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Medication errors at hospital admission and discharge in Type 1 and 2 diabetes

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Abstract

Aims To assess the prevalence and characteristics of medication errors at hospital admission and discharge in people with Type 1 and Type 2 diabetes, and identify potential risk factors for these errors.

Methods This prospective observational study included all people with Type 1 ($n = 163$) and Type 2 diabetes ($n = 508$) admitted to the Diabetology-Department of the University Hospital of Montpellier, France, between 2013 and 2015. Pharmacists conducted medication reconciliation within 24 h of admission and at hospital discharge. Medication history collected from different sources (patient/family interviews, prescriptions/medical records, contact with community pharmacies/general practitioners/nurses) was compared with admission and discharge prescriptions to detect unintentional discrepancies in medication indicating involuntary medication changes. Medication errors were defined as unintentional medication discrepancies corrected by physicians. Risk factors for medication errors and serious errors (i.e. errors that may cause harm) were assessed using logistic regression.

Results A total of 322 medication errors were identified and were mainly omissions. Prevalence of medication errors in Type 1 and Type 2 diabetes was 21.5% and 22.2% respectively at admission, and 9.0% and 12.2% at discharge. After adjusting for age and number of treatments, people with Type 1 diabetes had nearly a twofold higher odds of having medication errors (odds ratio (OR) 1.72, 95% confidence interval (CI) 1.02–2.94) and serious errors (OR 2.17, 95% CI 1.02–4.76) at admission compared with those with Type 2 diabetes.

Conclusions Medication reconciliation identified medication errors in one third of individuals. Clinical pharmacists should focus on poly-medicated individuals, but also on other high-risk people, for example, those with Type 1 diabetes.

Introduction

Medication errors are very common in hospitals and may have important clinical and economic consequences [1]. To decrease the error rate and improve medication safety, several institutions have recommended medication reconciliation at all transition points: admission, transfer and discharge [1–3]. Medication reconciliation consists of drawing up a complete and correct list of an individual's current medications and comparing it with prescriptions at the different steps of hospitalization in order to identify and document discrepancies [4]. A recent meta-analysis showed that medication reconciliation programmes run by pharmacists are effective in reducing medication discrepancies [5].

However, studies evaluating the efficacy of such programmes are very heterogeneous in terms of methodology, populations and definitions of outcome measures. Whereas most studies have included people admitted to hospital for various reasons [6–10], the few studies focusing on specific populations concerned those with heart disease [11,12] or the elderly [13,14]. As the number of medications is often a risk factor for medication errors [6,12], it is likely that people with chronic diseases like diabetes are at increased risk of these errors [15]. Indeed, we have already demonstrated that people with diabetes do have a higher risk of medication error than those without diabetes [15]. Further, because individuals with Type 1 and Type 2 diabetes have different clinical characteristics, it seems important to compare prescribing errors between these two groups. Our study assessed the prevalence and characteristics of these errors

What's new?

- Nearly one third of people with diabetes have errors on their medication prescription at hospital admission and/or discharge.
- The risk of medication errors and serious medication errors at hospital admission is higher in people with Type 1 than those with Type 2 diabetes.
- Our findings should heighten the awareness of diabetes care teams regarding the risk of medication errors in people with diabetes, especially in those with Type 1 diabetes.

detected at hospital admission and discharge according to the type of diabetes. This article is a complementary analysis of our previously published study [15].

Participants and methods

Study design and population

This study was carried out in the Diabetology Department of the University Hospital of Montpellier, France and has been described previously [15]. All adults with Type 1 or Type 2 diabetes admitted to this department between November 2013 and May 2015 were prospectively included and followed until hospital discharge.

Medication reconciliation at admission and discharge

At admission, the pharmacy team, including a senior pharmacist, one resident and two pharmacy students, undertook the medication reconciliation process within 24 h of admission. This is standard procedure in the Diabetology Department of the University Hospital of Montpellier, and follows a validated protocol, as described previously [15]. Pharmacists and physicians discussed each discrepancy between the medication history and the hospitalization prescription to determine whether it was intentional or unintentional. Unintentional medication discrepancies corrected by the physician were considered medication errors. The same procedure was followed at discharge before participants left the hospital.

Data collection

Demographic, clinical and biological data were collected prospectively. For each medication, we documented the name, dosage, dosage forms and administration frequency. For each medication error, we documented the drug class and the potential clinical impact for the participant. The potential clinical impact (very serious, serious, moderate and minor) was determined by the consensus of an expert panel

made up of two pharmacists and two senior clinicians from the department [15]. For 9 (5.5%) and 24 (4.7%) people with, respectively, Type 1 and Type 2 diabetes the discharge prescriptions could not be analysed because discharge took place at night or at the weekend.

Statistical analysis

Quantitative variables were compared using the Mann-Whitney *U*-test. For categorical variables, comparisons were made using chi-squared or Fisher's exact tests. Data are presented as median and interquartile range (IQR) or *n* (%). The relationship between the type of diabetes and the risk of medication errors (or serious medication errors) was analysed using logistic regression. We first built a crude model, followed by a model adjusted for the number of lines of the prescription at admission or discharge. We finally added age in a third and final multivariate logistic model.

Statistical analyses were performed at the conventional two-tailed α level of 0.05 using SAS version 9.1 (SAS Institute, Cary, NC, USA).

Results

Participant characteristics

We included 671 people; 163 (24.3%) with Type 1 diabetes and 508 (75.7%) with Type 2 diabetes. The median (IQR) age of those with Type 1 and 2 diabetes was 42 (31–58) and 63 (55–72) years respectively. People with Type 1 diabetes were more often admitted for management of diabetes at night or at the weekend, and more often via the emergency department. Participant characteristics on admission are presented in Table 1.

Medication errors

Overall, 197 people (29.4%) had at least one medication error detected at admission and/or discharge (Table 1). The percentage of medication errors per treatment was higher in people with Type 1 diabetes than in those Type 2 diabetes only at admission: median (IQR) 16.7% (12.5%–26.8%) vs 12.5% (9.0%–20%) ($P = 0.02$). At admission, people with Type 2 diabetes had significantly more medication errors involving cardiovascular medication than those participants with Type 1 diabetes (38.6% vs 19.3%, $P < 0.01$). A trend toward higher medication errors involving drugs used for diabetes management was observed on admission in people with Type 1 compared with Type 2 diabetes (17.9% vs 9.3%, $P = 0.08$). In both groups, at both admission and discharge, omissions were the first cause of medication errors (59.6%). At admission, added medications were more frequent in those with Type 1 diabetes (12.5% vs 1.2%, $P < 0.001$), whereas wrong administration frequencies or doses were found more often

Table 1 Baseline characteristics of study participants, according to the type of diabetes

	Type 1 diabetes (<i>n</i> = 163)	Type 2 diabetes (<i>n</i> = 508)	<i>P</i>
Age, years*	42 (31–58)	63 (55–72)	< 0.001
Sex, male	97 (59.5)	307 (60.4)	0.83
BMI ≥ 30 kg/m ²	26 (15.9)	288 (56.7)	< 0.001
Reason for admission			
Diabetes discovery	15 (9.2)	12 (2.4)	< 0.001
Hyperglycaemia > 15 mmol/L with or without symptoms	120 (73.6)	319 (62.8)	0.01
Diabetic foot	17 (10.4)	143 (28.1)	< 0.001
Treatment of obesity	9 (5.5)	31 (6.1)	0.78
Other	2 (1.2)	3 (0.6)	0.60
Associated chronic diseases			
Arterial hypertension	54 (33.1)	326 (64.2)	< 0.001
Dyslipidaemia	52 (31.9)	290 (57.1)	< 0.001
Cardiovascular diseases	32 (19.6)	258 (50.8)	< 0.001
Chronic renal failure			
GFR = 30–59 ml/min	20 (12.3)	95 (18.7)	0.06
GFR < 30 ml/min	8 (4.9)	62 (12.2)	< 0.01
Lung diseases	23 (14.1)	94 (18.50)	0.19
Infectious diseases	28 (17.2)	107 (21.1)	0.28
Obstructive sleep apnoea syndrome	12 (7.4)	138 (27.2)	< 0.001
No. of chronic diseases*	3 (1.5–5)	4 (5–6)	< 0.001
Type and time of admission			
From emergency department	33 (20.3)	57 (11.2)	< 0.001
Night or weekend	17 (10.4)	30 (5.9)	0.049
Length of stay, days	4 (3–6)	4 (4–7)	0.008
Number of medications*			
At admission	5 (2–9)	9 (6–12)	< 0.001
At discharge	6 (3–10)	10 (7–13)	< 0.001
Medication errors			
No. of participants with medication errors at admission	35 (21.5)	113 (22.2)	0.84
No. of participants with serious or very serious medication error at admission	14 of 35 (40.0)	38 of 113 (33.6)	0.49
No. of participants with medication errors at discharge	14 (9.0)	59 (12.2)	0.28
No. of participants with serious or very serious medication error at discharge	3 of 14 (21.4)	27 of 59 (45.8)	0.13
No. of medication errors per participant*			
At admission	1 (1–2)	1 (1–2)	0.44
At discharge	1 (1–1)	1 (1–1)	0.82
Percentage of medication errors per treatment*			
At admission	16.7 (12.5–26.8)	12.5 (9.0–20.0)	0.02
At discharge	11.1 (9.9–12.9)	9.1 (7.4–13.4)	0.15

Values are given as *n* (%) unless indicated otherwise; values are median (interquartile range). Number of chronic diseases included Type 1 and 2 diabetes. Very serious medication error was defined as all errors that could lead to very serious or life-threatening consequences. Serious medication error was defined for errors that may cause harm or extend duration of hospital stay.

in people with Type 2 diabetes (26.8% vs 41.5%, $P < 0.05$). Medication errors involving added medications were more frequent in people with Type 1 diabetes (17.1% vs 4.5%, $P < 0.001$) and in 57.1% of the cases a diabetic drug was wrongly added. The potential severity of medication errors did not differ significantly between groups, either admission or discharge, with 37% serious or very serious errors overall.

Risk factors of medication errors

Results for the association between type of diabetes and the risk of medication errors or the risk of serious medication errors are shown in Fig. 1. In model 1, which was a crude model, the type of diabetes was not significantly associated with the risk of medication errors or serious medication

errors. Adjustment for the number of lines of treatment (model 2) resulted in an increase in all ORs, corresponding to an increased risk in medication errors with Type 1 diabetes. Finally, further adjustment for age revealed an increased risk for Type 1 diabetes only at admission. So, for a given age and number of lines of treatment, people with Type 1 diabetes had an approximately twofold higher risk of medication errors (OR 1.72, 95% CI 1.02–2.94) and serious medication errors (OR 2.17, 95% CI 1.02–4.76), at admission. The effect of the number of lines of treatment in the prescription was highly significant ($P < 0.001$).

Discussion

The key finding of our study is that for a given number of treatments, people with Type 1 diabetes had an increased

FIGURE 1 Odds ratios (ORs) of medication errors in Type 1 vs Type 2 diabetes at admission (a) and discharge (b): multivariable logistic regression analysis. Model 2 is adjusted for the number of lines of treatment. Model 3 is adjusted for the number of lines of treatment and age. Bars indicate 95% confidence intervals (CI). Dotted line, null value (OR = 1.0).

risk of medication errors and serious medication errors compared with those with Type 2 diabetes. Several hypotheses could explain this result. First, people with Type 1 diabetes were more often admitted as an emergency. Second, higher medication errors involving added medications and drugs used for diabetes management were observed in people with Type 1 than in those with Type 2 diabetes. Lastly, the percentage of medication errors per treatment was significantly higher in the Type 1 diabetes population at admission. Thus, the association of these results may explain the finding that those with Type 1 diabetes were more at risk of medication errors and serious medication errors at hospital admission.

These results are comparable with those of the National Diabetes Inpatient Audit of 2015 [16]. This audit showed that medication errors were significantly more frequent for hospitalized people with Type 1 diabetes (48.1%) and Type 2 insulin-treated diabetes (48.9%) compared with those with Type 2 non-insulin-treated diabetes (29.7%). Moreover, in this audit, the logistic regression analysis highlighted that non-insulin-treated hospitalized people admitted for non-diabetes medical reasons had a lower risk of a medication error (OR = 0.77, 95% CI 0.66–0.89). Lastly, elective admission was associated with a reduced risk of having mild or severe hypoglycaemic episodes, whereas insulin or sulphonylurea treatment at admission was associated with an increased risk. Therefore, the type (elective or non-elective) and reason (related or not to diabetes) for admission and diabetes treatment (insulin or not) are crucial variables that

might explain the difference in terms of incidence and severity of medication errors depending on diabetes type.

Our study has some limitations, the main one being its observational design without any control arm and its monocentric nature, which might limit the generalizability of our results. Moreover, medication reconciliation programmes can prevent prescription errors, but they cannot prevent dispensing and administration errors, therefore precluding the evaluation of all types of medication errors.

In conclusion, our study highlighted that people with Type 1 diabetes had an approximately twofold higher risk of medication errors and serious medication errors at hospital admission compared with those with Type 2 diabetes. The interventions of clinical pharmacists should focus on at-risk populations such as poly-medicated people, but also other high-risk groups, such as those with Type 1 diabetes.

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Competing interests

None declared.

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