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Trends in bed occupancy for inpatients with diabetes before and after the introduction of a diabetes inpatient specialist nurse service

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Abstract

Aims To compare diabetes bed occupancy and inpatient length of stay, before and after the introduction of a dedicated diabetes inpatient specialist nurse (DISN) service in a large UK Hospital.

Methods We analysed bed occupancy data for medical or surgical inpatients for 6 years (1998–2004 inclusive), with a DISN service in the final 2 years. Excess bed days per diabetes patient were derived from age band, specialty, and seasonally matched data for all inpatients without diabetes. We also analysed the number of inpatients with known diabetes who did not have diabetes recorded as a discharge diagnosis.

Results There were 14 722 patients with diabetes (9.7% of all inpatients) who accounted for 101 564 occupied bed days (12.4% of total). Of these, 18 161 days (17.8%) were excess compared with matched patients without diabetes, and were concentrated in those < 75 years old. Mean excess bed days per diabetes inpatient under 60 years of age was estimated to be 1.9 days before the DISN appointment, and this was reduced to 1.2 bed days after the appointment ($P = 0.03$). This is equivalent to 700 bed days saved per year per 1000 inpatients with diabetes under 60 years old, with an identical saving for those aged 61–75 years ($P = 0.008$), a saving of 1330 diabetes bed days per year by one DISN. Excess diabetes bed occupancy was 167 excess bed days per year per 1000 patients with diabetes in the local population after the DISN appointment. One quarter of the known Type 2 diabetes population were admitted annually, but one quarter of patients had no diagnostic code for diabetes.

Conclusions Diabetes excess bed occupancy was concentrated in patients < 75 years old, and this was reduced notably following the introduction of a DISN service.

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Keywords diabetes, inpatient bed occupancy, specialist nurse

Abbreviations DISN, diabetes inpatient specialist nurse; IQR, interquartile range; LOS, length of stay; MFE, medicine for the elderly; NSF, National Service Framework

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Introduction

Many diabetic patients are dissatisfied with the quality of their inpatient diabetes care, as they lose control over their diet, mealtimes and insulin injections, and there is often a lack of staff competencies in diabetes care on non-specialist wards [1–3]. The prevalence of known diabetes among inpatients in the UK, Europe and the USA is high, up to 10% in some general inpatient populations, and bed occupancy is disproportionately higher, because diabetic patients stay in hospital longer [1,3–7]. Some of this so-called excess bed occupancy is because of greater case severity [4–10], but some is thought to be as a result of less than optimal diabetes care, or staff uncertainty about diabetes management, as most inpatients with diabetes are not reviewed or managed by a diabetes specialist team [1,6,11].

The UK National Service Framework (NSF) for diabetes emphasized improved care for all inpatients with diabetes [12], and many UK hospitals now employ senior diabetes inpatient specialist nurses (DISN) to provide inpatient diabetes management for all diabetes inpatients. The NSF also suggested that a reduction in excess diabetes bed occupancy could be used as a surrogate for improved inpatient diabetes care, based on small observational studies [13–17]. In the UK, there is pressure to further reduce bed occupancy by patients with chronic disease [18]. Much of this pressure has focused on reducing admission rates of people with diabetes through improved medical management in primary care [19,20], rather than by reducing length of stay following admission.

Despite the potential clinical and economic importance of this issue, there are no adequate UK data estimating the excess diabetes bed occupancy after adjusting for the confounding effects of factors such as age, speciality, case severity and seasonal variation in length of stay. The aim of this study was to describe bed occupancy data in people with diabetes after adjusting for these factors for a large inpatient population discharged with a diagnosis of diabetes, before and after the introduction of a DISN service.

Patients and methods

Population

Inpatient bed utilization data were analysed for the 989-bedded Norfolk and Norwich University Hospital NHS Trust, Norwich, UK an acute teaching hospital and the single provider of inpatient care for a mixed urban and rural population of 585 000 people. There are 16 944 people with known diabetes in this population, 95% of whom are Caucasian. Data were analysed separately for each of 24 consecutive 3-month periods ('quarters') beginning 1 October 1998 and ending 6 years later on 30 September 2004. The DISN service was introduced in the last 2 years (1 October 2002 to 30 September 2004) when one diabetes inpatient DISN was in post, a service unavailable previously. All data were anonymized hospital activity data, and approval for the use of the data was given by the Caldicott guardian.

The role of the diabetes inpatient specialist nursing service.

The role of the DISN service was to reduce excess diabetes-related bed occupancy solely on orthopaedic, general surgical, urological, general medicine, medicine for the elderly (MFE) and the other medical specialty wards by improving the quality of care for diabetes inpatients in these specialties, particularly those managed with insulin. Referral guidelines to the DISN service asked for patients from these specialties to be referred to the DISN under the following conditions:

- if they were treated with insulin with variable blood glucose control;
- had recurrent hypoglycaemia;
- treatment with insulin sliding scales;
- peri-operative sliding scale insulin;
- newly diagnosed Type 2 diabetes;
- Type 2 diabetes requiring inpatient or outpatient insulin conversion;
- admission with diabetic ketoacidosis;
- admission for acute hypoglycaemia.

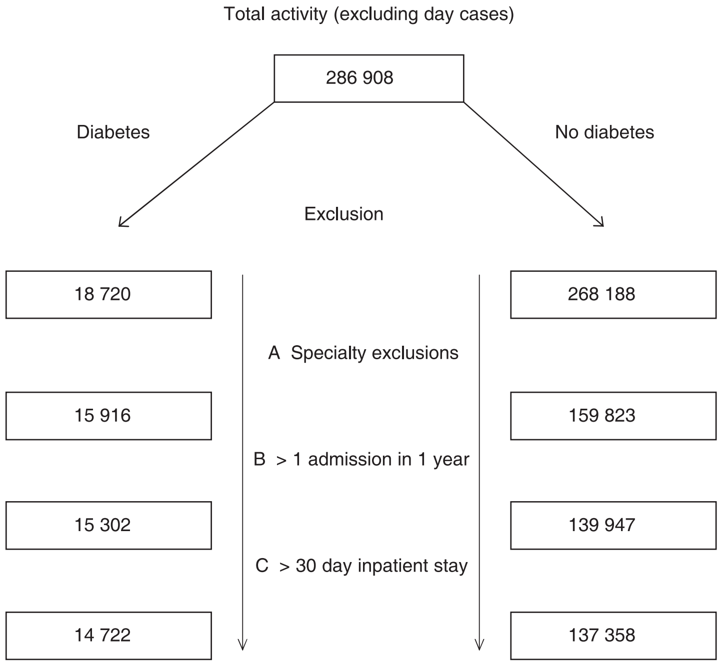
In addition, structured group education in diabetes management for all staff on wards in these clinical areas was introduced. The DISN service did not extend to other clinical areas. DISN activity is shown in Table 1.

Table 1 Summary of direct clinical and educational activity by one diabetes inpatient specialist nurse (DISN) in 1 year (1 October 2003 to 30 September 2004)

Activity	*n*
General review of insulin regimen	394
Follow-up visit	303
Insulin dose adjustment	223
Conversion to insulin regimen	113
Sliding-scale insulin adjustment	77
Type 2 diabetes review/education	63
Hypoglycaemia review	59
Review pre-discharge	40
Diabetic ketoacidosis review	28
Ward nurses attending group education	383

Exclusion of subjects from data analysis

Pre-specified exclusions from this study are shown in Fig. 1. These exclusions were designed to allow an estimate of excess bed days in only those specialties serviced by the DISN. Therefore, only data from orthopaedic surgery, general surgery, urology, MFE or acute medical specialities (general medicine, cardiology, respiratory, renal, gastroenterology and endocrine teams) were analysed. The main specialty titles and codes used for this analysis are those recognized by the UK Department of Health Hospital Episode Statistics (HES), and the UK Royal Colleges and Faculties, and are as follows: general medicine (300), general surgery (100), trauma and orthopaedics (110), urology (101), cardiology (320), respiratory medicine (340), endocrinology (302), gastroenterology (301), geriatrics (430) and renal medicine (361). Inpatients admitted more than once to the same speciality within one financial year have been excluded, to limit confounding by differences in survival



Year	1998/1999	1999/2000	2000/2001	2001/2002	2002/2003	2003/2004	2004/2005
Diabetes	934	1777	2239	2407	2824	3000	1541
No diabetes	11 556	23 062	22 359	22 221	22 641	23 591	11 930

Figure 1 Discharge exclusions and annual distribution of 286 908 discharges between 1 October 1998 and 30 September 2004. For definition of coding diagnosis of diabetes and specialty exclusions see text. Data are shown as numbers of discharges after the previous exclusion. Note that 1998/1999 and 2004/2005 data are derived from two quarters only.

between groups. The very small number of inpatients staying ≥ 31 days or more within a single admission spell (Fig. 1) were also excluded as most had overwhelming neurological morbidity or social delays in discharge that accounted for their prolonged stay. All day-case procedures were excluded, as were patients with a diagnosis of diabetic ketoacidosis, hyperosmolar coma, or severe hypoglycaemia who were admitted directly to endocrinology (302) on the day of admission. In-hospital deaths were recorded as a coded discharge.

Excess bed days because of diabetes

The final cohort (Fig. 1) consisted of 14 722 subjects with a primary or secondary discharge code for diabetes, and 137 358 without diabetes. The primary end point in this analysis was excess length of stay per diabetes patient estimated for each of the 24 quarterly periods in the 6-year observational period for general surgery (specialty code 100), for the general medicine group, and for a group of all the specialties—the above combined with urology and trauma and orthopaedics. In each of these specialty groupings and quarters, data were analysed for three age-bands: between 18 and 60 years old; 61–75 years old inclusive; and > 75 years old. Excess diabetes bed days were estimated separately for each quarterly period, specialty group and age group by analysing observed total diabetes bed occupancy (days) and an expected bed occupancy derived from all the equivalent population without diabetes in the matched age band, quarter and specialty. Excess diabetes bed occupancy per quarter was then adjusted for number of diabetes patients in that quarter, to give excess bed days per diabetic patient for each category.

Recording and under recording of diabetes on discharge coding

Diabetes was defined on discharge coding of ICD (International Classification of Diseases) codes E10 to E14. The frequency distribution of the number of patients in each category was: E10—insulin-dependent diabetes, 24.6%; E11—non-insulin-dependent diabetes, 74.9%; E12—malnutrition-related diabetes mellitus, 0.02%; E13—other specified diabetes, 1.3%; and E14—unspecified diabetes mellitus, 0.2%. The hospital records and codes all primary and secondary discharge diagnoses. It is recognized that routine inpatient discharge data does not always carry a correct co-diagnosis of diabetes [21,22]. Nearly all local patients requiring insulin have been managed in hospital outpatient care since 1987 and were coded as having diabetes post-discharge. Type 2 patients who were not treated with insulin were managed in primary care and enter our mobile complications-screening programme [23,24]. A randomly selected sample of 1000 subjects with known Type 2 diabetes in 1998 was created from this programme, and we examined their later admissions to determine the extent of missed diabetes-related discharge codes.

Data analysis

The primary outcome variable was mean excess bed days per diabetic patient for each quarter, age band and specialty group by comparison with matched groups who did not have diabetes, before and after the introduction of a DISN service. One-way repeated measures ANOVA was undertaken across the six consecutive years of data for each age group, specialty and quarterly period, and further analysis was only undertaken if there was a significant difference ($P < 0.05$) on one-way ANOVA. Unpaired post-hoc student *t*-tests were applied to quarterly data for the first year, or the second year of the DISN programme, matched to the preceding quarterly mean from the 4 years before the DISN appointment. All data is shown as mean and 1 SD, or median and interquartile range (IQR).

Results

Hospital bed utilization

After pre-specified exclusions (Fig. 1), 152 080 patients were discharged over 6 years, 14 722 (9.7%) with a primary or secondary diagnosis code of diabetes. This is an average discharge rate of 43.0 patients per 1000 of the general population, and 4.2 diabetes patients per 1000 of the general population per year. The 152 080 patients incurred 822 255 bed days, of which 101 564 (12.4%) were diabetes related. In the last year before the DISN appointment, median (IQR) lengths of stay for all inpatients with diabetes were 4.0 (6.0) days (< 60 years), 5.0 (8.0) days (61–75 years) and 6.0 (8.0) days (> 75 years old). The equivalent data for patients without a diabetes discharge code were 2.0 (4.0) days (< 60 years), 4.0 (7.0) days (61–75 years) and 6.0 (9.0) days (> 75 years old). In the diabetes population, 48.2% of diabetes inpatients aged < 60 years old were ICD E10 (insulin dependent), compared with 11.4% (61–75 years old) and 4.6% (> 75 years old).

Prevalence of diabetes by age band, specialty and year

There was a trend to increasing prevalence of recorded diabetes each year, significant for those under 60 years old ($y = 0.41x + 41.6$; $r = 0.92$ $P = 0.01$, a mean increase in prevalence per year of 0.41%), and for those aged 61–75 years old ($y = 0.76x + 7.9$; $r = 0.72$; $P = 0.04$, a mean increase in prevalence per year of 0.76%), but not for those over 75 years old ($y = 0.53x + 11.5$; $r = 0.41$; $P = 0.4$; Fig. 2).

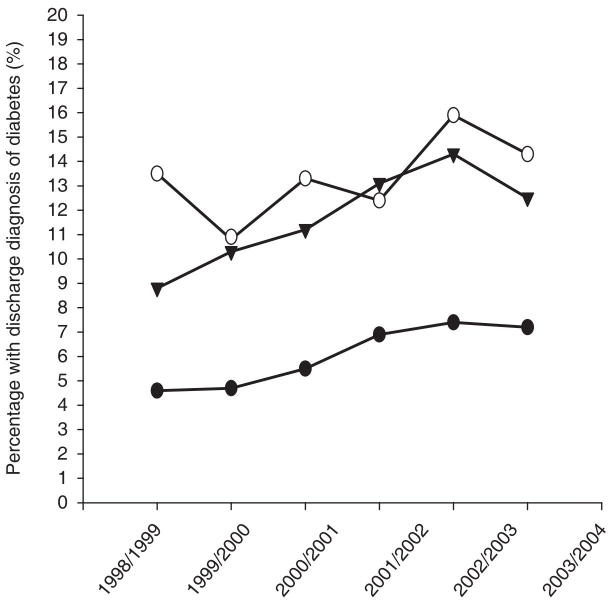


Figure 2 Percentage of inpatients with diabetes by age group and year, for 14 722 discharges with diabetes and 137 358 control subjects. Data are shown as percentage of discharges with coded diabetes for all subjects for consecutive years, by age band from 1 October 1998 to 30 September 2004. Subjects < 60 (●), 61–75 years (○), 75 years (▼).

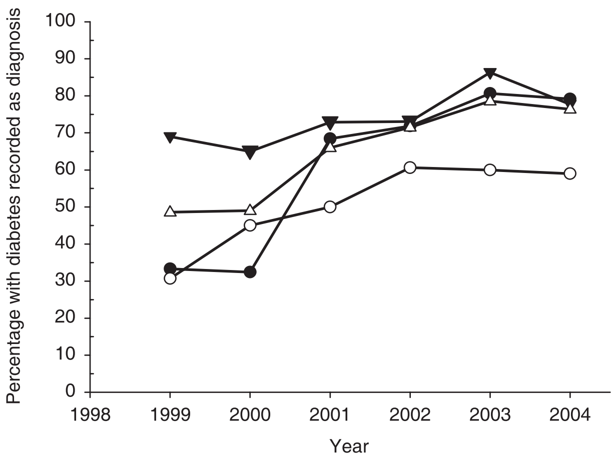


Figure 3 Percentage of patients known to have Type 2 diabetes in 1998, correctly discharge coded as having diabetes for admissions between 1999 and 2004 by specialty. Surgical (●), orthopaedic (○), 'medicine' (▼), all (△).

Correct recording of diabetes as a diagnosis

The separate cohort of 1000 patients with known Type 2 diabetes in 1998 (mean age 70.1 years, median diabetes duration 9 years, 34.1% treated with diet, 65.9% taking oral glucose-lowering agents) generated 179 admissions in 1999, increasing to 259 in 2004 (Fig. 3). Correct recording of known diabetes improved significantly between 1998 and 2004 for all patients with known diabetes ($y = 5.7x + 41.6$; $r = 0.91$, $P = 0.005$), an improved prevalence recording of 5.7% per year. However,

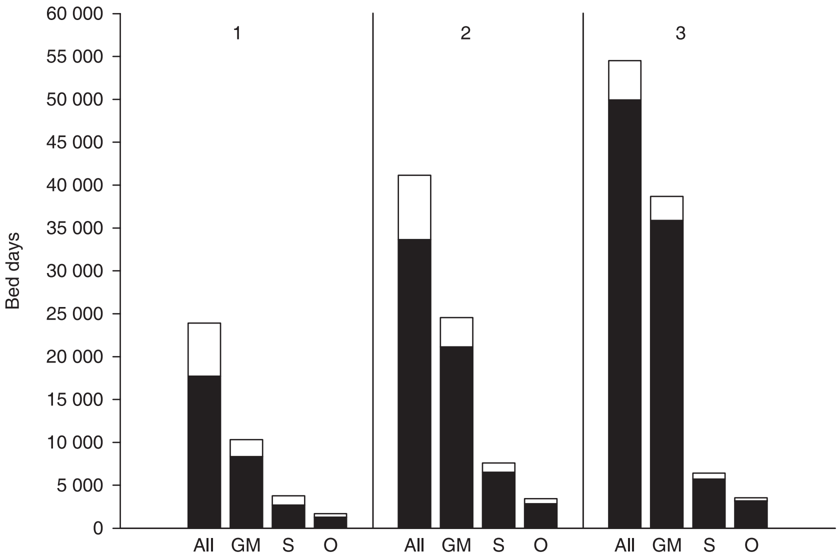


Figure 4 Appropriate and excess bed occupancy by age and specialty for 14 722 diabetes patient discharges. Data are shown for diabetes patients < 60 years old (panel 1), 61–75 years old (panel 2) and > 75 years old (panel 3). 'Excess' bed occupancy (□), defined as in the text; 'appropriate' diabetic bed occupancy (■), defined as expected bed occupancy derived from matched control populations without diabetes. All discharges include the medical (GM), surgical (S) and orthopaedic (O) populations. Distribution of discharges summarized in the text.

Table 2 Mean excess length of stay (days) per diabetic patient by age band and specialty group before and after the DISN appointment

	Year					
	1998/1999	1999/2000	2000/2001	2001/2002	2002/2003	2003/2004
All inpatients						
< 60 years	1.8 (0.5)	1.9 (0.6)	1.9 (0.3)	1.9 (0.2)	1.5 (0.2)	1.2 (0.3)*
61–75 years	1.7 (0.4)	1.8 (0.3)	1.4 (0.1)	1.4 (0.5)	1.3 (0.5)	0.8 (0.2)**
> 75 years	0.3 (0.4)	0.9 (0.2)	0.9 (0.5)	0.9 (0.6)	0.9 (0.5)	1.1 (0.5)
General surgical inpatients						
< 60 years	2.9 (1.2)	2.2 (0.8)	1.6 (1.5)	2.2 (1.1)	1.3(0.5)	1.1 (0.5)
61–75 years	1.5 (0.3)	2.3 (1.3)	2.0 (0.9)	1.8 (1.1)	0.8 (0.5)	1.0 (0.9)
> 75 years	0.7 (0.5)	2.1 (1.7)	1.5 (1.0)	0.8 (0.8)	0.8 (0.8)	0.9 (0.4)
General medical inpatients						
< 60 years	1.4 (07)	1.7 (0.7)	2.1 (1.5)	1.2 (0.4)	1.5 (0.4)	0.9 (0.2)
61–75 years	1.0 (0.7)	2.3 (2.3)	1.3 (0.7)	1.2 (0.8)	0.7 (0.8)	0.7 (0.3)
75 years	0.6 (0.5)	1.1 (0.5)	0.6 (0.5)	0.6 (0.6)	0.5 (0.4)	0.9 (0.4)

Data shown as excess bed days per diabetic patient per quarter, shown as mean (SD) for each year (n = 4 data points for each year).
Data across 6 years analysed by repeated measures ANOVA. The definition of the clinical groups is given in text.
*$P < 0.05$ for year 2003/2004 (second DISN year) compared with 4 years preceding baseline mean, if ANOVA $P < 0.05$.
**$P < 0.01$ for year 2003/2004 (second DISN year) compared with 4 years preceding baseline mean, if ANOVA $P < 0.05$.

23.6% of this cohort with known diabetes had an admission in 2004 for which diabetes was not recorded. Median hospital length of stay (LOS) in those correctly coded as having diabetes did not differ significantly from those with known diabetes not coded as having diabetes.

Total excess bed days by age group and specialty

The 101 564 diabetes bed days were distributed as 17.5% in those < 60 years, 33.2% in those 61–75 years, and 49.2% in those > 75 years. After adjusting for the confounding factors outlined above, 18 161 (17.8%) of these diabetes bed days were regarded as in excess of the matched groups without diabetes. This excess bed occupancy was concentrated in younger groups. In the 50 025 bed days in those > 75 years old only 4474 (8.9%) were excess, compared with 7493 excess days of 33 730 (22.2%) in those aged 61–75 years, and 6194 excess bed days of 17 809 (34.7%) in those < 60 years old. The distribution by specialty was similar (Fig. 4).

Estimated baseline excess bed days per patient

Excess bed days per diabetic patient by age band and specialty group are shown in Table 2. There was no significant change on ANOVA in excess mean bed days per diabetic patient in the 4 years before the DISN appointment in any category. However, after the DISN appointment there were significant falls ($P = 0.04$ on ANOVA) in mean excess bed days per diabetic patient over 6 years in the group of all specialties for those aged < 60 years, and in those aged 61–75 years.

In those aged < 60 years old, the mean excess bed days per diabetic patient was 1.2 (0.3) days in the second year of the DISN service, significantly lower ($P = 0.03$) compared with the first 4 years baseline mean excess LOS of 1.9 (0.3) days before the DISN appointment. This is equivalent to a reduction of 36.8% in excess bed days per diabetic patient, or 700 bed days per year per 1000 diabetic inpatients under 60 years old.

In those aged 61–75 years old, the mean excess bed days per diabetic patient was 0.8 (0.2) days in the second year of the DISN service, significantly lower ($P = 0.008$) compared with the first 4 years baseline mean excess LOS of 1.5 (0.1) days before the DISN appointment. This is equivalent to a 46.6% reduction in excess bed days per diabetic patient, or 700 bed days per year per 1000 diabetic inpatients aged 61–75 years old.

The reduction in excess diabetes occupancy based on this data was 1330 bed days saved in the second year of the DISN programme (2003/2004) when there were 738 diabetes inpatients under 60 years old, and 1330 aged 61–75 years old.

Population-adjusted excess diabetes bed days

Annual trends in excess diabetes bed days and diabetes inpatient numbers are shown in Fig. 5. The number of excess bed days increased significantly each year for the 4 years before the DISN appointment ($y = 420x + 1715$; $r = 0.94$; $P = 0.05$; a mean increase of 420 excess bed days per year), but after the DISN appointment, the trend to increasing excess bed days per year became non-significant over 6 years ($y = 211x + 2195$; $r = 0.66$; $P = 0.14$; a mean increase of 211 excess bed days per year).

In the second year of the DISN programme, 2838 excess diabetes bed days were recorded in all specialties (Fig. 5), giving an estimated 167 excess bed days per 1000 patients with known diabetes in the local population, and 4.9 excess diabetes bed days per 1000 subjects of the general population, based on local data (2003/2004) of 16 944 known patients with diabetes, and a total general population of 585 000.

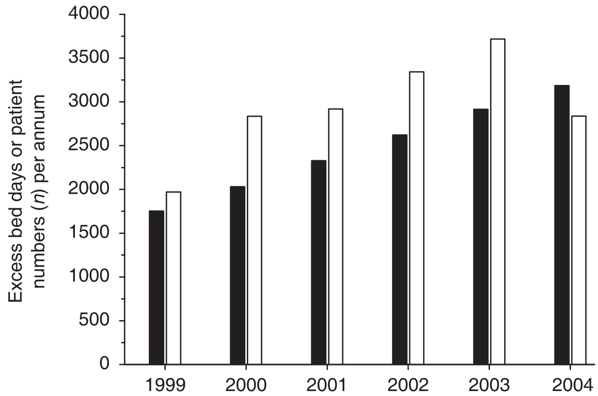


Figure 5 Trends in total excess diabetes bed occupancy (□) and diabetes patients (■) per annum, before (1999–2002) and after (2003–2004) the diabetes inpatient specialist nurse service. Data are shown for all diabetes inpatients and all diabetes excess bed occupancy.

Discussion

This study described patterns of bed occupancy for people with or without diabetes in the main medical and surgical specialties. For those with diabetes, bed occupancy was characterized before and after the introduction of a dedicated DISN service, to determine if excess bed occupancy could be reduced. In both absolute and relative terms, most excess diabetes bed occupancy was associated with younger inpatients, and excess diabetes bed occupancy by patients over 75 years old was less evident. The presence of a DISN service was associated with a notable reduction in excess bed days per patient, but only in younger age groups.

The strength of this analysis is that diabetes bed occupancy data was adjusted for age-, calendar quarter-, and specialty-matched equivalent data from people who did not have diabetes, and adjusted for long-term trends in bed occupancy. There are little accurate data on the true excess bed occupancy associated with inpatient stay by diabetes patients [5–11]. Most studies have not corrected for confounding variables, and have rarely stressed that most diabetes bed occupancy is appropriate once patients are admitted. The diabetes population under 60 years old would have lower absolute but higher relative rates of co-morbidity than the control subjects, particularly for cardiovascular disease, than those over 75 years old [5,6,10]. Half of these patients under 60 years old were treated with insulin. One possible interpretation of these data is that higher relative co-morbidity rates in younger diabetes groups, compared with matched groups without diabetes, and inefficient insulin management on non-specialist wards, are contributors to this excess. The majority of insulin-treated inpatients had direct contact from the DISN, mostly for insulin-management issues. Clinical selection bias means that adequate diabetes control groups were not available to test this hypothesis, but improved glycaemic control in inpatients with or without diabetes may result in improved outcomes and length of stay [25,26], and intervention data from small selected diabetes populations in the UK and USA suggest that diabetes educator or specialist nurse support for selected diabetes groups can reduce length of stay [13–17].

A limitation of this study is that excess LOS is partly a result of the case severity of admitted patients, and that some of the excess LOS in diabetes is unavoidable. In addition to increased LOS, diabetes patients also have an increased likelihood of being admitted in the first place for many medical conditions. The USA National Hospital survey [6,26] recorded 371 314 diabetes admissions in 45–64 years olds, and 712 725 diabetes admissions in those over > 65 years. The middle aged (although not the elderly) were more likely to be admitted (overall RR 1.6; OR 1.2–2.0; $P < 0.001$), for many medical conditions, for instance, peritonitis, respiratory failure or fractured neck of femur. This is similar to Scottish data from the DARTS–MEMO collaboration [7]. It is possible that increased admission rates for diabetic patients with general medical conditions reflect a bias towards admitting such patients if they have diabetes, and we observed that diabetic patients were more likely to be admitted than discharged on the day of presentation. However, one unexamined possibility is that obesity in diabetes populations drives increased admission rates for medical conditions not directly related to diabetes or diabetes complications [27,28]. Readmission rates were significantly lower for diabetic patients than control subjects and the reasons for this could include higher survival rates in control subjects [29], but one untested possibility was that a longer inpatient stay in diabetic patients was beneficial in reducing readmission rates [30]. A further weakness of this analysis is that it was observational, and the mechanisms underlying any impact of the DISN service needs to be examined with adequately powered multi-centre randomized control trials. This is particularly important as many hospitals in the UK now offer a DISN service, and it is unknown if the benefit of the DISN model is because of direct patient contact, or the DISN improving diabetes care skills in ward staff.

The annual admission rate of 25.9% for elderly Type 2 diabetes patients is compatible with data on diabetes admission rates in the UK and Scandinavia [7–9]. The cohort follow-up also indicates improving diabetes recording between 1998 and 2004, particularly for surgical specialties. Poor discharge coding of diabetes is not a problem confined to the UK [19,20] and is poorest for subjects not using insulin [8,20], perhaps because what is perceived to be the more serious primary diagnosis takes precedence for accuracy over a secondary diagnosis such as diabetes [20]. It is important to realize that this data underestimates the activity associated with inpatient diabetes management, as about one quarter of elderly inpatients with diabetes are not recorded as having diabetes, the cohort is a survivor cohort, and the present data applies only to the main medical and surgical specialties.

This study has important implications in terms of resource use, and supports previous studies that have demonstrated the cost-effectiveness and possible cost savings of a DISN model [13–17]. These data suggest that the costs and mechanisms of benefit of a DISN service should be assessed in a much wider randomized controlled trial. In the meantime, there is increasing evidence to support the introduction of similar services elsewhere.

Competing interests

None declared.

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