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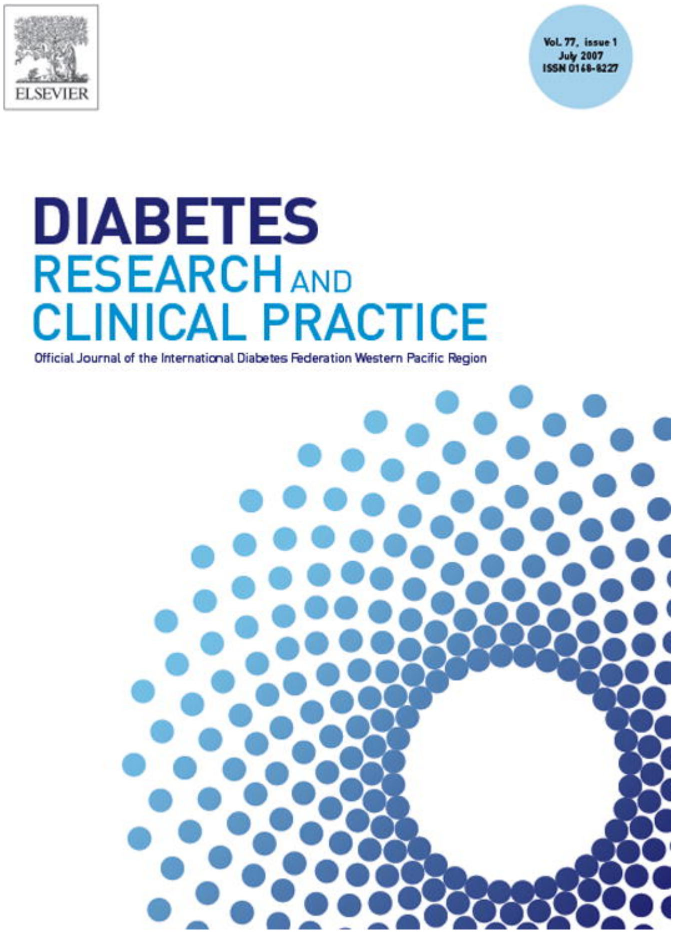

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Total and excess bed occupancy by age, specialty and insulin use for nearly one million diabetes patients discharged from all English Acute Hospitals

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Abstract

To investigate total diabetes bed occupancy and prolonged inpatient length of stay (LOS) in all English Acute Hospitals, we analysed hospital episode statistics (HES) discharge data for all English Acute Hospitals over 4 years for ICD10 discharge codes of E10 ('insulin-dependent diabetes') or E11 ('non-insulin dependent diabetes') by age-band (18–60, 61–75 and >75 years) and specialties. We matched these data to control discharges without these codes. There were 943,613 diabetes discharges (6,508,668 bed days) and 10,724,414 matched controls. Mean diabetes LOS increased with age for each specialty and both E10 and E11 codes, but excess diabetes LOS decreased with age. Excess diabetes LOS was <1.0 days in most groups and highest (1.2 days) in insulin-dependent surgical patients under 60 years old, where 19.7% of bed days were excess. A similar pattern was seen for 76,570 diabetes inpatients with key cardiac or surgical conditions. Excess bed occupancy due to prolonged mean LOS accounted for 325,033 bed days under general medical and surgical codes. There were 25,525 discharges with diabetic ketoacidosis (126,495 bed days) in these 4 years. Excess diabetes LOS is concentrated in younger age groups. Excess bed occupancy due to prolonged LOS in medical and surgical inpatients is three times greater than bed occupancy due to diabetic ketoacidosis. Strategies to reduce excess diabetes bed occupancy should emphasize reducing inpatient LOS in younger inpatients.
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Keywords: Diabetes; Inpatient; Bed occupancy; Length of stay

1. Introduction

Up to 10% of unselected inpatient populations have diabetes and most inpatients with diabetes are admitted because of medical or surgical conditions, rather than the acute or long term complications of diabetes [1–6]. Populations with diabetes have higher hospital admission rates and inpatients with diabetes stay in hospital longer than age-matched controls without diabetes [1–6]. The USA National discharge data described an excess mean inpatient length of stay (LOS) of 2.0 days in middle-aged diabetes inpatient populations [1,2] and there are equivalent data from local populations in the UK and Europe [4–9]. Although the causes for this excess length of stay are unknown, there is increasing evidence from the USA and UK that enhanced diabetes services for inpatients can reduce this excess diabetes bed occupancy [4,10–13]. The UK Diabetes National Service Framework (NSF) and the UK Long Term

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Conditions–Public Service Agreement (LTC–PSA) suggest ambitious targets for improving inpatient diabetes care and reducing chronic disease bed occupancy [14,15]. There are no data on overall or excess diabetes related bed occupancy in a national UK or European population, certainly nothing to compare with the national hospital survey data in the USA [1,2] and little on the contribution of excess LOS to overall national diabetes bed occupancy. The aim of this study was to provide an accurate descriptive analysis of total and excess diabetes bed occupancy due to prolonged length of stay in all English Acute Hospitals by age-band, specialty and insulin dependency in the main medical and surgical specialties and for key cardiac and surgical conditions.

2. Methods

2.1. Hospital episode statistics (HES) database

The UK Department of Health HES database contains discharge activity records for each financial year (1st April–31st March) for all National Health Service (NHS) providers in England. The HES dataset is created from nearly 300 NHS Hospitals. The presentation of these data are summarized elsewhere [16]. The diabetes population of England (2001) was estimated as 2,168,000 with an overall diabetes prevalence of 4.41% [17].

2.2. Diagnostic codes in HES

Diagnosis codes are taken from the established International Classification of Diseases, ICD10 [16]. To limit diagnostic uncertainty, data were obtained only for ICD10 E10 (‘insulin-dependent diabetes’) and ICD10 E11 (‘non-insulin-dependent diabetes’) as either a primary or any secondary diagnosis on discharge coding. The smaller number coded as diabetes E12–E14 (malnutrition, ‘other’, or ‘unspecified’ diabetes) have been excluded. The percentage of E12, E13 or E14 diagnoses were 0.00002, 0.2 and 3.2%, respectively in 1 year. HES data describe E10 or E11 patients as insulin-dependent, or non-insulin-dependent (rather than Type 1 or Type 2 diabetes), we have retained this terminology in this paper. E10 and E11 diagnostic codes include ICD subclasses for diabetic ketoacidosis (E10.1 or E11.1), renal complications of diabetes (E10.2 or E11.2), peripheral vascular complications (E10.5 or E11.5) or neurological complications (E10.6 or E11.6).

2.3. Specialty definitions

In the HES database, episodes are grouped according to the contracted specialty of the consultant physician or surgeon with primary responsibility for the patient. The main acute medical and acute surgical HES specialty titles and codes are those recognized by the UK Department of Health and UK Royal Colleges and Faculties [16]. These are: general medicine (300), general surgery (100), trauma and orthopaedics (110), cardiology (320), respiratory medicine (340), endocrinology (302), gastroenterology (301), geriatric medicine (430) and renal medicine (361). All inpatient activity of UK physicians is recorded under general medicine (specialty code 300) if they have any ‘generalist acute medical responsibilities’ [16]. Most UK physicians have acute general medical inpatient responsibilities and their activity (acute general medical or specialty) is recorded under HES 300. On 1.4.04, a new HES specialty code (307) of ‘diabetic medicine’ was created—the present analysis relates only to activity before these changes. Also, this analysis is based upon total inpatient spell and not to finished consultant episodes (FCE).

2.4. Data exclusions

Data were obtained and analysed for the period and specialty codes outlined above, for three age-bands (18–60, 61–75 and >75 years), with day-case and day-surgery activity excluded and with all inpatient stays greater than 30 days excluded. Age-band, year and HES specialty-code-matched data for all inpatients without an ICD E10 or E11 diagnosis were also obtained for the same period and with the same exclusions.

2.5. Key clinical indicators

The UK Diabetes NSF suggests studying changes in mean or excess LOS data for certain key clinical conditions as indicators of the quality of diabetes care [3]. We obtained and analysed national data using the same criteria as above, for these key clinical conditions as a primary diagnosis, in subjects also with a secondary diagnosis of ICD E10 or E11 coded diabetes and compared these data to age-band and specialty-matched controls with the same primary diagnosis, but no E10 or E11 code. These key clinical indicators were: congestive cardiac failure (ICD10 I50.0), left ventricular failure (ICD10 I 50.1), angina (ICD10 I 20.9), fractured neck of femur (ICD10 S72), total hip replacement (OPCS4 W40), cholecystectomy (OPCS4 J18) and cholelithiasis (ICD10 K80.1). The data for the cardiac indicators were analysed for general medicine alone (HES Specialty code 300), total hip replacement and fractured neck of femur for Trauma and Orthopaedics alone (HES Specialty Code 110) and cholecystectomy and cholelithiasis for general surgery alone (HES Specialty Code 100).

2.6. Data analysis

The primary variables in this analysis were numbers of discharges, mean length of stay (LOS in days) and occupied bed days per annum, by age, specialty code and type of diabetes (E10 or E11) for 4 consecutive years (1.4.00–31.3.04). For each year, specialty and age-band a mean LOS, excess mean LOS (mean diabetes LOS − mean control LOS) were estimated. An annual mean (S.D.) over 4 years for these variables was derived

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Table 1
Distribution by age-band and specialty of 943,613 patients discharged with a diagnosis of diabetes and 6,508,668 associated bed day from all English Hospitals over 4 years (2000–2004)

Specialty and age-band	Discharges			Bed days	
	E10	E11	Controls	E10	E11
18–60 years					
General surgery	18,032 (1.9%)	32,135 (3.4%)	1,501,453	102,041 (1.6%)	162,930 (2.5%)
Trauma and orthopaedics	8,178 (0.8%)	12,203 (1.3%)	885,606	43,226 (0.7%)	64,802 (0.9%)
General medicine	70,988 (7.5%)	82,446 (8.7%)	1,709,553	359,780 (5.5%)	428,555 (6.5%)
Cardiology	5,307 (0.6%)	15,009 (1.6%)	229,784	22,980 (0.4%)	62,590 (1.0%)
Geriatric medicine	2,444 (0.2%)	4,549 (0.5%)	85,197	13,982 (0.2%)	25,217 (0.4%)
61–75 years					
General surgery	13,459 (1.4%)	54,170 (5.7%)	765,346	91,361 (1.4%)	342,254 (5.2%)
Trauma and orthopaedics	5,851 (0.6%)	24,799 (2.6%)	385,630	48,920 (0.7%)	194,493 (2.9%)
General medicine	41,257 (4.4%)	166,714 (17.7%)	1,381,609	293,387 (4.5%)	1,105,481 (17.0%)
Cardiology	5,558 (0.6%)	29,751 (3.2%)	252,802	31,187 (0.5%)	157,196 (2.4%)
Geriatric medicine	6,178 (0.7%)	22,139 (2.3%)	180,081	45,909 (0.7%)	194,458 (2.9%)
>75 years					
General surgery	4,154 (0.4%)	34,966 (3.7%)	540,895	42,019 (0.6%)	250,921 (3.8%)
Trauma and orthopaedics	2,762 (0.3%)	18,005 (1.9%)	405,689	28,971 (0.4%)	189,830 (2.9%)
General medicine	19,795 (2.1%)	124,061 (13.1%)	1,291,770	162,185 (2.4%)	980,648 (15.1%)
Cardiology	1,619 (0.2%)	13,080 (1.4%)	139,279	10,462 (0.2%)	80,998 (1.2%)
Geriatric medicine	17,112 (1.8%)	86,892 (9.2%)	969,720	126,318 (1.9%)	845,567 (13.0%)
Total	222,694 (23.6%)	720,919 (76.4%)	10,724,414	1,422,728 (21.8%)	5,085,940 (78.2%)

Data shown as number and percentage (%) of all discharges or bed days.

from the four consecutive annual data points. Excess bed days for diabetes were estimated for each year as a point estimate derived from: excess diabetes LOS *x* number of diabetic patients, for each age-band and specialty.

3. Results

3.1. Distribution of total diabetes discharges and associated occupied bed days (Table 1)

There were 943,613 discharges with a diagnosis of diabetes and 6,508,668 associated bed days in this 4 year period. The distribution of these discharges and bed days are shown by age-band and diabetes discharge code (E10 or E11) (Table 1). There were 222,694 (23.6%) discharges coded as E10 ('insulin-dependent') and 720,919 (76.4%) coded as E11 ('non-insulin-dependent'). Of the E10 ('insulin-dependent') coded discharges, 104,949 (47.1%) were aged 18–60 years old compared to 72,303 (32.5%) and 45,442 (20.4%) for the 60–75 and >75 years age-bands, respectively.

3.2. Mean LOS (days) and excess mean LOS (Table 2)

Mean LOS for diabetes and control populations are shown in Table 2. Mean LOS increased progressively by age-band for each specialty and for both diabetes and control populations. Excess mean diabetes LOS (days) compared to controls was relatively modest, rarely more than 1.0 days and was highest (1.2 days) in surgical discharges aged 18–60 years old with an E10 ('insulin-dependent') code. Excess mean LOS declined with increasing age-band, was significantly lower in groups over 75 compared to the 18–60 year old group ($p = 0.038$ for E10 and $p = 0.003$ for E11) and was close to zero for most groups over 75 years old (Table 2).

3.3. Excess bed days due to excess mean LOS (Table 2)

The estimated excess bed days for each group and the percentage of excess bed days due to prolonged LOS are shown in Table 2. In the 18–60 year old group, 251,291 bed days were excess (19.5% of all bed days in this age-band). The highest percentage of excess bed days (24.0%) was for cardiology discharges with an E11 ('non-insulin-dependent') code, although numerically the greatest excess was for E11 ('non-insulin-dependent') codes with a general medicine discharge code (82,446 excess bed days). In the 61–75 year old group, 140,219 bed days were excess (5.6% of all bed days in this age-band). The highest percentage of excess bed

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Table 2
Mean length of stay (LOS), excess LOS and excess diabetes bed days due to prolonged LOS by age-band and specialty for 943,613 patients discharged with a diagnosis of diabetes from all English hospitals over 4 years (2000–2004)

Specialty and age-band	Mean LOS (days)			Excess LOS (days)		Estimated excess bed days (%)	
	E10	E11	Controls	E10	E11	E10	E11
18–60 years							
General surgery	5.4 (0.1)	5.1 (0.1)	4.2 (0.2)	1.2	0.9	18,032 (17.6%)	32,135 (19.7%)
Orthopaedics	4.8 (0.1)	5.3 (0.2)	4.6 (0.1)	0.2	0.7	8,178 (18.9%)	12,203 (18.8%)
General medicine	4.8 (0.2)	5.4 (0.2)	4.4 (0.1)	0.4	1.0	70,988 (19.7%)	82,446 (19.2%)
Cardiology	4.2 (0.1)	4.2 (0.1)	3.8 (0.1)	0.4	0.4	5,307 (23.1%)	15,009 (24.0%)
Geriatric medicine	4.8 (0.2)	5.6 (0.2)	4.7 (0.1)	0.1	0.1	2,444 (17.4%)	4,549 (18.0%)
61–75 years							
General surgery	6.7 (0.1)	6.3 (0.1)	6.3 (0.1)	0.4	0.0	5,386 (5.9%)	0 (0.0%)
Orthopaedics	7.9 (0.4)	8.0 (0.2)	7.7 (0.2)	0.2	0.3	1,170 (2.4%)	7,439 (3.8%)
General medicine	7.0 (0.2)	7.0 (0.3)	6.5 (0.1)	0.5	0.5	20,628 (7.0%)	83,357 (7.5%)
Cardiology	5.6 (0.2)	5.3 (0.1)	4.9 (0.1)	0.7	0.4	3,891 (12.5)	11,900 (7.5%)
Geriatric medicine	9.8 (0.7)	9.2 (0.2)	9.1 (0.2)	0.7	0.1	4,324 (9.4%)	2,124 (1.1%)
>75 years							
General surgery	7.7 (0.1)	7.3 (0.2)	7.3 (0.1)	0.4	0.0	1,661 (3.9%)	0 (0.0%)
Orthopaedics	11.0 (0.3)	10.7 (0.2)	11.0 (0.1)	0.0	−0.3	0 (0.0%)	5,402 (2.8%)
General medicine	8.2 (0.2)	8.2 (0.3)	8.1 (0.1)	0.1	0.0	1,711 (1.1%)	8,689 (1.0%)
Cardiology	6.5 (0.3)	6.2 (0.2)	6.2 (0.2)	0.3	0.0	485 (4.6%)	0 (0.0%)
Geriatric medicine	10.0 (0.2)	9.9 (0.2)	10.4 (0.1)	−0.4	−0.5	−6845 (−5.4%)	−43,446 (−5.1%)
Total						86,505	201,831

Data Shown as mean (S.D.) for LOS.
Data shown as number and % of bed days excess for each subgroup.

days (12.5%) was for cardiology discharges with an E10 ('insulin-dependent') discharge code, although numerically the greatest excess was once again general medicine discharges with an E11 ('non-insulin-dependent') discharge code (83,357 excess bed days). In the >75 years group, excess mean LOS and excess bed days were negligible. In the geriatric medicine group, the diabetes inpatient population had a shorter mean LOS than controls. Overall, excess bed occupancy due to prolonged mean LOS accounted for 325,033 bed days under general medical and general surgical codes (7.5% of total).

3.4. *Excess mean LOS in key clinical conditions (Table 3)*

The excess mean LOS for eight cardiac and surgical conditions in diabetes populations are shown in Table 3. In all of thee indicators, excess mean LOS in the diabetes population was modest, rarely more than 1.0

Table 3
Excess mean LOS (days) for 76,570 inpatients with diabetes and selected cardiac and surgical discharge diagnoses

Primary discharge diagnosis	*n*	Age-band (years)		
		18–60	61–75	>75
Myocardial infarction	9,098	0.37 (0.1)	0.14 (0.1)	0.02 (0.1)
Congestive cardiac failure	16,483	0.21 (0.2)	0.08 (0.1)	−0.18 (0.1)
Left ventricular failure	12,814	0.01 (0.1)	0.00 (0.1)	−0.04 (0.1)
Angina	12,915	0.22 (0.1)	0.38 (0.2)	0.04 (0.2)
Fractured NOF	10,373	0.81 (0.2)	0.74 (0.4)	0.01 (0.2)
Total hip replacement	7,722	0.49 (0.1)	0.31 (0.1)	−0.28 (0.1)
Cholecystectomy	4,527	1.04 (0.3)	0.55 (0.1)	0.21 (0.2)
Cholecystitis	2,638	1.12 (0.3)	0.47 (0.2)	0.11 (0.2)

Data as mean (S.D.) excess length of stay over 4 years for diabetes (E10 and E11) discharges compared to age-band, specialty and primary discharge diagnosis-matched controls without a diabetes (E10 or E11) discharge code.

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days and was concentrated in the younger age groups.

3.5. Discharges and bed days due to four complications of diabetes (Fig. 1)

In this 4 year period, there were 25,525 discharges with diabetic ketoacidosis (ICD E10.1 or E11.1), 26,067 with diabetes and renal complications (ICD10 E10.2 or E11.2), 35,768 with diabetes and peripheral vascular disease (IC10 E10.5 or E11.5) and 14,926 with diabetes and neurological complications (ICD10 E10.6 or E11.6). These 102,286 discharges represented 10.8% of the total diabetes discharges. The bed days associated with these 102,286 discharges were 126,495 for diabetic ketoacidosis, 176,480 for diabetes and renal complications, 325,055 for diabetes and peripheral vascular disease and 139,403 for diabetes and neurological complications. This was a total bed occupancy of 767,433 bed days (11.8% of total diabetes bed days). The distribution of these discharges and bed days by age-band and insulin dependence is shown for the last year of this period (Fig. 1).

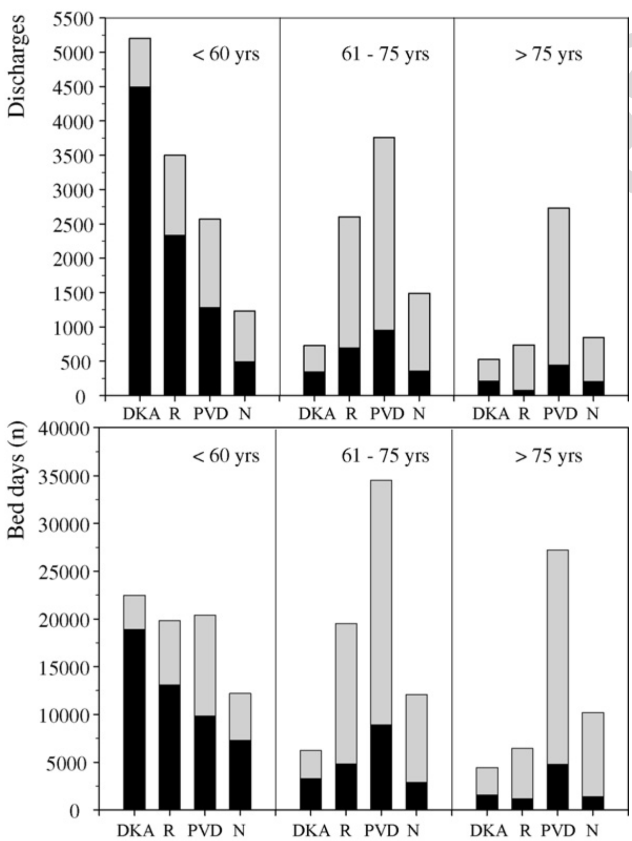

Fig. 1. Distribution of discharges and bed days due to diabetes complications for all English Trusts in 1 year (2003–2004).

4. Discussion

This analysis provides data on the distribution of nearly one million diabetes inpatient discharges by age-band, specialty and diabetes discharge code from the main medical and surgical specialties in all English Hospitals over 4 years. The main observations are that prolonged LOS in diabetes populations is relatively modest (rarely >1.0 days) and concentrated in younger age groups. This pattern also occurs in key cardiac and surgical conditions in diabetes inpatient populations. Finally, total excess bed days due to prolonged inpatient length of stay was three times greater than that due to diabetic ketoacidosis (DKA) bed occupancy over the same period.

Excess LOS was rarely greater than a mean of 1.0 days in any group and at most was 1.2 days (for insulin-dependent surgical patients under 60 years). The relative contributions of age, insulin use, clinical co–morbidities, blood glucose control and staff competencies in diabetes care to prolonged diabetes LOS are relatively unstudied. In the UK and elsewhere, inpatients are commonly managed with 'sliding-scale' insulin algorithms and not reviewed by staff with specific diabetes care competencies [18]. The contribution of this practice to excess LOS in diabetes inpatients is also unknown. The high clinical and economic costs of excess diabetes bed occupancy makes it surprising that the contributors to excess LOS in diabetes inpatients have not been studied in any depth.

Other UK, USA and European analyses on smaller samples, some from 10 to 15 years ago, have shown substantially higher excess mean or median LOS in some diabetes populations [6,8–13], For example, between 1990 and 1997 studies on heterogeneous populations in the UK and USA, reported mean or median diabetes LOS between 7.0 and 12.3 days [6,9–11,19,20] with excess LOS of up to 7.2 days even in an age-adjusted middle-aged UK diabetes population [9]. Intense pressure to limit inpatient LOS in most health care systems may well have driven down mean LOS in both non-diabetes and diabetes populations and reduced excess LOS in the diabetes population over the last decade [21,22]. Recent analysis of the USA National hospital discharge data has in fact shown that aggregate mean inpatient LOS in the USA has declined from 7.4 days (1990) to 4.8 days (2003), that this decline was also apparent in diabetes and other disease specific inpatient populations and that emergency dept. visits for endocrine conditions remained relatively constant over the same period [23]. The lower excess diabetes LOS in older age groups seen in this present analysis has been described before in UK, European and USA populations [1,2,4,5,7–9] and may reflect lower relative co-morbidity rates and perhaps less insulin use in elderly populations. Another possibility is that of shortened LOS in elderly patients because of increased early inpatient mortality in elderly patients with diabetes [24].

A weakness of the present analysis is inaccuracy of discharge coding for diabetes: both under-recording and incorrect recording. We have shown recently that up 23% of inpatients with known Type 2 diabetes discharged from our large UK hospital are still not recorded as having diabetes, although this improved progressively between 1998 and 2004 [4] and is significantly better than in earlier UK studies [25]. In the present analysis, the diagnostic code of E10 ('insulin-dependent') is not concordant with the clinical diagnosis of Type 1 diabetes and patients with insulin treated Type 2 diabetes may well be coded as E10. This would be supported by our observation that 20.4% of diabetes discharges in patients over 75 years old were recorded as E10 and it is more probable that many of these patients are insulin treated patients with Type 2 diabetes.

A common error in bed occupancy analyses is to attribute all bed occupancy by diabetic inpatients with coronary artery or peripheral vascular disease to the diabetes state, ignoring major independent contributions of age, gender, smoking and hypertension to vascular admissions in diabetes patients [26]. Bed occupancy due to DKA however can be regarded as entirely excess bed occupancy due to diabetes. There were 25,525 adults over 18 years old discharged with a diabetic ketoacidosis (DKA) coding in this 4 year period, a new observation for a UK population [27]. A small proportion of DKA patients were discharge coded as non-insulin-dependent diabetes with diabetic ketoacidosis (1CD10 11.1). This small group may be patients with Type 2 diabetes admitted with either severe intercurrent illness and metabolic decompensation [27], incorrect diabetes coding, or miscoding of hyperosmolar non-ketotic coma as DKA, but this is unknown. There were 126,495 bed days associated with DKA discharges, which was just over one-third of the total bed days associated with excess LOS in medical and surgical discharges.

The UK Long Term Conditions–Public Service Agreement (LTC–PSA) proposes an ambitious reduction in UK chronic disease related bed occupancy of 3.6 million bed days by 2008 [15], to be achieved by UK Acute Hospitals and primary care organisations. The growing evidence in the USA and UK that an enhanced inpatient diabetes nurse service can reduce excess diabetes bed occupancy in younger age groups [4], reinforces the value of estimating total and excess diabetes bed occupancy. It is unknown if strategies based on reducing excess diabetes bed occupancy [4] would provide greater or more rapid bed occupancy savings than strategies based on admission avoidance [25,27].

In conclusion, these data describe diabetes bed occupancy recorded centrally for English Acute Hospitals by the UK National Health Service. These data may be helpful for clinical teams in making the case for improved inpatient diabetes services, or for new models of inpatient diabetes care [28–30].

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