Impact of a DISN on hypoglycaemia-related hospital admissions

Karen Perkins, Susan Edwards, Sravan Thondam, Franklin Joseph, David Ewins, Niru Goenka

Hypoglycaemia is the most common reason for people with diabetes to attend the accident and emergency (A&E) department, and is associated with a negative impact on metabolic control, quality of life and subsequent health outcomes. In 2006 the authors established an inpatient DSN (DISN) outreach service for the A&E department at their institution, which was audited by collecting data for people with a coded diagnosis of hypoglycaemia (for 2004, 2006 and 2008). There was a year-on-year increase in the number of people presenting to A&E with hypoglycaemia, resulting in greater numbers of people seen by DISNs. However, despite this increase in A&E attendances, there was no simultaneous increase in the number of hypoglycaemia-related hospital admissions, although there was a corresponding increase in people who attended A&E more than once with hypoglycaemia. These data show that increasing DISN provision to A&E departments prevents admission of people with hypoglycaemia; however, this strategy may increase the likelihood of recurrent A&E attendances.

Hypoglycaemia is a side-effect of certain blood glucose-lowering therapies, particularly insulin, although it also occurs as a side-effect of sulphonylurea (SU) therapy (Campbell, 1985; Leese et al, 2003; Bolen et al, 2007), and can be precipitated by factors such as increased alcohol consumption, reduced food intake and concurrent illness.

The DCCT (Diabetes Control and Complications Trial; DCCT Research Group, 1993) in type 1 diabetes and the UKPDS (UK Prospective Diabetes Study; Holman et al, 2008) in type 2 diabetes demonstrated that tight glycaemic control results in a reduced risk of diabetes-related complications. However, in the DCCT there was a three-fold increase in the risk of hypoglycaemia in the intensive control arm compared with the conventional arm (DCCT Research Group, 1993), and similarly, rates of hypoglycaemia were significantly higher in the intensively controlled arm of the UKPDS (UKPDS Group, 1998). These studies demonstrated that tight glycaemic control with insulin or SU therapy was associated an increased risk of hypoglycaemia.

Article points

1. Hypoglycaemia is the most common reason for people with diabetes to attend an accident and emergency (A&E) department.
2. Improved liaison between diabetes inpatient specialist nurses and A&E results in reduced hospital admissions for hypoglycaemia.
3. Care must be taken to individualise glycaemic control based on an individual's specific circumstances rather than taking a strict target-based approach.
4. These interventions can potentially provide improved health outcomes for people with diabetes by avoiding hypoglycaemia-related admissions and prove to be cost-effective for PCTs.

Key words

- Admissions
- Diabetes inpatient specialist nurse
- Hypoglycaemia
- Inpatient care

Author details can be found at the end of this article.

Page points

1. Hypoglycaemia is the most common reason for people with diabetes to attend an accident and emergency (A&E) department.
2. Hypoglycaemia is associated with considerable NHS resource use as it results in increased ambulance call-outs, A&E attendances and hospital admissions.
3. In 2006, the authors had the opportunity to improve the diabetes outreach service to the A&E department by increasing provision of diabetes inpatient specialist nurses and ensuring proactive follow-up of people admitted to hospital with hypoglycaemia.
4. Data were collected for people with diabetes who presented to the A&E department of the Countess of Chester NHS Foundation Trust with hypoglycaemia for the years 2004, 2006 and 2008.

These findings have since been confirmed in more recent studies, including ACCORD (Action to Control Cardiovascular Risk in Diabetes; ACCORD Study Group et al, 2008), ADVANCE (Action in Diabetes and Vascular Disease: Preterax and Diamicron MR-Controlled Evaluation; ADVANCE Collaborative Group et al, 2008) and VADT (Veterans Affairs Diabetes Trial; Duckworth et al, 2009), in which an aggressive approach to achieving tight glycaemic control resulted in an increase in the number of people experiencing hypoglycaemia.

Hypoglycaemia is also the most common reason for people with diabetes to attend an accident and emergency (A&E) department (Holmwood et al, 1992; Goyder et al, 1997). These individuals only make up a small proportion of the total number of people with diabetes who have severe hypoglycaemic episodes as most cases are managed at home by carers (Potter et al, 1982; Frier, 1993; Hart and Frier, 1998; Leese et al, 2003).

Hypoglycaemia results in a significant negative impact on metabolic control, quality of life and subsequent health outcomes (Campbell, 1985; Davis et al, 2005; Lundkvist et al, 2005). It is also associated with considerable NHS resource use as it results in increased ambulance call-outs, A&E attendances and hospital admissions (Holstein et al, 2002; Lundkvist et al, 2005). Most cases of hypoglycaemia that present to the A&E department are managed without involvement of the diabetes specialist team (Daniels et al, 1999).

In 2006, the authors had the opportunity to improve the diabetes outreach service to the A&E department by increasing provision of diabetes inpatient specialist nurses (DISNs) and ensuring proactive follow-up of people admitted to hospital with hypoglycaemia. The impact of this service was audited to establish its effectiveness.

Methods

The Countess of Chester NHS Foundation Trust is a medium-sized district general hospital serving a population of approximately 14 000 people with diabetes. In 2004, a previous departmental audit demonstrated only sporadic contact of DISNs with inpatients presenting to the A&E department with hypoglycaemia, with approximately only one quarter having any contact. Therefore, in 2006, a diabetes outreach service for the A&E department was established. People with diabetes who attended the A&E department with hypoglycaemia were rapidly assessed by a DISN between the hours of 9–5 pm, Monday to Friday. People with diabetes presenting to A&E with hypoglycaemia outside of these times were contacted by the DISN using letters and telephone calls to ensure proactive follow-up.

The interventions used by the DISN included patient education together with adjustment of diabetes-related medications when necessary. The education provided fell into three broad categories – prevention, identification and treatment of hypoglycaemia – with the aim of improving the person's own awareness to reduce the incidence of hypoglycaemia. Where appropriate, literature was also provided to support the advice given to individuals with diabetes.

Data were collected for people with diabetes who presented to the A&E department of the Countess of Chester NHS Foundation Trust with hypoglycaemia for the years 2004, 2006 and 2008. These individuals were identified by searching the hospital IT system for people with diabetes who had presented to A&E and were coded as having hypoglycaemia. These data were collected from both the A&E department and nursing and medical notes.

SPSS version 13.0 for Windows was used for all data analyses. The data were first subjected to testing for normality, following which any non-parametric data were subjected to logarithmic conversion. An analysis of variance was used to compare means between the groups. Statistical significance was taken at the 5% level ($P<0.05$).

Results

There was a year-on-year increase in the number of people with diabetes presenting to A&E with hypoglycaemia, which resulted in a progressive

increase in the number of people seen by DISNs (*Table 1*). Despite the increase in A&E attendances, there was no simultaneous increase in the number of people admitted to hospital with hypoglycaemia; there were no more in 2008 (six admissions) than in 2004 (seven admissions). There was a small increase in the number of people with diabetes who attended A&E more than once with hypoglycaemia (two people in 2004 vs seven in 2008).

Each year, people admitted to hospital with hypoglycaemia had significantly lower mean HbA_{1c} levels ($P<0.0001$; *Table 1*) than the previous year. From 2004 to 2006, there was also a significant increase in the use of oral antidiabetes drugs (OADs), insulin, and combinations of insulin and OADs among people presenting to the A&E department with hypoglycaemia (*Table 2*).

The average age of the people presenting to A&E with hypoglycaemia increased between 2004 and 2006 ($P=0.018$), however the ages of those attending A&E in 2006 and 2008 did not significantly differ. Individuals admitted to hospital with hypoglycaemia were predominantly male (*Table 1*).

The factors precipitating hypoglycaemia varied from person to person. These included reduced food intake, increased alcohol consumption, increased activity, concurrent illness, impaired renal or hepatic function, and incorrect dose or time of treatment taken for their diabetes. Each cause was discussed on an individual basis with the person and followed with appropriate education and medication adjustment.

Discussion

The present study demonstrates the effectiveness of improving the liaison between DISNs and the A&E department in preventing hospital admissions of people with hypoglycaemia.

There was no rise in the number of hypoglycaemia-related hospital admissions from 2004 to 2008 despite increasing numbers of A&E attendances.

Previous research has shown that the management of people presenting to A&E with hypoglycaemia is of a variable standard and that this population is inadequately educated about the causes and management of hypoglycaemia (Brackenridge et al, 2006). The fact that these were the precise issues that were targeted by the DISNs may explain the improvements seen in the present study.

The results also show that an unintended consequence of admission avoidance for these people may have been an increased risk of recurrent attendance to A&E, i.e. that admission avoidance may not have been the best course of action for a few people with diabetes who then would have re-presented and were then better managed with a short inpatient

Page points

1. Each year, people admitted to hospital with hypoglycaemia had significantly lower mean HbA_{1c} levels ($P<0.0001$) than the previous year.
2. From 2004 to 2006, there was a significant increase in the use of oral antidiabetes drugs (OADs), insulin, and combinations of insulin and OADs among people presenting to the accident and emergency (A&E) department with hypoglycaemia.
3. There was no rise in the number of hypoglycaemia hospital admissions from 2004 to 2008 despite increasing numbers of A&E attendances.

Table 1. People who were coded as presenting to A&E with hypoglycaemia in 2004, 2006 and 2008.

Year	Number of people presenting to A&E with hypoglycaemia	Mean age (years) ±SEM (range)	Sex	Type of diabetes	Mean HbA_{1c} (%) ± SEM (mmol/mol)	Number of people presenting with hypoglycaemia who were seen by DISNs
2004	37	43.7±2.6 (16–82)	M=23 F=14	Type 1=19* Type 2=15*	9.3±0.35 (78±3.8)	9 (24.3%)
2006	71	55.7±3.1 (19–89)	M=41 F=30	Type 1=39* Type 2=27*	8.6±0.24 (70±2.6)	21 (29.5%)
2008	97	52.3±2.8 (17–84)	M=63 F=34	Type 1=51* Type 2=43*	7.7±0.16 (61±1.7)	41 (42.2%)

* The total number of people with type 1 and type 2 diabetes in each year do not add up to the total number of people presenting to A&E with hypoglycaemia as each year there were a few people who did not have type 1 or type 2 diabetes (e.g. those with gestational diabetes on insulin, post-pancreatic diabetes or maturity onset diabetes of the young). These numbers have therefore been omitted from the results.
A&E=Accident and emergency department; DISN=Diabetes inpatient specialist nurse; F=Female; M=Male; SEM=Standard error of mean.

Table 2. Treatment of people coded as presenting with hypoglycaemia.

Treatment	2004	2006	2008
Diet	3	5	5
Oral antidiabetes drugs (OADs)	6	15	20
Insulin	20	40	52
Insulin and OADs	8	11	20
Total	**37**	**71**	**97**

Page points

1. The policy of encouraging the management of diabetes in the community rather than in hospital settings has meant that more insulin initiation occurs in primary care, potentially increasing the numbers of people with diabetes treated with insulin.
2. The present data would suggest that the numbers of people with type 2 diabetes attending the accident and emergency department (A&E) as a result of hypoglycaemia is only slightly less than those with type 1 diabetes.
3. The main limitations of the present study are the potential inaccuracies in clinical coding in diabetes.

admission to deal with the consequences and causes of severe hypoglycaemia.

The increased number of people with diabetes presenting to A&E with hypoglycaemia since 2004, with an accompanying reduction of mean HbA_{1c} level over the same period, is likely to be a reflection of improved glycaemic control across the local population with diabetes. This is probably a result of the incentivisation provided by the Quality and Outcomes Framework (QOF) in 2004 (Roland, 2004; Calvert et al, 2009), a system of performance-related pay for GPs. Payment is given for points gained according to the level of achievement against groups of set indicators, which in diabetes include recording the HbA_{1c} level, the proportion of people with an HbA_{1c} below 7.5% (58 mmol/mol), and the proportion of people with an HbA_{1c} level below 10% (86 mmol/mol) (NHS Employers, 2009).

In addition, the push towards more aggressive blood glucose lowering in people with diabetes has partly been driven by the publication of diabetes-related NICE guidance, which has provided national standards and targets for glycaemic control (NICE, 2002; 2009).

The policy of encouraging the management of diabetes in the community rather than in hospital settings has meant that more insulin initiation occurs in primary care (Dale et al, 2010), potentially increasing the numbers of people with diabetes treated with insulin. The net result of all of these factors has been substantial increases in the number of blood glucose-lowering therapies (even accounting for the increased prevalence of diabetes) prescribed to people with diabetes over the years (Yorkshire and Humber Public Health Observatory, 2009).

Traditionally it was felt that hypoglycaemia was predominately a problem in people with type 1 diabetes (Pramming et al, 1991), and that the rates of hypoglycaemia in people with insulin-treated type 2 diabetes was much lower by comparison (Abraira et al, 1995). However, the present data would suggest that the numbers of people with type 2 diabetes attending A&E as a result of hypoglycaemia is only slightly less than those with type 1 diabetes.

These results are broadly consistent with published research showing that hypoglycaemia requiring emergency assistance from healthcare professionals is almost as common in people with type 2 diabetes treated with insulin as it is in those with type 1 diabetes (Leese et al, 2003; UK Hypoglycaemia Study Group, 2009). In addition, a recent large-scale Diabetes UK survey revealed that half of the people with type 2 diabetes (excluding those treated with insulin) experienced at least one episode of hypoglycaemia during a fortnightly period (Diabetes UK, 2009).

The main limitations of the present study are the potential inaccuracies in clinical coding in diabetes (Stone et al, 2010). Another potential source of error is the accuracy of the initial diagnosis of hypoglycaemia, as it can be seen from *Table 2* that some people who are not taking any medication for diabetes had apparently attended A&E for hypoglycaemia, which seems improbable. However, these numbers are small and appear to be consistent year after year, and therefore should not have had a major influence on the overall results.

Conclusion

This study highlights the beneficial impact of improved liaison between DISNs and A&E, which resulted in reduced hospital admissions for hypoglycaemia. However, care needs to be taken to ensure that this approach does not increase multiple attendances.

These findings also highlight the need to individualise glycaemic control based on a person's specific circumstances rather than taking a strict target-based approach. Both of these interventions have the potential to result in better health outcomes for people with diabetes

by avoiding hypoglycaemia-related admissions and may therefore be cost-effective for PCTs. ■

Karen Perkins is a Diabetes Specialist Nurse; Susan Edwards is a Diabetes Inpatient Specialist Nurse; Sravan Thondam is a Specialist Registrar; Franklin Joseph is a Consultant in Diabetes and Endocrinology; David Ewins is a Consultant in Diabetes and Endocrinology; Niru Goenka is a Consultant in Diabetes and Endocrinology. All are based at the Diabetes Centre, Countess of Chester NHS Foundation Trust, Chester.

Abraira C, Colwell JA, Nuttall FQ et al (1995) Veterans Affairs Cooperative Study on glycemic control and complications in type II diabetes (VA CSDM). Results of the feasibility trial. Veterans Affairs Cooperative Study in Type II Diabetes. *Diabetes Care* **18**: 1113–23

Action to Control Cardiovascular Risk in Diabetes Study Group et al (2008) Effects of intensive glucose lowering in type 2 diabetes. *N Engl J Med* **358**: 2545–59

ADVANCE Collaborative Group et al (2008) Intensive blood glucose control and vascular outcomes in patients with type 2 diabetes. *N Engl J Med* **358**: 2560–72

Bolen S, Feldman L, Vassy J et al (2007) Systematic review: comparative effectiveness and safety of oral medications for type 2 diabetes mellitus. *Ann Intern Med* **147**: 386–99

Brackenridge A, Wallbank H, Lawrenson RA, Russell-Jones D (2006) Emergency management of diabetes and hypoglycaemia. *Emerg Med J* **23**: 183–5

Calvert M, Shankar A, McManus RJ et al (2009) Effect of the quality and outcomes framework on diabetes care in the United Kingdom: retrospective cohort study. *BMJ* **338**: b1870

Campbell IW (1985) Metformin and the sulphonylureas: the comparative risk. *Horm Metab Res Suppl* **15**: 105–11

Dale J, Martin S, Gadsby R (2010) Insulin initiation in primary care for patients with type 2 diabetes: 3-year follow-up study. *Prim Care Diabetes* 12 April [Epub ahead of print]

Daniels A, White M, Stander I, Crone D (1999) Ambulance visits for severe hypoglycaemia in insulin-treated diabetes. *N Z Med J* **112**: 225–8

Davis RE, Morrissey M, Peters JR et al (2005) Impact of hypoglycaemia on quality of life and productivity in type 1 and type 2 diabetes. *Curr Med Res Opin* **21**: 1477–83

Diabetes Control and Complications Trial Research Group (1993) The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *N Engl J Med* **329**: 977–86

Diabetes UK (2009) *Type 2 Diabetes and Hypoglycaemia Survey*. Diabetes UK, London. Available at: http://tinyurl.com/2w2b3s6 (accessed 14.05.10)

Duckworth W, Abraira C, Moritz T et al (2009) Glucose control and vascular complications in veterans with type 2 diabetes. *N Engl J Med* **360**: 129–39

Frier BM (1993) Hypoglycaemia in the diabetic adult. *Baillieres Clin Endocrinol Metab* **7**: 757–7

Goyder EC, Goodacre SW, Botha JL, Bodiwala GG (1997) How do individuals with diabetes use the accident and emergency department? *J Accid Emerg Med* **14**: 371–4

Hart SP, Frier BM (1998) Causes, management and morbidity of acute hypoglycaemia in adults requiring hospital admission. *QJM* **91**: 505–10

Holman RR, Paul SK, Bethel MA et al (2008) 10-year follow-up of intensive glucose control in type 2 diabetes. *N Engl J Med* **359**: 1577–89

Holmwood KI, Williams DR, Roland JM (1992) Use of the accident and emergency department by patients with diabetes. *Diabet Med* **9**: 386–8

Holstein A, Plaschke A, Egberts EH (2002) Incidence and costs of severe hypoglycemia. *Diabetes Care* **25**: 2109–10

Leese GP, Wang J, Broomhall J et al (2003) Frequency of severe hypoglycemia requiring emergency treatment in type 1 and type 2 diabetes: a population-based study of health service resource use. *Diabetes Care* **26**: 1176–80

Lundkvist J, Berne C, Bolinder B, Jonsson L (2005) The economic and quality of life impact of hypoglycemia. *Eur J Health Econ* **6**: 197–202

NICE (2002) *Management of Blood Glucose in Type 2 Diabetes. NICE Inherited Clinical Guideline G: September 2002*. NICE, London

NICE (2009) *Type 2 Diabetes: The Management of Type 2 Diabetes*. NICE, London

Potter J, Clarke P, Gale EA et al (1982) Insulin-induced hypoglycaemia in an accident and emergency department: the tip of an iceberg? *Br Med J (Clin Res Ed)* **285**: 1180–2

Pramming S, Thorsteinsson B, Bendtson I, Binder C (1991) Symptomatic hypoglycaemia in 411 type 1 diabetic patients. *Diabet Med* **8**: 217–22

Roland M (2004) Linking physicians' pay to the quality of care – a major experiment in the United kingdom. *N Engl J Med* **351**: 1448–54

NHS Employers (2009) Quality and Outcomes Framework guidance for GMS contract 2009/10: Delivering investment in general practice. NHS Employers, London. Available at: http://tinyurl.com/2u87zpm. Accessed 08.07.10)

Stone MA, Camosso-Stefinovic J, Wilkinson J et al (2010) Incorrect and incomplete coding and classification of diabetes: a systematic review. *Diabet Med* **27**: 491–7

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

UK Prospective Diabetes Study Group (1998) Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *Lancet* **352**: 837–53

Yorkshire and Humber Public Health Observatory (2009) *Prescribing for Diabetes in England – An Update: 2002-2008. An Analysis of Volume, Expenditure and Trends*. YHPHO, York. Available at: http://tinyurl.com/l5rbpd (accessed 21.06.10)

"This study highlights the beneficial impact of improved liaison between diabetes specialist nurses and A&E, which resulted in reduced hospital admissions for hypoglycaemia".