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# Reviewing hospital patients retrospectively following hypoglycaemia prevents further episodes

Naomi Wood, Sally Butter, Jos M Latour

**In 2016, NHS England announced the opportunity for Clinical Commissioning Groups (CCGs) to acquire additional funds to transform diabetes services. Within Somerset CCG, diabetes specialist nurses (DSNs) were recruited with the goal of improving outcomes for inpatients with diabetes. This quality improvement project aimed to evaluate whether next-day follow-up of all inpatients who had an episode of hypoglycaemia, as determined by the hospital connective blood glucose meter, could support inpatients' glycaemic control. Overall, this project was successful as it showed that 50% of inpatients who were reviewed retrospectively following a hypoglycaemic episode required no further diabetes medication changes. It also suggests that the use of connective blood glucose meters is important for clinical practice, as they support DSNs to review appropriate patients in a timely manner, helping to prevent further episodes of hypoglycaemia.**

Nationally, people with diabetes occupy around one in six hospital beds, with 18% of all inpatients with diabetes experiencing hypoglycaemia whilst in hospital (NHS Digital, 2018). With the number of hospital beds occupied by people with diabetes set to rise, management of inpatient diabetes is increasingly important as optimal glycaemic control is associated with better health outcomes (Barnabas et al, 2010). For example, critically ill patients with hypoglycaemia have an increased risk of mortality (Finfer et al, 2011). It is estimated that 9600 inpatients in 2017 required rescue therapy following severe hypoglycaemia that resulted in an unconscious episode (Diabetes UK, 2018). Hypoglycaemia is often mismanaged, leading to prolonged and further multiple episodes (Coats and Marshall, 2013). Therefore, it is vital to focus on hypoglycaemia prevention in hospitalised patients.

In 2016, Somerset Clinical Commissioning Group (CCG) bid for part of the £40 million Transformation Fund announced by NHS England, and in March 2017 it received funding to appoint three Diabetes Specialist Nurses (DSNs) to work in clinical sites across the county, focusing specifically on inpatient care. Once the DSNs were recruited, key performance indicators were established, one of which specifically focused on reduction of inpatient hypoglycaemia. The DSNs were each encouraged to focus on their own improvement ideas to reduce the number of episodes of inpatient hypoglycaemia.

Within Musgrove Park Hospital, part of Taunton and Somerset NHS Foundation Trust, the focus of the DSN was to review all inpatients within 24 hours of a hypoglycaemic episode and, if required, to alter their diabetes medication. This quality improvement project aimed to evaluate whether reviewing daily reports of inpatients' blood glucose values <4 mmol/L, as determined from the

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## Article points

1. Common errors relating to insulin and sulfonylurea prescriptions, as well as unpredictable meal timing and consuming fewer carbohydrates, can pose a risk to inpatients with diabetes and cause hypoglycaemia.
2. This quality improvement project showed that retrospectively reviewing inpatients who develop hypoglycaemia could help to reduce further episodes.
3. The use of connective blood glucose meters may be important for clinical practice, as they support DSNs to review appropriate patients in a timely manner.

## Key words

- Hypoglycaemia
- Inpatient care
- Insulin

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### Transforming healthcare professional diabetes education to improve patient safety outcomes

Winner of the 2018 Rowan Hillson Inpatient Safety Award, the Inpatient Training and Support (ITS) Diabetes programme is a blended educational toolkit designed to deliver key safety messages to frontline ward staff in order to improve quality of care for adult inpatients with diabetes. This article describes the content of the toolkit and discusses accessibility for healthcare professionals across an NHS Trust in Leicestershire.

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hospital connective blood glucose meter, would improve inpatients' glycaemic control by reducing the risk of repeated hypoglycaemia.

## Method

### Research ethics

The reported project is a quality improvement project. Governance was supported by the Quality Improvement team at Taunton and Somerset NHS Foundation Trust, Musgrove Park Hospital.

### Background

Prior to this project, patients in the hospital were reviewed by the DSN after an online referral form had been completed by ward staff, based on the Think Glucose traffic light system (NHS England, 2011). This system was introduced to ensure appropriate referrals of inpatients to the diabetes team. The Think Glucose traffic light system was designed to give nursing and medical staff a structured decision tool to refer patients to the DSN (Ryder et al, 2014). Once a referral was received, the DSN would make a ward-based visit to assess the patient and alter diabetes medications if required.

### Quality improvement intervention

A quality improvement intervention was initiated with a philosophy of changing from passively waiting for referral to actively seeking out patients with hypoglycaemia, defined as a capillary blood glucose (CBG) <4 mmol/L. Innovative ideas were initially discussed amongst the DSN and Quality Improvement teams in the hospital. The Quality Improvement team helped to provide the DSNs with a structured plan to focus on a key strategy. The plan was to use the StatStrip connective blood glucose meter system (Nova Biomedical UK, Runcorn, Cheshire), overseen by the point-of-care team, to highlight all inpatients with a CBG <4 mmol/L.

### Data collection method

The Nova Biomedical point-of-care team was asked to allow the DSNs access to the connective system whereby a report could be generated daily at 08:00 hours. At this time point, the DSN was able to review all patients in the hospital who had a CBG <4 mmol/L in the previous 24 hours. All reports from the connective glucose meter system

were saved onto an Excel database accessible only via a secured hospital drive. Data on the spreadsheet consisted of each patient's name, unique hospital number, location, and date and time of the hypoglycaemic episode. Once the report was generated, the inpatients were triaged by looking at their electronic notes and recent HbA<sub>1c</sub> results to assess whether they had diabetes and their level of diabetes control.

Once the relevant information was gathered, the DSN would review the patient on the ward within 24 hours. This review was to identify possible causes of the hypoglycaemia and to make alterations in diabetes medication if required. If changes were necessitated, they were either made immediately by one of the DSN non-medical prescribers, or recommendations were made to the doctors if the DSN was not able to prescribe. If changes were made, the Excel database was updated with the patients' new diabetes medication regimens.

Between January 2018 and January 2020, DSN visits were carried out on weekdays following the reports of a CBG <4 mmol/L. For this analysis, out of all inpatients who had a reported CBG <4 mmol/L, a convenience sample was chosen by looking at the first 10 patients who had an episode of hypoglycaemia in each quarterly period over the two years. This resulted in a purposive sample of 80 people. Reviewing this sample, 58 inpatients were seen within the next day by a DSN, whereas 22 were not reviewed the next day due to the hypoglycaemic episode occurring on a weekend. The data of these patients were excluded from the analysis. The quality improvement intervention was not initiated on the maternity and paediatrics wards.

## Results

### Medications

Of the 58 inpatients seen, 40 were on subcutaneous insulin, five on an intravenous insulin infusion, seven on a sulfonylurea (SU), two on metformin and four on a combination of diabetes medications, such as metformin, insulin, SU and dipeptidyl peptidase-4 (DPP-4) inhibitors (*Figure 1*).

### Insulin and oral medication adjustments following hypoglycaemia

Following the review, the predominant changes made were to inpatients on insulin monotherapy or

dual therapy. Most changes involved dose reduction ( $n=29$ ). Three inpatients self-titrated their own insulin and two had their prescription timings changed (Figure 2). The five inpatients receiving intravenous insulin had no changes made on the initial visit.

For those on oral medications, 11 had medication changes, of which six were SU dose reductions and three were SU discontinuation (Figure 2).

### Number of follow-up reviews

Of the 58 inpatients seen by the DSNs for an initial episode of hypoglycaemia, 31 were seen again by the DSN in a follow-up visit, while 26 required no further review and one was under consultant care. Of the 31 inpatients who received follow-up visits, 25 were seen for subsequent hypoglycaemia, four were seen for hyperglycaemia and two had a follow-up visit where no changes were required.

Of the 25 inpatients seen for subsequent hypoglycaemic episodes who were taking insulin, 17 required further insulin reductions, three had their insulin regimen changed, one had their mealtime insulin corrections altered and one was self-adjusting their insulin. Of the three patients who were on oral medication alone or combined with insulin, one had their metformin discontinued, one had the SU discontinued and one had the insulin and SU discontinued.

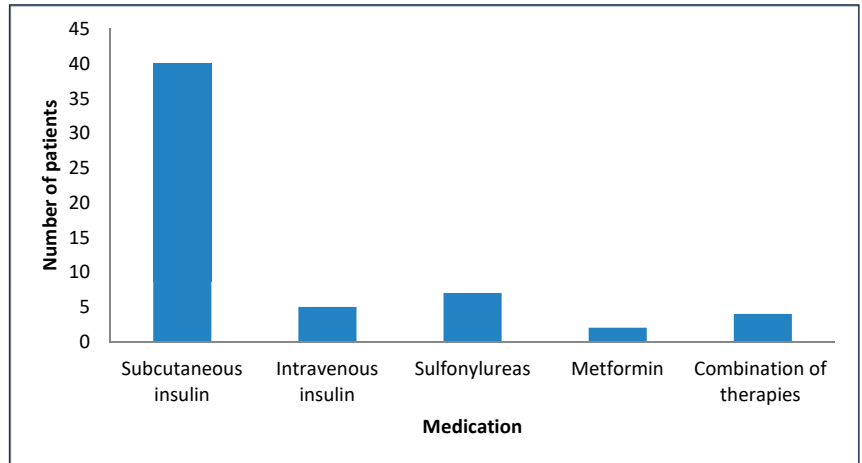


Figure 1. Medication breakdown for diabetes inpatients experiencing hypoglycaemia.

Of the four inpatients who were seen again for hyperglycaemia, two had oral diabetes medication initiated, one had their insulin increased following improved appetite and one required a change in insulin regimen.

### Discussion

Insulin therapy is often the preferred choice of diabetes medication to treat inpatients with hyperglycaemia (Shomali, 2011). During this project, 45 inpatients who were prescribed either intravenous or subcutaneous insulin as monotherapy were seen following an episode of hypoglycaemia. Figures from the 2016 National Diabetes Inpatient

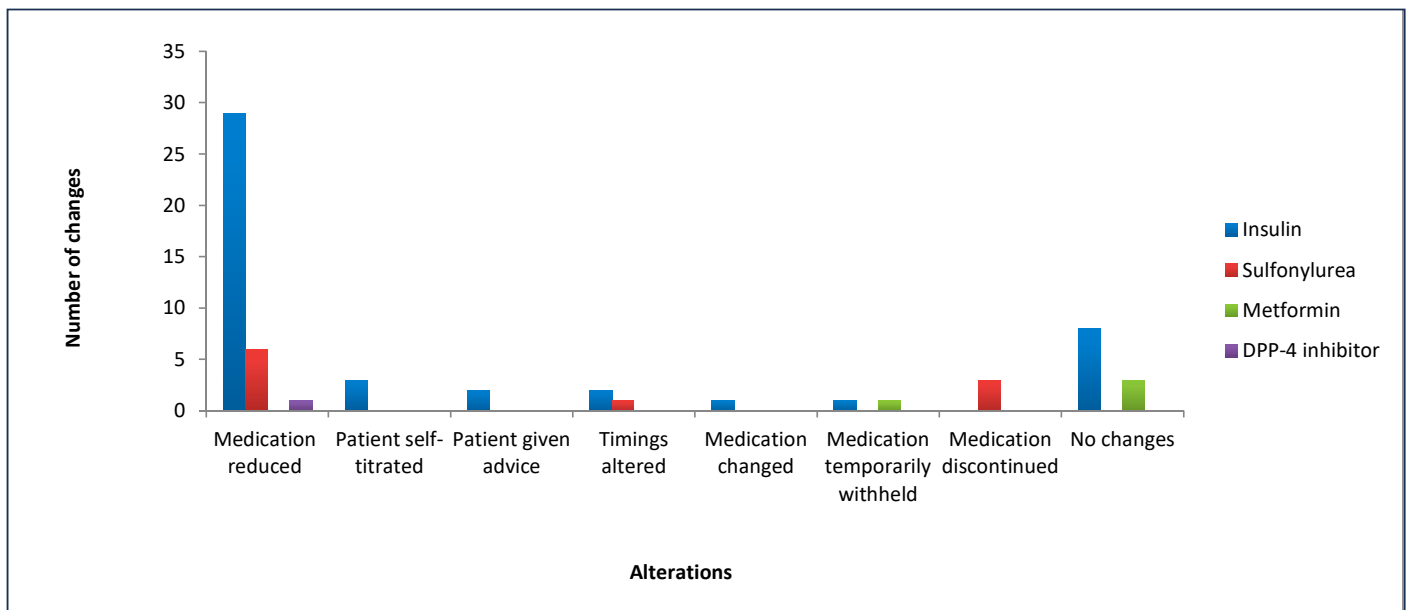


Figure 2. Medication changes and alterations. DPP-4=dipeptidyl peptidase-4.



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Martha Stewart creates a resource for nurses, nursing assistants and students to provide education in the busy clinical environment.

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Audit showed 27% of inpatients with type 1 diabetes had a severe episode of hypoglycaemia (Diabetes UK, 2017). Although during this project inpatients were not categorised into types of diabetes, those on insulin had significantly more episodes of hypoglycaemia, suggesting that a greater emphasis on other clinical factors should be considered before intensifying glucose management (Gosmanov, 2016). Diabetes medications such as metformin, pioglitazone, DPP-4 inhibitors, acarbose, sodium–glucose cotransporter 2 inhibitors and glucagon-like peptide-1 receptor agonists are less likely to cause hypoglycaemia, unless prescribed in combination with insulin or SUs (Joint British Diabetes Societies for Inpatient Care, 2018), which was reflected in this project.

Common errors relating to insulin and SU prescriptions, as well as unpredictable meal timing and consuming fewer carbohydrates, can pose a risk to inpatients and cause hypoglycaemia (Shomali, 2011). Medication timings for three inpatients in the project sample were altered due to timing errors. If we assume that our error rate is similar to the 31% identified in the 2017 National Diabetes Inpatient Audit (NHS Digital, 2018), this indicates that timing of doses was not a large cause of hypoglycaemia in our patient population.

This project did not focus on meal timings and the impact of inpatients consuming fewer carbohydrates but rather concentrated on reviewing inpatients retrospectively. Other studies have taken a more proactive approach and introduced bedtime snacks to prevent nocturnal hypoglycaemia. Kalergis et al (2003) found that in the absence of a bedtime snack, only a blood glucose level >10 mmol/L at bedtime was protective against nocturnal hypoglycaemia between 23:00 and 07:00 hours. The timings of hypoglycaemia were also looked at in the present project. Overall, 67 inpatients experienced a CBG <4 mmol/L in the day (between 06:00 and 22:00 hours), while only 13 hypoglycaemic episodes occurred between 22:00 and 06:00 hours. Our project could have put more focus on addressing nocturnal hypoglycaemia, but this would not have addressed the majority of episodes.

The diabetes nursing team consists of a mixture of non-medical prescribers and non-prescribers. When recommendations were made

by a non-prescriber, the diabetes nurse in question did not always follow up on whether the actions were taken. A study by Murray et al (2018) found that 67% of inpatients needed diabetes medication alterations based on a blood glucose level <4 mmol/L. We had similar results in our quality improvement project. However, 32% of the diabetes treatment in that study remained unchanged prior to discharge (Murray et al, 2018). This could highlight the need for all DSNs to be non-medical prescribers in order to make changes in diabetes medication at the point of contact.

**Conclusion**

This quality improvement project showed that reviewing inpatients retrospectively could help to reduce further inpatient hypoglycaemia. Overall, 33 inpatients (56.9%) required no further input for hypoglycaemia, with only four requiring subsequent medication intensification due to hyperglycaemia following initial changes made for hypoglycaemia.

Future improvement projects may place more emphasis on reviewing all patients within 24 hours of a hypoglycaemic episode. This could be achieved with the introduction of weekend working of the DSNs. ■

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