diabetic ketoacidosis can occur [13]. If this is the case, insulin treatment should be started sooner rather than later.

Table 4 Diagnostic criteria for diabetic ketoacidosis

You need the **'D'**
• A glucose concentration of > 11.1 mmol/l **or**
• A previous diagnosis of diabetes
You need the **'K'**
• Plasma ketones of ≥ 3.0 mmol/l
• (Urine ketones can be misleading and unhelpful)
You need the **'A'**
• A pH of < 7.3
• An anion gap of > 12
• A bicarbonate of < 15 mmol/l

Adapted from Savage *et al.* [9].

If the individual is eating and drinking normally

Capillary glucose concentration should be checked every 4–6 h, depending on clinical need. The ideal target range is 6.0–10.0 mmol/l, with an acceptable range of 4.0–12.0 mmol/l. If the glucose concentration is ever < 4.0 mmol/l then the medication must be adjusted to avoid further episodes of hypoglycaemia.

If the glucose concentration is > 12.0 mmol/l, it may not be necessary to treat immediately. However, plasma ketones should be checked, and if > 3.0 mmol/l venous blood gases should be done, if these confirm ketoacidosis, a fixed rate intravenous insulin infusion should be started and local guidelines for the management of diabetic ketoacidosis must be followed. Capillary glucose concentrations should be measured hourly whilst a fixed rate intravenous insulin infusion is in use. The ideal target range is 6.0–10.0 mmol/l, with an acceptable range of 4.0–12.0 mmol/l. The diabetes specialist team should be informed.

If ketones are not present, it may be necessary to wait for 24 h to check the pattern of dysglycaemia and make the necessary adjustments to the medication on a daily basis to achieve glucose concentrations of between 6.0 and 10.0 mmol/l. Local guidelines should be used to make the change to subcutaneous insulin, or oral medication when the individual is eating and drinking normally, and no longer requires intravenous insulin [9]. The diabetes inpatient specialist team should be involved as necessary.

If the individual is not eating and drinking normally and not in diabetic ketoacidosis

A variable rate intravenous insulin infusion may be required to ensure that glucose concentrations remain between 6.0 and 10.0mmol/l, with an acceptable range of 4.0 to 12.0mmol/l.

Capillary glucose concentrations should be measured hourly whilst a variable rate intravenous insulin infusion is in use [14].

If the glucose concentration is > 12.0 mmol/l, then the plan outlined above in the section for those eating and drink should be followed.

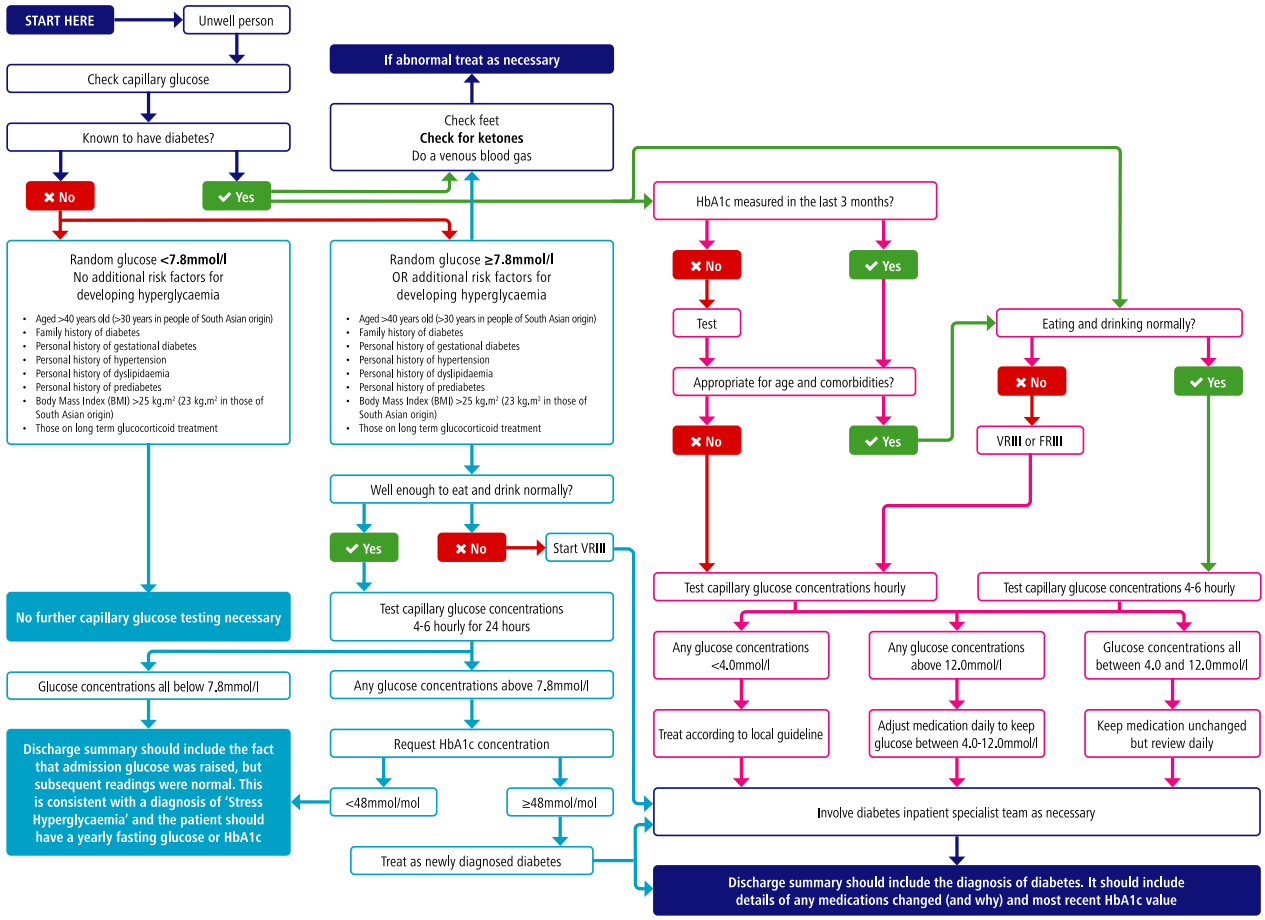

FIGURE 3 Diabetes assessment in people with known and unknown previous diagnosis of diabetes.

An algorithm for assessment in those with undiagnosed and in those with previously diagnosed diabetes is shown in Fig. 3.

A decision tool on the management of hyperglycaemia admissions is shown in Fig. 4.

The diabetic foot

The diabetic foot can present in many different formats, chronic or acute ulceration, abscess or collection, gangrene, critical limb ischaemia and acute Charcot neuroarthropathy.

It is estimated that between 5 and 7% of people with diabetes will have a diabetic foot ulcer at some point in their lives, at an estimated annual cost of £935 million to the NHS [15].

The annual number of diabetes-related amputations in England is now > 7000 and the likelihood that someone with diabetes will undergo a leg, foot or toe amputation is around 23 times that of a person without diabetes [16]. There is variation in the incidence of amputation of the lower limb in England [17].

Admission for the diabetic foot is common, with NaDIA reporting almost 50% of emergency admissions for those with a diabetes-specific complication are for foot emergencies [18]. This number has increased year on year [18,19].

The National Diabetes Foot Care Audit revealed that people with severe ulcers are 1.5 times as likely to be admitted to hospital and three times as likely to be admitted for foot disease [19].

One-fifth of hospital sites do not have a multidisciplinary foot care team (20%), although this proportion has reduced from 42% in 2011 [19].

Not everyone needs to be admitted; the degree of infection can be assessed using the Infectious Diseases Society of America guidelines [20] (Table 5). The vascular status of the individual should also be taken into consideration as if there is a non-palpable pulse, the individual may require vascular assessment prior to discharge.

- Dressings should always be removed to asses ulcers and shoes should be examined.
- Assess the individual for signs of sepsis or toxicity.
- Feel the temperature of the feet with the dorsum of the hand. Increased warmth with redness and swelling might

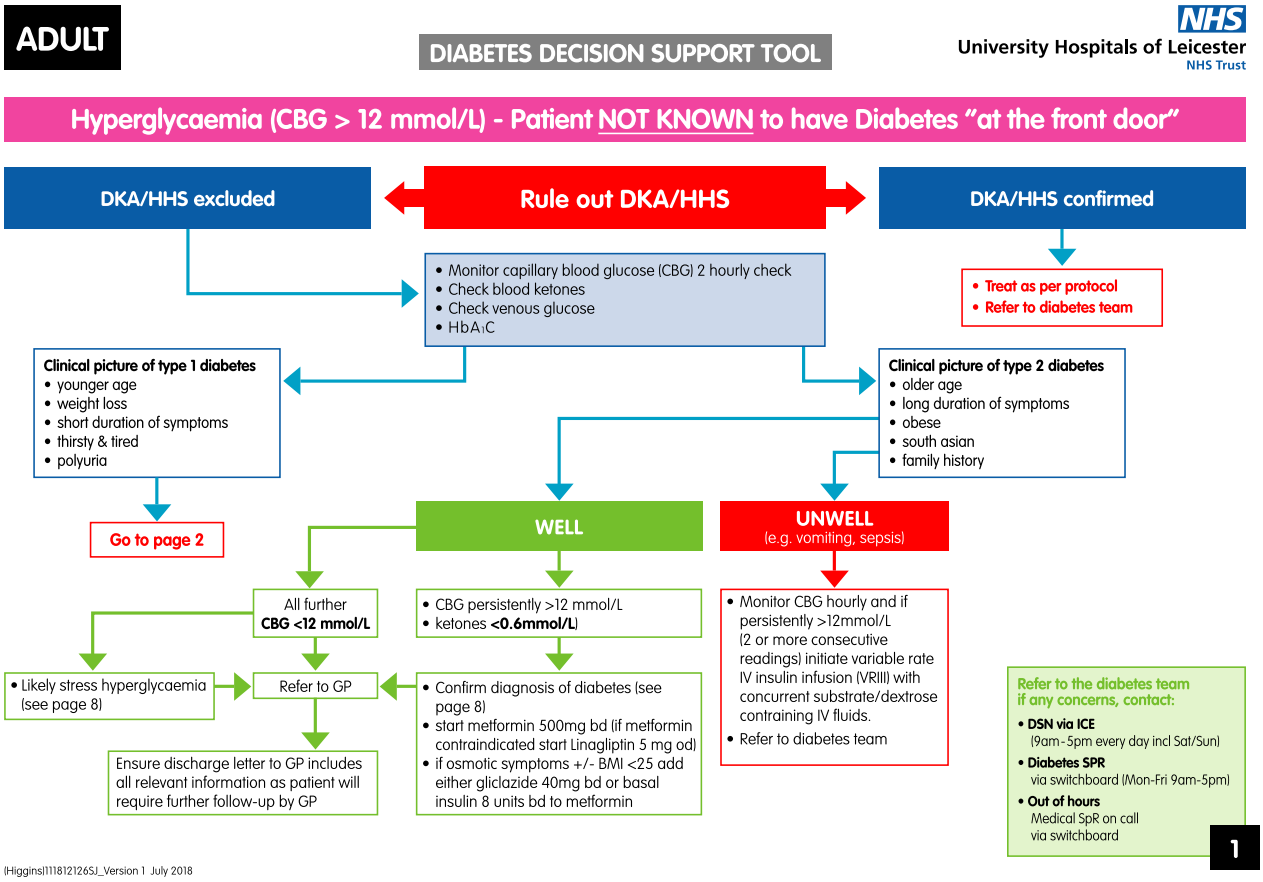

FIGURE 4 Diabetes decision support tool: Management of hyperglycaemia. CBG, capillary blood glucose; DKA, diabetic ketoacidosis; HHS, hyperosmolar hyperglycaemic state; DSN, Diabetes Specialist Nurse; ICE, Integrated Clinical Environment® (Sunquest, Tucson, AZ); SPR, Specialist Registrar. Reproduced with kind permission from Dr Kath Higgins University Hospitals of Leicester NHS Trust.

indicate inflammation such as cellulitis or acute Charcot foot whereas a cold foot might suggest ischaemia.

Which individuals should be admitted?

- People with a life threatening/limb-threatening problem such as foot ulceration with fever or signs of sepsis.
- People with ulceration with limb ischaemia.
- People with wet gangrene.
- Those with suspected deep-seated soft tissue or bone infection, usually indicated by a grossly swollen foot with shiny skin.

See Diabetic Foot Assessment (Fig. 5).

Table 5 Severity of infection (as defined by Infectious Diseases Society of America guidelines) [20]

Mild infection: presence of 2 or more manifestations of inflammation (purulence, or erythema, pain, tenderness, warmth or induration), but any cellulitis/erythema extends to ≤ 2 cm around the ulcer and infection is limited to the skin or superficial subcutaneous tissues; no other local complications or systemic illness.
Moderate infection: (as above) in a person who is systemically well and metabolically stable but who has ≥ 1 of the following characteristics: cellulitis extending > 2 cm, lymphangitic streaking, spread beneath the superficial fascia, deep tissue abscess, and involvement of muscle tendon, joint or bone.
Severe infection: infection in a person with systemic toxicity or metabolic instability (e.g. fever, rigors, tachycardia, hypotension, confusion, vomiting, leucocytosis, severe hyperglycaemia).

End of life care and diabetes (reproduced by permission from Diabetes UK and the Joint British Diabetes Societies [21,22])

It is estimated that each year half a million people die in the UK and 75 000 of these will have diabetes. The average age expectancy of the population increases year on year and the average age of inpatients with diabetes is 75 years [18]. In 2014, nearly half of all deaths in England occurred in hospitals [23].

This is despite the fact that, given a preference, the majority of individuals would prefer to die at home. The possibility of a home death will depend on various factors, such as illness progression, symptom control,

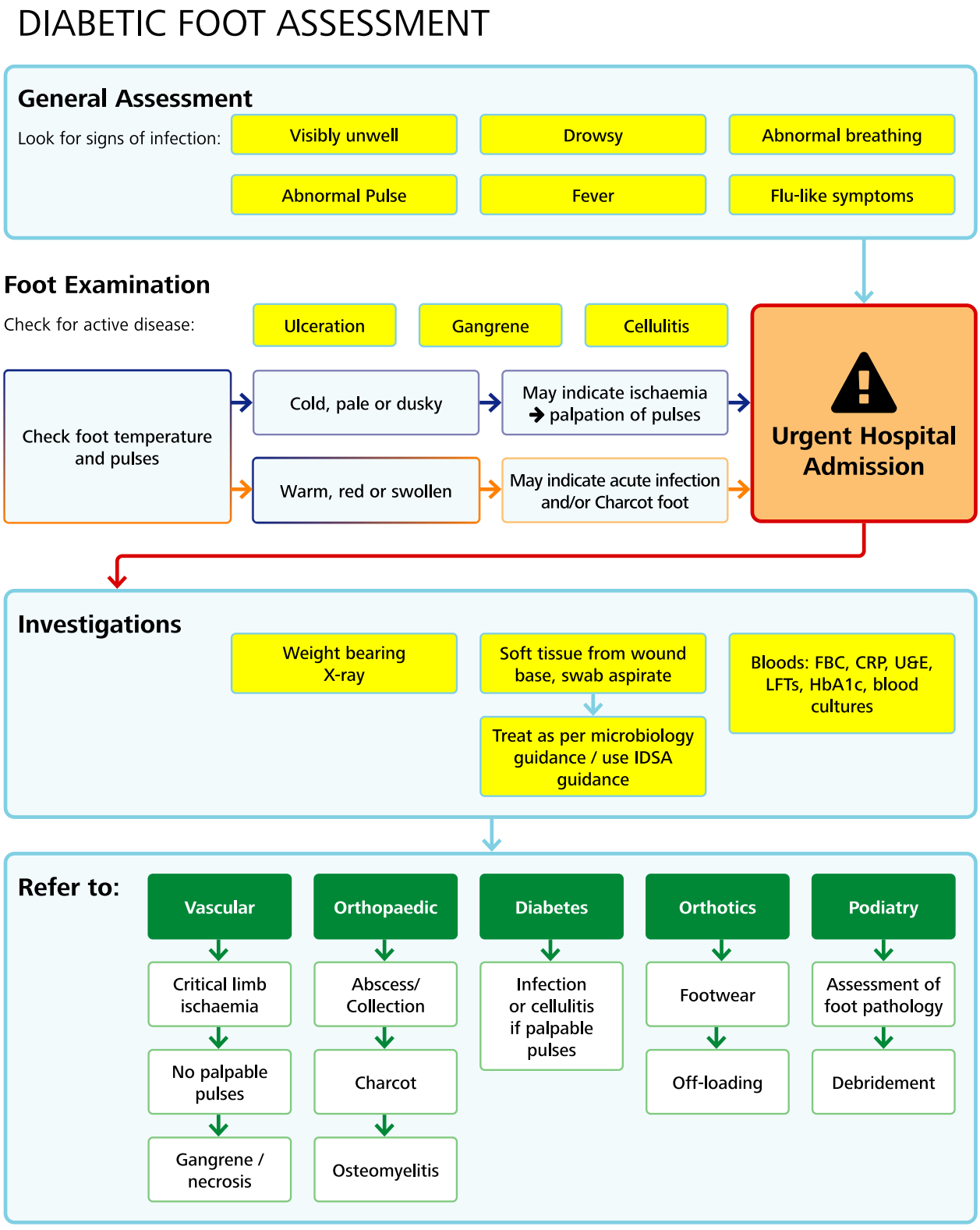

FIGURE 5 Diabetic foot assessment.

complications, family support available, and access to community-based palliative care services and equipment [21]. This has possibly led to acute emergency services seeing an increase in those already considered being in the last phase of life and who have been cared for in the home or in nursing homes. Individuals include the frail and people with

advanced dementia, some of whom will already have advanced care planning in place.

This may take the form of:

- **An advance decision**—this document is legally binding—it should have been signed and witnessed. It informs all those involved in the individual's care, e.g. family, carers, health professionals, that the individual has a specific wish to refuse specific treatments in the future and this becomes essential if that individual loses the ability to communicate effectively.
- **An advance statement**—this document is not legally binding but sets out the individuals' wishes, preferences and beliefs about future care.
- **Emergency healthcare planning**—this makes communication easier in the event of a healthcare emergency. It includes shared decision-making and recording around expectations and capabilities of the individual and carers in the event of predictable situations or emergencies. The plan should include a list of regular and 'as needed' (PRN) medications, and indications for any rescue medications left in the individual's home for emergency use. It could include plan for insulin adjustment or rescue doses of short-acting insulin analogues [21].

Diabetes management at the end of life centres on symptomatic relief at the right stage. It aims to prevent glycaemic emergencies such as diabetic ketoacidosis and hyperosmolar hyperglycaemic state or hypoglycaemia, as well as dehydration and the development of foot ulceration or pressure sores. Hypoglycaemia is common in the dying as appetites reduce, and if renal impairment is present, due to the slow clearance of medications such as insulin and sulphonylureas.

Specific recommendations in the care of dying people with diabetes as shown in the Diabetes UK *End of Life Diabetes Care: Clinical Care Recommendations* (Fig. 6) are as follows:

- Recommended blood glucose target is 6.0–15.0 mmol/l.
- HbA_{1c} measurement is not generally recommended unless it is used to estimate long-term hypoglycaemia; fasting blood glucose readings are not required.
- Fluids should not be withdrawn unless it is the wish of the individual or if they lack capacity, the family or carer.
- Insulin must not be discontinued in people with type 1 diabetes.
- Insulin regimens in type 2 diabetes should be simplified; these individuals may only require a single injection of intermediate insulin e.g. Insuman Basal®, Humulin I®, Insulatard®;
- If hypoglycaemia is a significant risk, long-acting analogue insulin such as insulin degludec or insulin glargine can be given. This is useful if the insulin has to be administered by community nurses.
- Insulin and other non-insulin injectable treatments such as glucagon-like peptide-1 (GLP-1) receptor agonists and oral diabetes therapies may be withdrawn in people with type 2 diabetes if clinically appropriate.
- If the individual is transferred to a ward or back to a nursing home or home, a clear diabetes treatment plan must be in place and medication and supplies provided.
- Contact numbers for the primary care team or diabetes specialist nurse team caring for the individual must be included in the management plan.

Unknown insulin regimen in people with diabetes admitted acutely unwell

People with diabetes admitted to hospital acutely unwell or with chronic confusion/cognitive impairment may not know their usual medications/doses, including insulin. There are several ways the admitting doctor may be able to identify the correct insulin regimen. This section provides a management guide to minimize the risk of hypo-/hyperglycaemia in the short term until the individual's usual regimen can be ascertained. In all cases, contact the diabetes specialist nurse team for on-going management as soon as able.

Identifying persons usual insulin regimen

1. Ask the individual! He or she may not remember the dose, but may know which insulin(s) they take, or vice versa.
2. Check on in-house electronic databases.
3. Ask to see the insulin pens(s), insulin safety card and/or monitoring book: many people document their current insulin doses in their monitoring book.
4. Ask a family member: he/she may have the correct information, or may be able to provide the individuals insulin passport/ insulin safety card, detailing which insulin is taken.
5. Contact the person's primary care provider: this will allow you to identify which insulin is prescribed, but unless the individual has been seen in the general practice very recently (i.e. within last month), any record of insulin dose cannot be certain.
6. Some individuals have their insulin administered by district nurses or nursing home staff: contact these teams for further information.

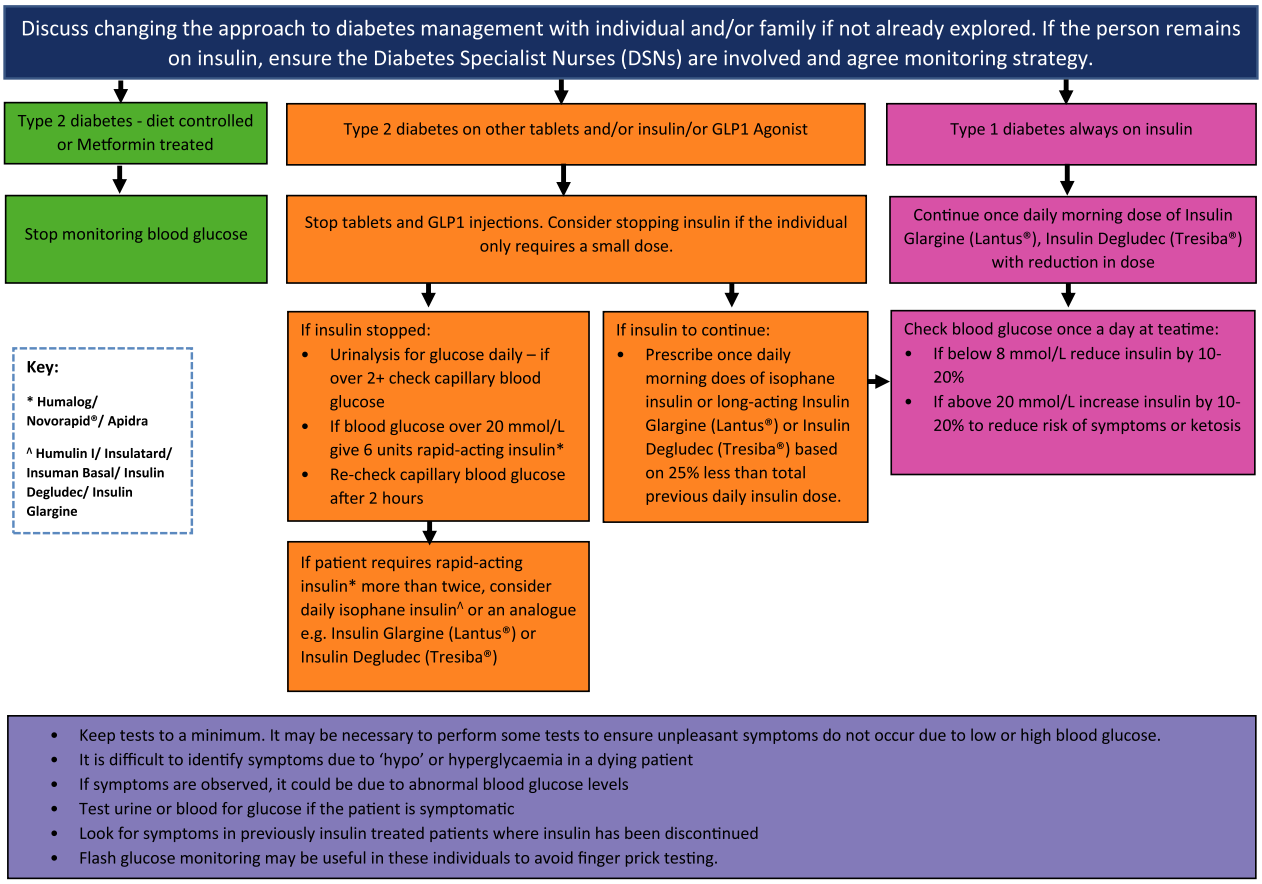

FIGURE 6 Management of diabetes during the last days of life. Kindly reproduced from Diabetes UK, *End of Life Diabetes Care: Clinical Care Recommendations*, 3rd edition (March, 2018).

Short-term management when insulin regimen is unknown

Type 1 diabetes

If the person is suspected to have type 1 diabetes or if this is a possibility, but they are unable to recall either which insulin is taken or the usual dose, and if they are acutely unwell and/or unable to eat or drink:

- Start variable rate intravenous insulin infusion and monitor capillary blood glucose hourly.
- If the person is unwell OR their blood glucose > 11.0 mmol/l, a venous blood gas may be necessary. If appropriate measure finger-prick blood ketone level. If diabetic ketoacidosis is diagnosed, then treat this accordingly. Otherwise, do not stop the variable rate intravenous insulin infusion until the patient has recovered, and the usual insulin/dose is known and prescribed and given.
- Continue long-/intermediate-acting insulin in addition to the variable rate intravenous insulin infusion.

If the type of insulin is known but not the dose:

- Calculate a safe total daily dose (TDD) based on bodyweight.
- This dose should be sufficient to prevent development of ketoacidosis but be very unlikely to cause hypoglycaemia.
- Monitor blood glucose levels at least four times per day pre-meal and pre-bed, and titrate insulin doses as required.

For some worked examples, see below.

Type 2 diabetes

Where the individual is usually managed on insulin and is acutely unwell

- Test blood glucose and ketones and rule out hyperosmolar hyperglycaemic state.
- If the blood glucose is > 12 mmol/l and the individual is unable to take diet and or fluids commence a variable rate insulin infusion.

Where the individual is not acutely unwell and able to take diet and or fluids

- Test blood glucose 4-hourly and aim for blood glucose readings of 6.0 and 10.0 mmol/l (although a range of 4.0–12.0 mmol/l is acceptable).

- Commence subcutaneous NPH insulin such as Human Insulatard®, Humulin I® and Insuman Basal® once daily until the correct insulin has been identified if clinically indicated).
- Titrate dose as necessary.
- If the individual is in end of life care aim for blood glucose readings of 6.0–15.0 mmol/l with no glycaemic symptoms.

Method A: Calculating estimated insulin dose from patient's weight

Insulin requirements for an adult can be calculated from a weight-based formula (see worked example).

- Frail older individuals, those in renal failure (chronic kidney disease stage 4 or 5) or severe hepatic failure, and those with newly diagnosed type 1 diabetes:

$$\text{Total daily insulin dose} = 0.3 \times \text{body weight in kg}$$

- All other adults

$$\text{Total daily insulin dose} = 0.5 \times \text{body weight in kg}$$

Worked example using method A [14]

Patient with chronic kidney disease stage 4 weighs 100 kg	100 kg
TDD insulin requirement = 0.3 × body weight	0.3 × 100 = 30 units
Basal bolus insulin regimen*	Basal dose: 30 ÷ 2 = 15 units
Give half of TDD as basal insulin and divide the remainder by three for bolus doses with each meal	Bolus dose: 15 ÷ 3 = 5 units with each meal
Twice-daily pre-mixed insulin regimen*	Breakfast dose: 60% = 18 units
Give 60% of TDD with breakfast and 40% with evening meal	Evening meal: 40% = 12 units

*For specific insulin brands to be used, see local protocols and stock lists or seek advice of your local diabetes team.

Method B: Calculating estimated insulin dose from insulin requirements during the variable rate intravenous insulin infusion

An estimate of the daily insulin requirement can be estimated from the last 6 h of the variable rate intravenous insulin infusion as follows:

Divide the total dose of insulin administered in last 6 h of the variable rate intravenous insulin infusion by 6 to calculate average hourly dose of insulin. Multiply this by 20 (not 24, to reduce risk of hypoglycaemia) to estimate the total daily insulin requirement. A further correction may be needed in some people, depending on individual insulin sensitivity, previous degree of glycaemic control and severity of intercurrent illness.

Worked example using method B [14]

Total dose of insulin administered in last 6 h (6 times hourly rate)	12 units
Divide by 6 to calculate hourly dose	12 ÷ 6 = 2 units
Multiply by 20 (not 24 to reduce risk of hypoglycaemia) to estimate total daily insulin requirement TDD	2 × 20 = 40 units
Basal bolus insulin regimen*	Basal dose: 40 ÷ 2 = 20 units
Give half of TDD requirement as basal insulin and divide the remainder by three for bolus doses with each meal	Bolus dose: 20 ÷ 3 = 7 units with each meal
Twice-daily pre-mixed insulin regimen*	Breakfast dose: 60% = 24 units
Give 60% of TDD with breakfast and 40% with evening meal	Evening meal: 40% = 16 units

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