Reduction in insulin prescription errors in hospital: more stick than carrot?

**Abstract**

People with diabetes are more likely to be admitted to hospital and have longer stays in hospital than people without diabetes. Data from the National Diabetes Inpatient Audit suggest that people with diabetes experience avoidable prescription errors such as wrong insulin, incorrect doses and omitted doses. These errors result in increased length of stay and harm to the patient. Many of the errors occur due to deficiencies in knowledge.

Our aim was to reduce prescription errors and improve health care professionals’ knowledge by introducing the following initiatives: (1) redesign of the diabetes prescription chart; and (2) implementing a root cause analysis prescription error pathway which involves a targeted approach to education for the individual who made the error.

Following introduction of the changes to the insulin prescription chart, data from our participation in the National Diabetes Inpatient Audit reported that prescription errors were reduced from 65% to 14% and management errors from 40% to 14% from 2009 to the beginning of 2012. The results of the internal audit during 2012–2013 demonstrated a further reduction in prescription/management errors to 2% following the introduction of the root cause analysis pathway.

The changes have demonstrated a significant reduction in prescription errors and an increased awareness of diabetes following the targeted approach to education. Copyright © 2013 John Wiley & Sons.

**Key words**

diabetes; insulin; prescription errors; audit

**Introduction**

Improper use of insulin for people hospitalised with diabetes can lead to serious adverse clinical outcomes with important health economic consequences and a poor patient experience.1 Insulin prescription errors are especially common and can be very serious with reports that over one-third of fatal medical errors occur within 48 hours of erroneous insulin administration.2

In the UK, 15% of hospital beds are occupied by people with diabetes. Data from the 2012 national audit of inpatient diabetes services indicate that around 40% of patients are treated with insulin while in hospital and a similar percentage experienced at least one diabetes medication error with a dramatic increase in the risk of severe hypoglycaemia. Unfortunately, prescription error rates have remained relatively unchanged in recent years (44.5% in 2010 to 40.0% in 2011 and 39.8% in 2012) and are mostly due to failure to sign for an insulin prescription and failure to alter the dose of insulin (and oral hypoglycaemic agents) when recorded blood glucose levels are rising.3

In response, the UK Department of Health has included ‘maladministration of insulin’ in its Never Event list.4 A never event is classified as ‘a serious, largely preventable patient safety incident that should not occur if the available preventable measures have been implemented by healthcare providers’. An insulin-associated never event occurs when there is ‘Death or severe harm as a result of maladministration of insulin’ and refers to when a health professional:

- Uses any abbreviation for the words ‘unit’ or ‘units’ when prescribing insulin in writing.
- Issues an unclear or misinterpreted verbal instruction to a colleague.
- Fails to use a specific insulin administration device, e.g. an insulin syringe or insulin pen to draw up or administer insulin, or fails to give insulin when correctly prescribed.

Locally, our participation in the National Diabetes Inpatient Audit in 2009 identified insulin errors in 65%
of charts surveyed for prescription errors and 40% for management errors. Over the years, we had tried many approaches to improve education, including group teaching sessions, study days and ward-based education, which involved teaching on a daily basis in the ward environment. All proved difficult due to restraints and lack of resources on the wards. There was also the risk of individuals who had made the error not attending the session.

Our aim was to develop novel approaches to lowering the rate of prescription errors in hospital using two approaches:

- A redesign of the diabetes prescription chart by implementing innovations to reduce the frequent prescribing errors.
- Root cause analysis and one-to-one education for individual insulin errors.

**Methods**

Insulin errors were defined using the criteria embedded within the UK National Diabetes Inpatient Audit based on two categories.

- **Prescription errors:**
  - Insulin not written up.
  - Name of insulin incorrect.
  - Number (dose) unclear.
  - Unit abbreviated to ‘u’ or written unclearly.
  - Insulin prescription not signed.
  - Insulin not signed as given.
  - Insulin given/prescribed at the wrong time.
- **Management errors:**
  - Insulin not increased when persistent blood glucose values were above 11mmol/L if appropriate.
  - Insulin dose not reduced if unexplained blood glucose values were less than 4mmol/L.
  - Inappropriate omission of insulin after an episode of hypo-glycaemia.

In this hospital, there is a specific chart for the prescription of insulin (and oral diabetes medicines) which includes space for recording blood glucose measurements. Redesigning the diabetes prescription chart at the end of 2009 involved:

- Changing U printed to units for insulin prescriptions.
- Including guidelines for insulin initiation.
- Including guidance on how to titrate insulin doses according to the prevailing blood glucose levels.
- Using meal times (breakfast, lunch and dinner) rather than clock times.
- An action plan if blood glucose <4mmol/L and >11mmol/L on more than two occasions.
- A default column allowing the nurse to give a dose of insulin for when insulin had not been prescribed on the specific day, reducing the risk of hyperglycaemia and omission of doses.

At the beginning of 2012 we also introduced a diabetes prescription error management pathway using a root cause analysis approach involving the risk management department and the clinical leaders. After an error was detected the following process was implemented:

- Adverse incident report (AIR).
- Clinical leader identifies individual (doctor/nurse) and refers to inpatient diabetes specialist nurse (DSN).
- Individual has a 30-minute teaching session on the specific error with the DSN.
- Individual completes specific e-learning module.
- Certificate presented to DSN and recorded on a database.

As part of this, a Safe Use of Insulin e-learning module developed by NHS Diabetes was also implemented as mandatory for all newly trained doctors. This module along with the further three modules produced by NHS Diabetes have also been promoted at ward level for all health care professionals involved in direct patient care. The diabetes prescription error management pathway also included twice-weekly review of all diabetes prescription charts by inpatient DSNs on the 22 wards within the hospital. This proved an integral part of the process. If there were more than three prescription errors found on the same ward during this chart review, all ward staff were recommended to take the specific e-learning module.

**Results**

Following introduction of the changes to the insulin prescription chart, data from our participation in the National Diabetes Inpatient Audit reported that prescription errors were reduced from 65% to 14% and management errors from 40% to 14% from 2010 to the beginning of 2012 (Figure 1).

Subsequently, a twice-weekly chart review of all inpatient insulin prescription charts was introduced at the beginning of 2012 (Figure 2).

The results of the internal audit from 2012 to 2013 demonstrated a further reduction in prescription/management errors to 2% for the first six months of 2013 following the introduction of the root cause analysis pathway (Figure 3).

**Discussion**

Insulin prescription errors remain a significant problem for people with
diabetes admitted to hospital. Insulin doses vary enormously between patients and also within patients depending on the stage of their illness necessitating hospital admission. Furthermore, the majority of people with diabetes admitted to hospital are managed on ward areas where there may be variable interest and enthusiasm for diabetes care.

Between 2003 and 2009, the UK National Patient Safety Agency identified more than 16 000 incidents involving insulin and 24% reported harm to the patient. There were 18 incidents with fatal and severe outcomes. The majority (61%) occurred during insulin administration, with a further 17% caused by prescribing errors. The top three medication error types were wrong dose, omitted or delayed insulin and wrong insulin product.

Although the problem of insulin prescription errors is widely appreciated, the approach to reducing the risk of these occurring is variable and subject to local influences and interpretation of current guidance. In addition, risk management in this area appears to be based upon the actual consequences of the error at an individual level rather than the error itself and the potential for harm in others. Here, changes to the diabetes prescription chart based on data from the UK National Diabetes Inpatient Audit resulted in a progressive fall in these errors. More recently, this has been accelerated following the introduction of a root cause analysis pathway for individual errors based on one-to-one teaching and the use of existing online educational material.

A key improvement in rates of insulin errors seen here followed changes to the diabetes prescription chart. As an example, illegible writing of the letter ‘u’ in place of units can lead to a 10-fold increase in the dose of insulin being given, with lethal consequences. Elsewhere, the use of a structured validation system to review high-dose insulin prescribing and administration, supported by education and product alerts, was successful in reducing the risk and incidents of these potentially fatal medication errors.

Recently, the use of an educational programme using a patient’s journey from admission to discharge to teach avoidance of common errors, while enhancing familiarity with local charts and protocols, has been shown to reduce insulin prescription errors by almost 50% among junior doctors. Additional approaches have included computerised clinical decision support systems, although the evidence of benefit remains to be substantiated.

We found marked additional benefit following the introduction of our root cause analysis pathway. In the UK, around 16% of medication errors are due to missed or delayed medicines. Recently, the use of a modified electronic prescribing system to include visual indicators for delayed medicines and a root cause analysis of events resulted in some improvement in medicine omission rates. A challenge that we have faced relating to our root cause analysis pathway is that if a whole ward needs to complete the e-learning module due to more than three errors on that ward, it is a difficult task to ensure they have all completed the module and documenting the names on our database. To overcome this challenge we have found continuous communication with the nursing staff and clinical leaders is a powerful lever.

In conclusion, we and others have shown previously that development of an inpatient diabetes
specialist nursing team is a cost-effective service development. Here, our latest initiatives have reshaped and transformed our current practice and this could easily be adapted in other hospitals to improve their inpatient diabetes service.

Initially, we looked at our diabetes prescription chart identifying areas for improvement from which changes to the chart were made based on our performance within a national audit of inpatient diabetes care. All health care professionals were provided with education regarding the changes to the prescription chart and the chart was piloted for a year. Through evaluation and audit we were able to demonstrate the effectiveness of this initiative showing a reduction in prescription and management errors.

Declaration of interests
There are no conflicts of interest declared.

References