

# Safe care for people with diabetes in hospital

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## ABSTRACT

Diabetes is the most prevalent long-term condition, occurring in approximately 6.5% of the UK population. However, an average of 18% of all acute hospital beds are occupied by someone with diabetes. Having diabetes in hospital is associated with increased harm – however that may be defined. Over the last few years the groups such as the Joint British Diabetes Societies for Inpatient Care have produced guidelines to help medical and nursing staff manage inpatients with diabetes. These guidelines have been rapidly adopted across the UK. The National Diabetes Inpatient Audit has shown that over the last few years the care for people with diabetes has slowly improved, but there remain challenges in terms of providing appropriate staffing and education. Patient safety is paramount, and thus there remains a lot to do to ensure this vulnerable group of people are not at increased risk of harm.

**KEYWORDS:** Inpatient, optimisation, diabetes, dysglycaemia, harm

## Introduction

The current estimate for the prevalence of diabetes in the UK is approximately 6.5% and yet the National Diabetes Inpatient Audit (NaDIA), which is an almost annual event over the last several years, has shown the prevalence of patients with diabetes occupying an acute hospital bed has steadily risen to an average 18%.<sup>1,2</sup> The vast majority of these individuals are not in hospital because of their diabetes, but they have diabetes in addition to whatever other condition they were admitted with.

Recent data have suggested that one in 20 people being treated in a medical care setting experiences harm.<sup>3</sup> There are now several data to show that having diabetes in hospital also increases the risk of harm, however that harm is defined.<sup>4</sup> Most commonly this is an increased risk of hypoglycaemia – mild (ie self-treated) or severe (ie requiring third-party assistance), or hyperglycaemia (including the occurrence of diabetic ketoacidosis (DKA) and hyperosmolar hyperglycaemia state), medication errors, hospital acquired foot ulcers and overall increase in death.<sup>5–7</sup> When these

harms occur, it is often associated with an increased length of stay (Table 1 and Box 1).<sup>7</sup> As recently described, there are a number of quality improvement initiatives that can improve the safe delivery of care for inpatients with complex needs.<sup>8</sup> A few of the risk mitigation strategies that have become available in commonly encountered scenarios in hospital are discussed. The data that are available can be used by specialist teams to ensure that they have sufficient resources to provide safe and appropriate care for the increasing number of people with diabetes occupying an acute hospital bed. Non-specialists can use these data to ensure that they are aware of the issues facing these vulnerable individuals and that, in addition to safety, the suboptimal care that people with diabetes often receive leads to increasing length of stay and thus higher costs to the health economy.<sup>6,9</sup>

## The patient perspective

Most individuals with diabetes who answered the 2017 NaDIA patient bedside questionnaire reported being either satisfied or very satisfied with the diabetes care they had experienced during their hospital stay.<sup>2</sup> However, there were a number of other important parts of their management that they were not satisfied with in particular with the choice of food that is offered and the timing of the meal in relation to their diabetes medications.<sup>10</sup> The addition of the carbohydrate content of meals to the menu would allow those who carbohydrate count to dose themselves with greater accuracy than at present. The routine provision of bedtime snacks would also help to reduce the frequency of night time hypoglycaemia.<sup>11</sup>

Diabetes UK also carried out a survey of people with diabetes while they were in hospital and more than half of the individuals said that they did not feel they were in control of their diabetes and an almost equal number felt that they did not trust the healthcare professionals who cared for them while they were in hospital.<sup>12</sup> Almost half of the individuals who replied to the survey reported an ongoing concern about their diabetes care if they ever had to be in hospital again. The lack of control led to them having feelings of anxiety and fear, as well as frustration and the increased stress of having to advocate for themselves during this difficult time. Thus, to try and improve care, hospitals should put into place increased diabetes training for medical and nursing staff to allow them to manage diabetes better, to understand the needs and concerns of the people with diabetes and to support them to self-manage when appropriate. Essential to this is an inpatient diabetes specialist team to support the upskilling of the medical and nursing staff who look after these individuals and to be readily accessible to those people with diabetes who require specialist input.

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**Table 1. Examples of harm.** Data from Joint British Diabetes Societies for Inpatient Care. *A good inpatient diabetes service.* JBDS-IP, 2019.<sup>7</sup>

Metric	Percentage of people experiencing this harm in the 2017 NaDIA
Medication errors	31.2%
Insulin prescription errors in those with type 1 diabetes	40.4%
Hypoglycaemia (all forms)	18.4%
Hypoglycaemia (severe)	7.9%
Hypoglycaemia requiring IV/IM rescue treatment	1.3%
Hospital acquired foot ulceration	0.97%

IM = intramuscular; IV = intravenous; NaDIA = National Diabetes Inpatient Audit.

### The National Diabetes Inpatient Audit

NaDIA is the world's first national audit of bedside inpatient diabetes care. The data show that between 2011 and 2018, the prevalence of inpatient diabetes in England and Wales rose from 14.9% to 17.9%. In some hospitals the prevalence of people with diabetes occupying a hospital bed is as high as 30%.<sup>2</sup>

In addition, approximately one in 25 people with type 1 diabetes admitted to hospital experience an episode of DKA during that admission.<sup>2</sup> A smaller proportion experience an episode of hyperosmolar hyperglycaemic state (HHS). One in five people experience an episode of low blood glucose concentrations and of most concern, possibly, is that one in three experience a medication error. Insulin is one of the most high-risk medications, and errors arise due to several factors including unfamiliarity (and similarity) of insulin names and action profiles, and the use of the abbreviation 'u', instead of 'units' on hand written charts. In addition, the multiple new diabetes medications may be a mystery to those not familiar with them.

While there are data to show that dysglycaemia (high or low blood glucose concentrations) is associated with harm,<sup>13</sup> until very recently there has been little evidence to show that improving diabetes care made a difference to outcomes.<sup>14</sup> However, there are

**Box 1. Examples of insulin errors.** Adapted from Joint British Diabetes Societies for Inpatient Care. *A good inpatient diabetes service.* JBDS-IP, 2019.<sup>7</sup>

- > Insulin not written up.
- > Name of insulin not correct.
- > Number (dose) unclear.
- > Units abbreviated to 'u' or written unclearly.
- > Insulin or prescription not signed.
- > Insulin not signed as given.
- > Insulin given/prescribed at the wrong time.

now emerging data from the surgical field and on intensive care to show that maintaining good glycaemic control is associated with a reduction in the level of harm.<sup>15</sup> However, pathways to optimise glycaemic control – particularly within the surgical population – have been hard to implement.<sup>16</sup>

This increased length of stay and increased harm that occurs to people with diabetes in hospital, is associated with significant cost implications. Part of this is the lack of specialist staff. For example, the most recent NaDIA data show that almost one in seven hospitals in England and Wales have no inpatient podiatry service, despite diabetes related foot problems being the commonest reason for a 'diabetes specific' hospital admission, and the costs of hospital admission for foot disease being estimated at £322 million.<sup>17</sup> People with diabetes are also at greater risk of developing hospital acquired foot lesions, with a relative risk of 2.24 compared to those without diabetes.<sup>18</sup> The good news, however, is that NaDIA suggests there has been a significant reduction in hospital acquired foot ulcerations, dropping from 2.2% in 2010 to 0.97% in 2017.<sup>2</sup>

There are other areas that could be addressed to improve the care of people with diabetes in hospital. Almost two-thirds of all hospitals have no specialist inpatient dietetics service for people with diabetes, meaning the opportunity to explain the intimate relationship between diet and diabetes to patients and staff is lost. And less than one in 11 provide a 7-day specialist diabetes inpatient specialist nurse service. People with diabetes also felt that there was a lack of knowledge among the staff caring for them while in hospital. This is consistent from a junior doctor's point of view as well, with data showing that diabetes care is one of the main areas where knowledge among front-line medical staff is low.<sup>19</sup>

One of the ways in which harm can be reduced is by increasing the education and training of healthcare professionals involving the care of people with diabetes in hospital.<sup>10</sup> Nursing staff also benefit from inpatient diabetes education.<sup>20</sup> This raises the question of whether all healthcare professionals in hospitals and other care institutions should have regular mandatory training for diabetes.

### Hypoglycaemia

Hypoglycaemia is an extremely common reason why people are taken to the emergency room and the occurrence of hypoglycaemia during hospital admission is associated with an increased length of stay and increase in hospital mortality.<sup>21</sup> There are many reasons why people in hospital could experience hypoglycaemia (Table 2).<sup>22</sup> Therefore, avoidance of hypoglycaemia is an important consideration. It has recently been shown that the use of a colour coded glucose chart is associated with the prevention of hypoglycaemia and reduction in length of stay.<sup>23</sup> In addition, the increasing use of electronic prescribing may be one of the factors that has led to a reduction in prescribing errors seen in NaDIA.<sup>2</sup> The use of electronic medical records and integrated network blood glucose testing also make a similar impact but this has not yet been determined.

### Diabetes at the front door

The increasing prevalence of diabetes in the community and the occurrence of stress hyperglycaemia (ie hyperglycaemia

**Table 2. Risk factors for developing hypoglycaemia in hospital.** Adapted from Walden E, Stanisstreet D, Graveling A *et al.* *The hospital management of hypoglycaemia in adults with diabetes mellitus*, 3rd edn. Joint British Diabetes Societies for Inpatient Care, 2018.<sup>22</sup>

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 eg gastroenteritis pancreatic enzyme insufficiency, coeliac diabetes and gastroparesis.
Cognitive dysfunction/dementia.	Bariatric surgery involving bowel resection.
Frailty.	
Reduction in steroids.	

that occurs during times of physiological trespass that often resolves once the underlying problem has resolved) remains a challenge. In response to this, the Joint British Diabetes Society for Inpatient Care (JBDS-IP) has recently produced a guideline which suggests that any person who is unwell, who presents to an emergency department, regardless of whether they are known to have diabetes or not, should have a random capillary glucose measured.<sup>24</sup> If the glucose is less than 11.0 mmol/L and they have no additional risk factors for the development of hyperglycaemia, then no further action needs to be taken. However, if an initial capillary glucose is greater than 11.0 mmol/L at presentation and they have any risk factors for the development of hyperglycaemia then they should have a venous gas taken to exclude DKA, and their feet should be examined for signs of ischaemia, infection or injury. These risk factors are listed in Box 2. It should be remembered that hyperglycaemia most frequently occurs due to a mismatch between glucose concentrations, carbohydrate intake and

insulin dose. However, if DKA is excluded and the feet are fine, then capillary concentrations should be measured every 4–6 hours during the first 24 hours. If at any time the glucose is greater than 30.0 mmol/L then a serum osmolality should be calculated to exclude HHS.<sup>25</sup>

Individuals known to have diabetes should have a random capillary glucose measured, and those at risk – eg those who present with a glucose >11.1 mmol/L, those with a history of DKA or those on sodium-glucose cotransporter-2 (SGLT2) inhibitors should have a ketone concentration measured because DKA can occur with a normal blood glucose concentration.<sup>26</sup>

### Perioperative diabetes care

Perioperative diabetes care consists of the journey starting at primary care, through to referral to surgical outpatients, then on to the preoperative assessment clinic, through to admission, theatres and recovery, and then through to discharge.<sup>27</sup> At each stage of this journey the primary goal is communicating that the individual has diabetes, what kind of diabetes they have and how they are treated. There is guidance on this which is now firmly embedded in UK anaesthetic practice.<sup>28</sup> This is timely, because there are data to show that people with diabetes are less likely to be offered day-case surgery, once again increasing the length of stay for people with diabetes and increasing costs.<sup>9</sup> A recent document from the National Confidential Enquiry into Patient Outcome and Death (NCEPOD) looked at the entire care pathway for people with diabetes undergoing surgery and came up with several recommendations which would improve the perioperative care of people with diabetes.<sup>29</sup> The road to improving care starts with good communication, but there are also data to show that even though just under 9% of all referrals made to all surgical specialties were for people with diabetes, a substantial proportion of those referral letters had no mention of diabetes in the referral letter.<sup>30</sup> The JBDS-IP has produced a specific guideline on the

### Box 2. Risk factors for developing hyperglycaemia

- > Aged >40 years old (or >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.
- > Body mass index >25 kg/m<sup>2</sup> (23 kg/m<sup>2</sup> in those of South Asian origin).
- > Those on long-term glucocorticoid treatment.

management of perioperative care, which has been taken up very extensively around the UK and other parts of the world, suggesting that for elective surgery, glycated haemoglobin (HbA1c) should be less than 69 mmol/mol before any procedure is undertaken because of the risks of harm.<sup>27</sup>

### Hyperglycaemia and acute coronary syndrome

To date, there is no consensus on how hyperglycaemia in the context of acute coronary syndrome should be managed, with a variety of different recommendations from international organisations (Table 3).<sup>31–36</sup>

### Hyperglycaemia and glucocorticoid use

The management in steroids in people who are either known to have diabetes or not known to have diabetes is complex. Steroid administration in hospital is common and it is well recognised that high-dose steroids can worsen existing diabetes or can induce diabetes in those people who are at risk.<sup>37,38</sup> A recent systematic review suggested that there are little data to show which is the best management strategy for this condition, thus for individuals with variable intake, an insulin-based regimen may be the most appropriate strategy while in hospital.<sup>39</sup>

### Diabetes in the delivery suite

The management of diabetes in the delivery unit is an area that has received little attention to date. It is estimated that about 5% of all women who become pregnant in the UK have either pre-existing diabetes or develop gestational diabetes during their pregnancy. Recent data has highlighted the lack of knowledge among midwives and a need for further education.<sup>40</sup> While the management of diabetes in

pregnancy is outside the scope of this paper, the management of diabetes at the time of delivery is an important aspect to consider, in particular, because many women with diabetes are given steroids when there is a risk of the baby being delivered early. This can worsen glycaemic control, and it is essential to keep glucose concentrations within an agreed reference range to reduce the risk of neonatal hypoglycaemia.<sup>41,42</sup> Because of the prolonged fasting that women often go through when in labour, there is a rationale to use a variable rate intravenous insulin infusion, however, if used, meticulous attention must be given to the adjustment of the infusion rate in response to no less than hourly blood glucose monitoring to avoid hypoglycaemia. Hypoglycaemia could be avoided by setting a higher lower limit of blood glucose but, as yet, there is no consensus on how low blood glucose concentrations should be maintained to minimise the risk of neonatal hypoglycaemia.<sup>43–45</sup>

### Diabetes on the renal unit

Estimating the overall glycaemic control in people who are undergoing dialysis is difficult because HbA1c is not a useful measurement in this condition due to overestimation from carbamylation of haemoglobin. This can make it difficult to establish good diabetes control in these patients. In addition, rapid fluid changes and the presence of several comorbidities makes the care of people with diabetes on the dialysis unit very challenging.<sup>46</sup> In particular, they often have peripheral vascular disease and are at great risk of developing diabetes-related foot disease.<sup>47</sup> Individuals with chronic kidney disease or on dialysis also have a higher risk of hypoglycaemia and avoidance of hypoglycaemia should remain a priority particularly when they are acutely unwell.

**Table 3. Summary of guidelines for the management of patients with acute coronary syndrome and diabetes**

Society	Recommendations	Level of recommendation where available
AACE/ADA <sup>31</sup>	Target 7.8–10.0 mmol/L most non-critical patients.	Evidence level C
ACC/AHA <sup>32</sup>	Treat hyperglycaemia if >10.0 mmol/L and avoid hypoglycaemia.	Downgraded recommendation for use of insulin from class 1 to class II (evidence level B)
Canadian Diabetes Association <sup>33</sup>	Patients with acute MI and admission glucose >11.0 mmol/L may receive glycaemic control in the range of 7.0–10.0 mmol/L. Insulin may be required to achieve this target.	Grade C level 2 Grade D (consensus)
ESC/EASD <sup>34</sup>	Insulin based glycaemic control should be considered in ACS patients with significant hyperglycaemia (10.0 mmol/L) with the target adapted to possible comorbidities.	Recommendation class IIa, evidence level C
NICE <sup>35</sup>	Keep blood glucose levels below 11.0 mmol/L. Consider intravenous insulin as a method to achieve target.	
SIGN <sup>36</sup>	Patients with ACS and glucose >11.0 mmol/L should have immediate blood glucose control aiming for target of 7.0–10.9 mmol/L.	

AACE = American Association of Clinical Endocrinologists; ACC = American College of Cardiology Foundation; ADA = American Diabetes Association; AHA = American Heart Association; EASD = European Association for the Study of Diabetes; ESC = European Society of Cardiology; NICE = National Institute for Health and Care Excellence; SIGN = Scottish Intercollegiate Guidelines Network.

## Protocol driven management of dysglycaemia

Given the multiple complexities of managing inpatients with diabetes, there are data showing that when protocols are followed, outcomes are improved.<sup>48,49</sup> In the UK, an inquiry into excess deaths at one hospital suggested that one of the causes was an excess in variation in care and therefore any attempt to reduce variations in care across institutions and within institutions is to be welcomed.<sup>50</sup> It is perhaps for this reason that within the UK the JBDS-IP guidelines have been rapidly adopted because, even though they are consensus based, they are recognised as being useful, practical and of good quality.<sup>4</sup>

## Technology and innovation in diabetes

There are, of course, many innovations in the pipeline that may further improve safety, including the use of technology. The use of network glucose monitoring allows diabetes inpatient teams to focus on those individuals who have severe or recurrent hypoglycaemia or hyperglycaemia, thus enabling teams to target limited resources appropriately. The increasing use of electronic prescribing may be one of the factors that has led to a reduction in prescribing errors seen in NaDIA.<sup>2</sup> In addition, the JBDS-IP has for the last few years run an inpatient insulin safety award, named after the former national clinical director for diabetes in England and Wales, Dr Rowan Hillson. These awards have been won by the most useful initiatives using the wider multidisciplinary team, eg the best insulin prescription chart, and the best pharmacy and diabetes team initiative to improve insulin prescribing safety.<sup>51,52</sup> Other categories have been the best digital initiative and the best hypoglycaemia avoidance initiative.<sup>53,54</sup>

The use of closed looped systems in inpatients is a technology currently under development and has shown some promising results.<sup>55,56</sup> There are also data to show that education in insulin prescribing reduces insulin errors.<sup>57</sup> Whether electronic records and electronic prescribing will make a difference to the incidence and prevalence of prescribing errors remains to be seen.

Increasingly, people with diabetes use technology including insulin pumps, continuous glucose monitoring and flash monitoring systems.<sup>58</sup> For the vast majority of people using these technologies, the specialist diabetes team will have provided them with the skills and knowledge on how to use these devices appropriately. However, when admitted to hospital, many staff are unfamiliar with the devices and thus there is a need for them to be aware of these technologies to avoid harm (eg DKA or hypoglycaemia) and potential damage as a result of inappropriate discontinuation in those undergoing surgery or investigations (eg magnetic resonance imaging). Thus, the ability to 'know what you don't know' and then close liaison with the specialist diabetes team is essential.

## Summary and conclusion

There have been some significant strides in improving the care for hospital inpatients with diabetes over the last few years. However, there remains a large amount to do and the data suggest that patient safety is still being compromised. To reduce these risks, the ongoing education of medical and nursing staff, and all other groups involved in the care of patients with diabetes in hospital remains paramount given the increasing prevalence of the condition and its ongoing impact. As part of this, the Care

Quality Commission working with the JBDS-IP is looking at the management of inpatients with diabetes as a marker of quality of care across all aspects of inpatient management. However, ultimately the provision of safe and effective care of the person with diabetes in hospital will rely on the recognition by senior management that, by investing in diabetes inpatient services, there may be a lot to be gained. For non-specialists looking after people with diabetes, there are a number of resources available which, together with communication with the local diabetes teams, should help teams improve the provision of safe and effective care.<sup>24</sup> ■

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