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High diabetes prevalence and insulin medication errors in hospital patients

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Abstract

We conducted three single-day point type 2 diabetes prevalence surveys of all inpatient clinical records in November 2013, 2014 and 2016. The prevalence of diabetes was 19.7–25.3%. The majority (63.4–76%) had type 2 diabetes. Twenty-one percent (n = 21) in 2013, 12% (n = 9) in 2014 and 22.6% (n = 21) in 2016 were diagnosed with diabetes during hospital admission; 41.8% (n = 41) in 2013, 46.7% (n = 35) in 2014 and 51.6% (n = 48) in 2016 required insulin. The high prevalence of diabetes among inpatients mandates active detection and specialist management of diabetes during the admission.

Approximately 1.2 million (6%) Australian adults have diagnosed diabetes[1] with a further 500 000 estimated to have undiagnosed diabetes.[2] Up to 280 Australians develop diabetes every day.[2] The number of Australians diagnosed with diabetes over the age of 25 years is expected to reach 3 million by 2025.[3]

Individuals with diabetes are hospitalised more frequently than those without diabetes.[4] In Australia, 10% of all hospital admissions include diabetes as the principal and/or an additional diagnosis; the vast majority of these (96%) are additional diagnoses.[1] These figures are based on hospital coded data, but the number of inpatients with comorbid diabetes is likely to be higher. Indeed, surveys from the UK and Melbourne, Australia, report a prevalence of diabetes in the inpatient population of 17.3% and 24.7%, respectively.[5,6]

Uncontrolled hyperglycaemia in hospitalised patients is associated with prolonged length of stay (LOS) and increased risk of adverse outcomes.[7–11] Oral diabetic agents are often contraindicated during hospitalisation due to fasting, renal insufficiency and exposure to investigations involving radio-contrast dye. Therefore, insulin is frequently used to manage hyperglycaemia during acute illness. Insulin is one of the top five high-risk medications used in hospitals[12–14] and accounts for 15% of the highest risk incidents in acute care settings.[14] Insulin has been associated with a greater number of errors than any other class or type of medication.[15]

In 2016, the National Diabetes Inpatient Audit (NaDIA) conducted by 209 hospital sites in the UK found that 22.7% of inpatient medication charts had at least one insulin medication error in the 7-days preceding the audit.[5]

The primary aim of our survey was to determine the prevalence of diabetes at a Sydney Metropolitan Teaching Hospital in 2013, 2014 and 2016. Secondary aims were to provide patient outcome data for strategic planning and to document effect of improvement initiatives for inpatient diabetes management.

We surveyed the clinical records of all inpatients on three single-days. The study was approved by the Human Research and Ethics Committee, St Vincent's Hospital Sydney (LNR/13/SVH/327). On 14 November 2013, 13 November 2014 and 17 November 2016, an 18-item Inpatient Diabetes Survey Form (adapted from the UK NaDIA Audit Form 2012) was completed at the bedside, using data from clinical records, for all inpatients admitted to St Vincent's Hospital (including psychiatry, subacute and non-admitted patients in the Emergency Department). St Vincent's Hospital does not have a maternity unit. Twelve surveying teams, comprising two members each, completed the surveys. Most teams consisted of a diabetes clinician and a ward-based clinical staff member. All surveyors attended a training session 1 week prior to conducting the survey. All received a 'tool-kit' documenting the survey aims and methodology, the survey protocol and survey form explanatory notes. Two onsite coordinators were available on the day of the surveys to answer surveyor questions. Diabetes diagnosis was ascertained if diabetes was documented in the medical record or if the patient was taking diabetes medication or if fasting blood

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Table 1 Prevalence of diabetes

Year	Diabetes prevalence (%)	Newly diagnosed (%)
2013	24.9 (*n* = 98)	21.4 (*n* = 21)
2014	19.7 (*n* = 75)	12 (*n* = 9)
2016	25.3 (*n* = 93)	22.6 (*n* = 21)

glucose was ≥7 mmol/L and/or if random blood or capillary glucose was ≥11.1 mmol/L and/or if HbA1c was ≥6.5% (48 mmol/mol).

At our institution, prescription of insulin and recording of blood glucose levels (BGL) are through a paper chart. Referral to the endocrine team is recommended for all patients with type 1 diabetes, patients with type 2 diabetes with a BGL > 11 mmol/L for >24 h, those with an HbA1c > 8% (64 mmol/mol), all patients with newly diagnosed diabetes or those with hyperglycaemia (BGL > 11 mmol/L without a previous diabetes diagnosis) and all patients who required an intravenous insulin infusion.

We surveyed all available inpatient records in 2013 (*n* = 394), 2014 (*n* = 381) and 2016 (*n* = 368). The prevalence of diabetes was 19.7–25.3% (Table 1). In 2016, the highest prevalence of diabetes was observed among patients who were under the heart/lung transplant (58.8%) and heart failure (50%) services and in the 71–80-year range in 2013 and in the 61–70-year range in 2014 and 2016. Patient demographics, reason for admission and prevalence by type of diabetes and treatment are shown in Table 2.

Median LOS (measured in 2016 only) was 16 days (1–230 days). Approximately, one-third of patients (34.4% (*n* = 32)) had a LOS > 30 days and 6.5% (*n* = 6) had a LOS > 100 days. Our LOS may be consequent to the unique aspects of the hospital population, particularly the high prevalence of diabetes in heart–lung transplant patients. The median LOS was longer in those referred to the Diabetes Team (30 days (*n* = 27) vs those not referred 13 days (*n* = 66)). Patients admitted for surgical reasons had more than double the median LOS than those admitted for medical reasons (30 days (*n* = 32) vs 14 days (*n* = 58)). Those admitted for direct diabetes related reasons (hypoglycaemia, hyperglycaemia, active foot disease) had the shortest median LOS (9 days (*n* = 3)).

In 2013, 41.8% (*n* = 41) of patients with diabetes were prescribed insulin during their admission. This steadily increased to 46.7% (*n* = 35) and 51.6% (*n* = 48) in 2014 and 2016, respectively. Of those treated with insulin in the 7-days preceding the survey, 41.5% (*n* = 17) of insulin charts revealed one or more prescription or administration error in 2013, 28.6% (*n* = 10) in 2014 and 35.4% (*n* = 17) in 2016 (Table 3).

Of those patients with diabetes who had blood glucose monitoring performed in the 24-h preceding the survey (*n* = 75 in 2013, *n* = 70 in 2014 and *n* = 80 in 2016), mean BGL was 9.3 mmol/L in 2013 and 9.2 mmol/L in 2014 and 2016, respectively. Mean BGL was 5–10 mmol/L in 65% (*n* = 49) of patients in 2013, 58.6% (*n* = 41) in 2014 and 62.5% (*n* = 50) in 2016 respectively.

Of those patients with diabetes that had blood glucose monitoring performed in the 7-days preceding the survey (*n* = 86 in 2013, *n* = 72 in 2014 and *n* = 80 in 2016), 12.8% (*n* = 11) in 2013, 11.1% (*n* = 8) in 2014 and 15%

Table 2 Demographics, admission reason and prevalence by diabetes type and treatment

	2013	2014	2016
Demographics			
Age (years, range)	65 (20–93)	61 (25–89)	67 (18–98)
Male	66.3% (*n* = 65)	66.7% (*n* = 50)	57% (*n* = 53)
Born in Australia or New Zealand	62.2% (*n* = 61)	64% (*n* = 48)	51.6% (*n* = 48)
Aboriginal/Torres Strait Islander	6.1% (*n* = 6)	4% (*n* = 3)	3.2% (*n* = 3)
Admission reason			
Medical (not directly related to diabetes)	74.5% (*n* = 73)	76% (*n* = 57)	62.4% (*n* = 58)
Surgical (not directly related to diabetes)	23.5% (*n* = 23)	21.3% (*n* = 16)	34.4% (*n* = 32)
Diabetes-related	2% (*n* = 2)	2.7% (*n* = 2)	3.2% (*n* = 3)
Admitted via Emergency Department	56% (*n* = 55)	63% (*n* = 47)	67% (*n* = 62)
Type and treatment			
Type 2 diabetes (all treatments)	70.4% (*n* = 69)	76% (*n* = 57)	63.4% (*n* = 59)
Type 2 diabetes (no diabetes medication)	15.3% (*n* = 15)	21.3% (*n* = 16)	11.8% (*n* = 11)
Type 2 diabetes (oral diabetes medication only)	31.6% (*n* = 31)	29.3% (*n* = 22)	30.1% (*n* = 28)
Type 2 diabetes (insulin)	23.5% (*n* = 23)	25.3% (*n* = 19)	21.5% (*n* = 20)
Type 1 diabetes	3% (*n* = 3)	4% (*n* = 3)	3% (*n* = 3)
Steroid-induced diabetes	9.2% (*n* = 9)	12% (*n* = 9)	10.8% (*n* = 10)
Cystic fibrosis-related diabetes	1% (*n* = 1)	2.7% (*n* = 2)	0% (*n* = 0)
Unknown	15.3% (*n* = 15)	5.3% (*n* = 4)	20.4% (*n* = 19)
Other	1% (*n* = 1)	0% (*n* = 0)	2.2% (*n* = 2)

Table 3 Proportion of insulin charts with prescription or administration errors

Chart errors	2013	2014	2016
Incorrect/incomplete insulin name	4.9% (n = 2)	0% (n = 0)	2.1% (n = 1)
Unclear prescribed dose	17.1% (n = 7)	11.4% (n = 4)	10.4% (n = 5)
Unsigned dose by prescriber	2.4% (n = 1)	8.6% (n = 3)	12.5% (n = 6)
Dose prescribed incorrect time	7.3% (n = 3)	5.7% (n = 2)	6.3% (n = 3)
Dose not signed as administered	24.4% (n = 10)	8.6% (n = 3)	16.7% (n = 8)

(n = 12) experienced at least one episode of hypoglycaemia (BGL < 4 mmol/L). In 2013, 65.1% (n = 56), 62.5% (n = 45) in 2014 and 61.3% (n = 49) in 2016 experienced at least one episode of hyperglycaemia (BGL > 11 mmol/L).

Our survey demonstrated that 62.2% (n = 61) of patients with diabetes met endocrine referral criteria in 2013; of those, only 41% (n = 25) were referred. In 2014, 52% (n = 39) met referral criteria and 74.4% (n = 29) were referred. In 2016, 57% (n = 53) met referral criteria, but only half were referred (49% (n = 26)).

Discussion

The main finding from this comprehensive survey, using laboratory results to define diabetes (in addition to clinical note interrogation), is that the prevalence of diabetes at a Sydney Metropolitan Teaching Hospital was up to 25%. Our prevalence is higher than the 17.3% reported by the UK NaDIA 2016 survey of 209 sites,[5] but comparable to the prevalence of 25% reported by a survey of 11 Melbourne hospitals (range: 15.7–35.1%).[6] The lower rate of diabetes reported in some Melbourne hospitals is likely due to the fact that their surveys relied on self-reported data, which would have excluded all hospital-diagnosed cases based on elevated capillary or formal BGL. In the UK, only the prevalence data were based on a pre-existing diabetes diagnosis. In our survey, diabetes diagnosis was based on a known diabetes history, treatment with diabetes medication and/or documentation of an elevated capillary or formal glucose or HbA1c reading. A striking observation was that half of the patients in the heart/lung transplant and heart failure service had diabetes. These results highlight the need for increased vigilance for detecting and treating diabetes in high-risk populations.

Another important observation from our data was the high prevalence of undiagnosed diabetes (22.6% in 2016). Using HbA1c to screen for undiagnosed diabetes, Valentine *et al*. found a prevalence of 11%.[16] The use of HbA1c is likely superior to a single, random BGL in detecting diabetes during acute illness, although an elevated glucose level measured during an emergency hospital admission is associated with a higher risk of subsequent type 2 diabetes.[17]

Almost half of the patients with diabetes were treated with insulin during their hospital admission. Insulin prescription and administration errors, in particular insulin omission, were not uncommon. This is an important problem to address in the quest to improve the inpatient management of hyperglycaemia. At least one episode of hypoglycaemia (BGL < 4 mmol/L) in the 7-days preceding the survey was documented in 12.8% (in 2013), 11.1% (in 2014) and 15% (in 2016) of patients. In comparison, 20% of inpatients surveyed in the UK NaDIA 2016 survey experienced at least one hypoglycaemic episode (BGL < 4 mmol/L) in the 7-days preceding their survey.[5]

In summary, our survey demonstrates that one-quarter of inpatients had previously diagnosed or newly diagnosed diabetes, with almost half requiring insulin therapy during their admission. The information obtained from the prevalence surveys has (i) confirmed that diabetes management remains a major component of daily service delivery among inpatients; (ii) highlighted areas for improvement and (iii) provided information to strengthen clinical governance in diabetes management.

These data provide a basis for planning workforce education, quality improvement activity and resource allocation. Our survey also highlights the fact that the inpatient hospital admission is an opportune time for detecting undiagnosed diabetes and optimising management. Future surveys are necessary to determine whether the prevalence of diabetes among the inpatient population is increasing and whether diabetes clinical practice improvement initiatives can improve in-hospital diabetes care.

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