JBDS-IP Joint British Diabetes Societies for inpatient care

Joint British Diabetes Societies for In-Patient Care (JBDS-IP)

The Rowan Hillson Inpatient Safety Award 2017
Improving Inpatient Diabetes Safety: Best Digital Initiative

How to enter:

1. Email your completed entry to: Christine Jones, JBDS Administrator at christine.jones@nnuh.nhs.uk

   All entries must be emailed by: 28.02.17

2. Please submit any supplementary materials to support your initiative, as these will be considered as part of the judging process.

3. **Please note this competition is only for projects undertaken in the last 3 years i.e. since 1.1.2014.**

Your contact details:

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Trust name and address where work was undertaken: King's Insulin Safety Group, King's College Hospital NHS Foundation Trust, London

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Title of entry (10 words maximum)

Preventing hypoglycaemia following treatment of hyperkalaemia in hospitalised patients

Brief summary of entry

Provide a short summary of your initiative in **no more than 200 words (The box will expand)**

Hyperkalaemia is common in hospitalised patients with an estimated prevalence of over 10%. Hypoglycaemia following hyperkalaemia treatment with insulin and dextrose is a frequently observed complication. We implemented a hyperkalaemia treatment care bundle to ensure prescription of both insulin and dextrose together and to ensure capillary blood glucose monitoring was undertaken following hyperkalaemia treatment. This led to a significant reduction in hypoglycaemia from 30% to 12% (P<0.05) and an increase in the frequency of capillary blood glucose monitoring from 32% to 92%.

We subsequently analysed over 1000 electronic patient records over a two year period to determine the incidence of hypoglycaemia following this intervention and to establish risk factors for hypoglycaemia.

During this analysis we noted that despite the orderset, almost one third of prescriptions did not have any dextrose prescribed. We have now adjusted the orderset so that insulin is added to a 20% dextrose solution vial to further improve safety of administration.

We have also used the risk factors identified in our dataset; older age, lower weight and pre-treatment capillary blood glucose to design a decision support tool for personalised prescriptions for high risk individuals and we plan to implement this in due course.

Background/Situation analysis/Innovation (300 words maximum)

Briefly provide the background and rationale for the initiative. From this the judges should be able to understand why there was a need for the initiative to be undertaken. Explain what makes your initiative innovative or pioneering.

Hyperkalaemia is common in hospitalised patients with an estimated prevalence of 1-10% although the actual prevalence is likely greater with increased use of ACE inhibitors and Angiotensin-2 receptor blockers in recent years. Hyperkalaemia can be life-threatening (cardiac arrhythmias) and is associated with increased in-hospital and all-cause mortality.

Management is based on consensus and expert opinion. Insulin activates the sodium/potassium ATP-pump leading to intracellular shift of potassium. Dextrose is used to prevent hypoglycaemia. However, hypoglycaemia is common following insulin/dextrose treatment for hyperkalaemia but the reported incidence varies from 8-75% depending on the population studied, doses of insulin/ dextrose used and the definition of hypoglycaemia.

Inpatient hypoglycaemia occurs in 0.5-1.5% of inpatients and more than 50% of hypoglycaemia episodes in hospital occur in people without diabetes. Hypoglycaemia itself is associated with increased length of stay, increased inpatient and 1-year mortality

Following a serious adverse event (and other adverse events) in which a patient had severe hypoglycaemia after hyperkalaemia treatment and then subsequently had an acute cardiac event, King's College Hospital multidisciplinary insulin safety group implemented a new care

bundle to ensure insulin and dextrose are administered together and compulsory capillary blood glucose monitoring is carried out. This led to a significant reduction in the incidence of hypoglycaemia and an improvement in frequency of capillary blood glucose monitoring.

We assessed the impact of this intervention examining 1174 episodes of hyperkalaemia treatment over 2 years. We further amended the orderset in response to the fact that 37% of hyperkalaemia episodes were treated with insulin but no dextrose. The adjusted orderset prescribes insulin Actrapid to be added to a dextrose solution vial.

Risk factors for hypoglycaemia in our dataset have been used to develop a decision support tool to further improve the safety of insulin prescriptions for hyperkalaemia.

Objectives (200 words maximum)
State clearly the objectives of the initiative(s).

The aim of this series of initiatives was to improve patient safety by reducing hypoglycaemia following the administration of insulin/dextrose for the purpose of treating hyperkalaemia in all patients (with or without diabetes). Hypoglycaemia is not always considered as a complication of hyperkalaemia treatment at the time of prescribing or by those administering this treatment. Hyperkalaemia treatment is frequently prescribed to patients without diabetes and therefore capillary blood glucose is often monitored infrequently or not at all in these patients.

The objective of the care-bundle was to both provide a safer prescription for insulin administration in this common clinical scenario in order to reduce the incidence of this complication and to raise awareness of the risk of hypoglycaemia following hyperkalaemia treatment with insulin in order that the impact of human factors may also be addressed.

Project plan/methods (400 words maximum)
Please outline the method(s) you used to achieve your objectives. The judges will also be looking for a clear rationale for your method(s).

We undertook a retrospective analysis of Electronic Patient Records from 01/01/2013 to 20/03/2017 and extracted all those in which there was treatment of hyperkalaemia with insulin and dextrose. We excluded those prior to May 2015 as the care bundle was implemented in April 2015. A further 435 were excluded as despite the orderset, 20% dextrose was not prescribed or administered. Sixty-three episodes were excluded as there was no record of any capillary blood glucose measurements in the six hours following insulin/dextrose treatment

This left 662 episodes of hyperkalaemia treatment which occurred over 445 admissions in 415 individuals reflecting multiple treatments in individual patients. We established the incidence of hypoglycaemia (≤3.9mmol/l) and the incidence of severe hypoglycaemia (≤2.2mmol/l) in this cohort.

In order to establish the risk factors for hypoglycaemia, we compared the characteristics of

those with and without hypoglycaemia. We then used this data and the correlation between the risk factor and the lowest capillary blood glucose following insulin/dextrose treatment to design a decision support system to highlight those at higher risk of hypoglycaemia (due to the presence of risk factors determined from our dataset). The prescription for these high risk individuals uses more dextrose 30g v 20g in lower risk individuals.

Evaluation and results (400 words maximum)
Use this section to report the results and demonstrate how you measured the success of your initiative/project

The initial implementation of the care-bundle was audited for one month immediately after its introduction and resulted in a significant reduction in hypoglycaemia from 30% to 12% ($P<0.05$). There was also a large increase in the frequency of blood glucose monitoring from 32 to 92%.

When we looked over a longer (2 year) period to determine the durability of this intervention. This improvement in hypoglycaemia was sustained with an overall incidence of 17.5%. The frequency of capillary blood glucose monitoring was also maintained at 91.4%.

However in our large dataset of hyperkalaemia episodes, we were also able to refine the care bundle in response to the fact that over one third of prescriptions had dextrose omitted from the order-set. We were able to examine whether there was any clinical reason for this decision such as baseline hyperglycaemia or increased prevalence of diabetes however no plausible explanation as found. We therefore adjusted the care bundle to ensure that both insulin and dextrose are given by prescribing insulin within a 20% dextrose solution.

Our evaluation also allowed us to identify risk factors for hypoglycaemia and use these to develop personalised prescriptions for those at high risk of hypoglycaemia. Our dataset demonstrated that lower pre-treatment capillary blood glucose, lower weight and older age were all associated with increased risk of hypoglycaemia (Table 1). The best correlation was observed with the pre-treatment capillary blood glucose level (Figure 1).

	No Hypo (n= 546)	Hypo ≤ 3.9mmol/l (n=116)	P
Age on admission (years)	67.0 (55.0-77.0)	71.0 (54.8-83.5)	0.023
Female gender, n (%)	215 (38.7)	45 (39.3)	0.907
Weight (kg)	81.0 (63.1-96.0)	66.1 (55.4-72.5)	<0.001
Diabetes, n (%)	178 (32.6)	28 (24.1)	0.074
Creatinine (μmol/l)	168 (113-255)	156 (112-271)	0.727
eGFR (ml/min/1.73m^2)	29.5 (19.0-46.0)	29.0 (17.0-41.0)	0.722
Renal Replacement Therapy, n (%)	58 (10.6)	15 (12.9)	0.472
Insulin in previous 24h, n (%)	348 (63.7)	57 (49.1)	0.003
SU in previous 24h, n (%)	52 (9.5)	7 (6.0)	0.232
Pre-treatment CBG (mmol/l)	8.7 (6.4-11.4)	5.8 (5.0-7.3)	<0.001

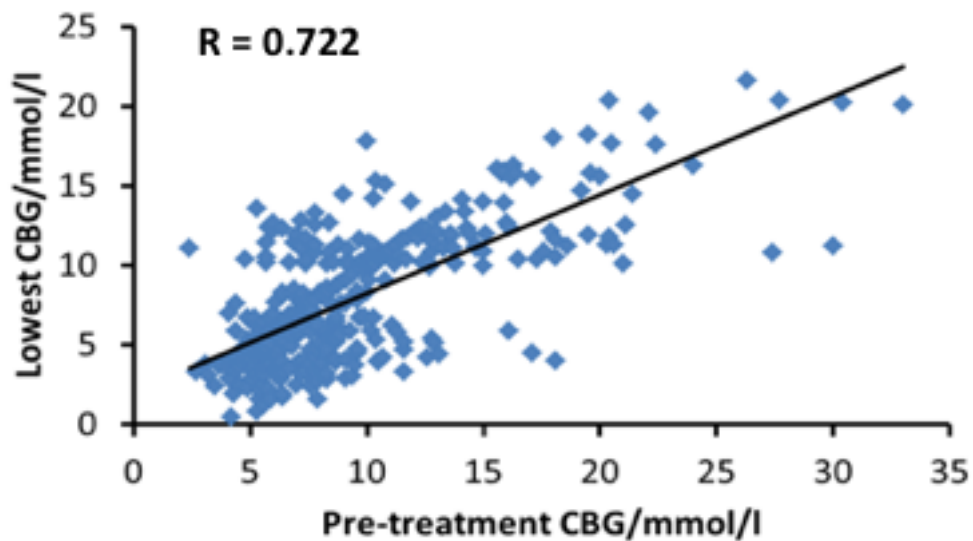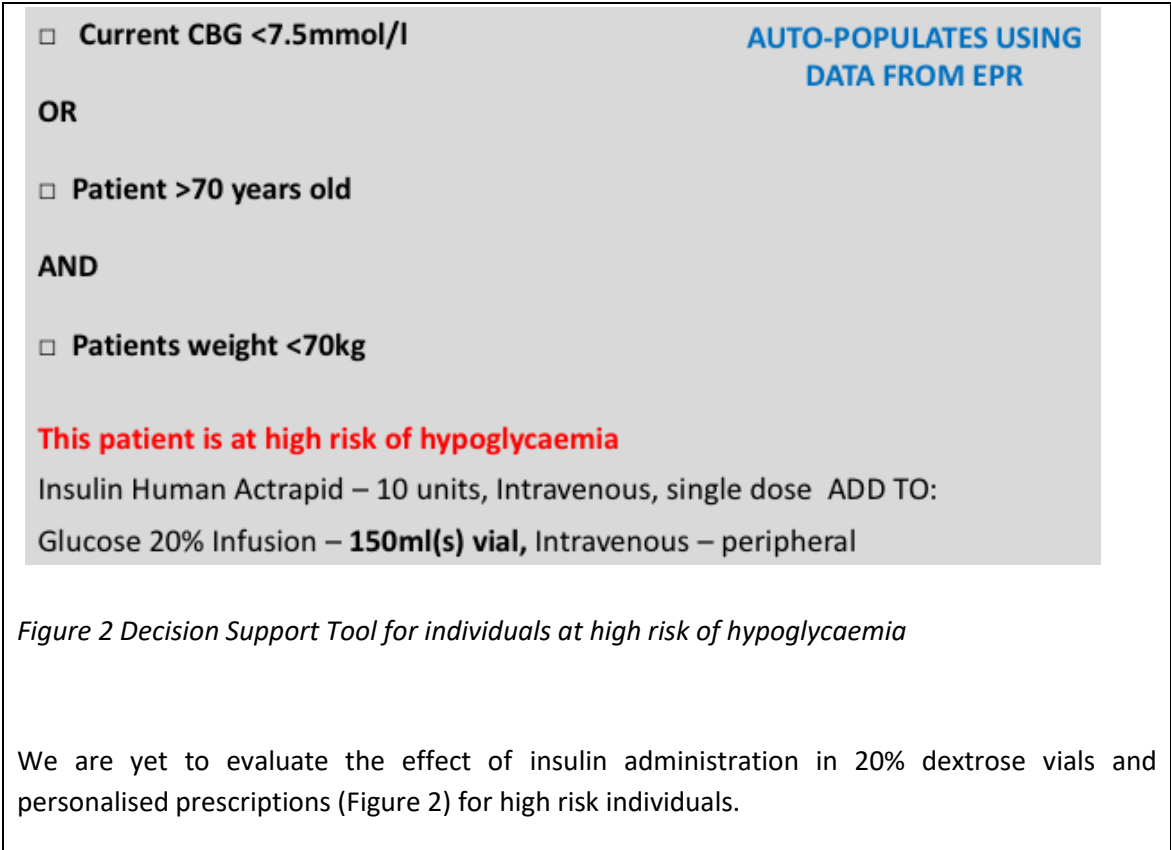*Table 1. Risk Factors for hypoglycaemia following hyperkalaemia treatment*

Figure 1. Correlation between pre-treatment capillary blood glucose and lowest blood glucose within 6 hours of insulin/dextrose treatment.

☐ Current CBG <7.5mmol/l

OR

☐ Patient >70 years old

AND

☐ Patients weight <70kg

AUTO-POPULATES USING DATA FROM EPR

This patient is at high risk of hypoglycaemia

Insulin Human Actrapid – 10 units, Intravenous, single dose ADD TO:

Glucose 20% Infusion – **150ml(s) vial,** Intravenous – peripheral

Figure 2 Decision Support Tool for individuals at high risk of hypoglycaemia

We are yet to evaluate the effect of insulin administration in 20% dextrose vials and personalised prescriptions (Figure 2) for high risk individuals.

Impact (300 words maximum)
Describe the impact of the initiative(s) for inpatients with diabetes and how this was measured.

This initiative has reduced the incidence of hypoglycaemia from 30% to 17.5% (sustained over 2 years after the implementation of the bundle) in our hospital following hyperkalaemia treatment. It has the potential to reduce length of stay in this relatively frail and comorbid population. As this was an observational study we cannot assume causality however those with hypoglycaemia following hyperkalaemia treatment had a much longer length of stay than those without hypoglycaemia although this did not achieve statistical significance (19.2 v 27.5 days).

The initial implementation of the care-bundle was audited for one month immediately after its introduction and there was large increase in the frequency of blood glucose monitoring from 32 to 92%. The frequency of capillary blood glucose monitoring was also maintained at 91.4% in the following 2 years which is important in improving the safety of monitoring of the therapy and subsequently enhance the early detection of hypoglycaemia with potential for prevention of hypoglycaemia.

With our personalised prescription for individuals at high risk of hypoglycaemia we hope to further reduce the incidence of hypoglycaemia while at the same time minimising hyperglycaemia using patient-centred precision approach.

Adaptability, Cost and Sustainability (300 words maximum)
How easily could your initiative(s) be adapted to other hospital Trusts? Please state whether any other Trust(s) has adapted your initiative(s) and/or any steps you have taken to promote wider dissemination of your initiative(s).

Please demonstrate the sustainability of your initiative(s). Include the cost incurred and the source of funding i.e. acute trust or CCG or any other means. Describe the process by which the funding has been sought and the challenges experienced.

Although our initiative has utilised an electronic prescribing system, which is being increasingly adopted in hospitals, this can be adapted for use in other electronic prescribing systems. We feel the principles we have learnt can also be applied to paper-based prescribing charts.

Care bundles are frequently used in other clinical areas with good efficacy, safety and utility. Generation of a care bundle is a cheap and sustainable safety intervention provided the appropriate stakeholders are involved in its creation highlighting the importance of the multidisciplinary team.

Prescribing insulin added to a a 20% dextrose solution vial can be done in any hospital setting and just requires a change in local guidelines. Prescriptions for specific glucose monitoring requirements are widely adopted for patients with diabetes and those receiving steroid therapy and can be applied to this specific clinical scenario.

In recognition of the importance of human factors in insulin safety, education around the potential for hypoglycaemia following hyperkalaemia treatment needs to be targeted to prescribers (doctors) and those administering the medication (nurses). However, also highlighting this via electronic prescribing by identifying risk factors and individuals at high risk of this complication reduces the cost associated with repeated education and improves the sustainability but likely both approaches need to be undertaken.

This work has been presented to a wider audience at Diabetes UK Professional Conference at two stages of its development. We plan to publish this work in a peer-reveiwed journal with a focus on hospital medicine in order to disseminate our experiences more widely.

Due to the intervention being designed by a multidisciplinary team and quick to implement due to the electronic prescribing system, it was cost neutral.

Learning (300 words maximum)
One of the main aims of the competition is to enable learning and sharing of initiatives for the benefit of inpatients with diabetes. Use this section to outline any learning(s) that can be taken from the initiative(s) and/or challenges faced along the way that could be transferred to other Trusts looking at introducing similar initiatives.

Despite the improvements in both hypoglycaemia incidence and frequency of capillary blood glucose monitoring following our initial initiative, we noticed that implementing a safer electronic prescription did not eliminate all insulin prescribing errors. One third of episodes

of hyperkalaemia treatments did not have any dextrose prescribed or administered and 8.6% of hyperkalaemia episodes did not have any capillary blood glucose monitoring following treatment.

This highlights the importance of human factors and we learnt that in addition to this initiative around electronic prescribing, education around insulin prescribing and its risks along with investigation and understanding of the reason behind insulin prescribing errors is key to changing behaviours. The lessons from diabetes-related incidents have been integrated into a high-fidelity multiprofessional simulation in diabetes and endocrinology currently run at King's College Hospital. The learning from this project during implementation was disseminated across the Trust using the local intranet and safety newsletters (SureMed).

We also adjusted our orderset in response to the data to reduce the occurrence of dextrose omissions and further improve safety by ensuring insulin Actrapid is co-administered by adding it to a i 20% dextrose solution vial.

Feedback from staff and patients (300 words maximum)

Please include a summary of any patient feedback and evaluations of the initiative(s). It will be helpful if you can provide (as supporting materials) the tools used to gather this information. If available please include summary of staff feedback to demonstrate their perspective on the initiative(s)' impact on the care of inpatients with diabetes in relation to improved insulin and prescribing safety.

This initiative has been designed and implemented by a multi-disciplinary team including pharmacists, IT staff, nurses and doctors. The input from these different disciplines has been essential in ensuring the utility of the initiative and the success of implementation. Another important factor in its success was the ability to rapidly prototype solutions to day-to-day inpatient insulin prescribing problems by having all stakeholders involved including in-house IT/electronic prescribing and direct involvement of patient risk and medication safety.

It has been presented locally at the medication safety and diabetes & endocrinology governance committees and the King's Health Partners Safety Connections event (won first prize for innovation and impact).

It has also been presented nationally at the Diabetes UK Professional Conference in 2016 and 2018 at two different stages in its development with positive feedback.

Supporting materials

The judges' core assessment of your initiative will be based on this entry form. However, we do recommend that you **_support your entry_** with relevant materials, as these will be made available to the judges and are often the deciding factor in short listing the finalists.

Supporting materials could include: IT based programmes, pamphlets, booklets, audits, events, reports, journal articles, evaluation documentation, websites etc.

Supporting materials along with your entry form should be submitted by email to christine.jones@nnuh.nhs.uk.

<u>Closing date: 28.02.2018</u>

The winners of the Rowan Hillson Insulin Safety Award 2017: Improving Inpatient Diabetes Safety: Best Digital Initiative will be published on the Association of British Clinical Diabetologists (ABCD), Diabetes UK and DISN UK Group websites and will appear and be referred to in future journal articles. By submitting your entry, you will be consenting to your initiative being used for these purposes.