**Outcomes and inequalities in diabetes from 2004/5 to 2011/12: English longitudinal study**

Robert Fleetcroft, Honorary Senior Fellow, Norwich Medical School, University of East Anglia, Norwich, UK 01493 717796 [robert.fleetcroft@nhs.net](mailto:robert.fleetcroft@nhs.net)

Miqdad Asaria, Research Fellow, Centre for Health Economics, University of York, York, UK

Tel 01904 321401 [miqdad.asaria@york.ac.uk](mailto:miqdad.asaria@york.ac.uk)

Shehzad Ali, Research Fellow, Centre for Health Economics, University of York, York, UK

Tel 01904 321401 [shehzad.ali@york.ac.uk](mailto:shehzad.ali@york.ac.uk)

Richard Cookson, Professor, Centre for Health Economics, University of York, York, UK

Tel 01904 321401 [richard.cookson@york.ac.uk](mailto:richard.cookson@york.ac.uk)

Corresponding author, Robert Fleetcroft

[robert.fleetcroft@nhs.net](mailto:robert.fleetcroft@nhs.net)

**Abstract**

**Background**

Outcomes of diabetes care are unequal and the NHS has a duty to consider reducing inequality in healthcare outcomes.

**Aim**

To quantify trends in socioeconomic inequality in diabetes outcomes.

**Design and Setting**

Whole-population longitudinal study of 32,482 neighbourhoods (Lower Layer Super Output Areas) in England between 2004/5 and 2011/12.

**Method**

Slope indices of inequality between more and less deprived neighbourhoods measured annually for: (i) glycated haemoglobin control in diabetics, (ii) emergency hospitalisation for diabetes and (iii) mortality from diabetes.

**Results**

Between 2004/5 to 2011/12 glycaemic control improved in all social groups, although inequality was unchanged as measured by the SII (0.04, 95% CI -0.43 to 0.52). Diabetes mortality improved in all social groups, with faster mortality declines in more deprived neighbourhoods. Inequality in diabetes mortality improved, with the SII falling by 2.68 (95% CI 1.93 to 3.43) resulting in 594 (95% CI 420 to 767) fewer deaths. In contrast emergency hospitalisations for diabetes increased in all social groups, with faster growth in more deprived neighbourhoods. The socioeconomic gradient increased with the SII widening by 19.59 admissions for diabetes per 100,000 (95% CI 16.00 to 23.17) resulting in an increase in excess admissions associated with socioeconomic inequality of 5,991 (95% CI 5,084 to 6,899) compared to 2004/5.

**Conclusion**

In diabetes mortality declined faster, but emergency hospitalisation grew faster in more deprived neighbourhoods. Unequal growth in hospitalisation for diabetes is partly due to increased diabetes prevalence and patients living longer, but may also be due to over-use of glycaemic control medication.

Keywords

Diabetes mellitus, socioeconomic factors, quality of healthcare, mortality, emergency medicine, patient admission.

**How this fits in**

More than 2.7 million adults in the UK had a diagnosis of diabetes in 2013, 90% of which is type II diabetes.

Type II diabetes is socially patterned with prevalence 50% higher in the most deprived fifth of the population compared with the least deprived fifth.

Our research found that mortality from diabetes improved faster in more deprived neighbourhoods between 2004/5 and 2011/12, inequalities in glycaemic control were unchanged, while inequalities in emergency hospitalisations for diabetes complications increased faster.

**Introduction**

In 2013, 2.7 million adults over the age of 17 were diagnosed with diabetes in the UK.[1] 10% had type I diabetes [2] and 90% had type II diabetes, which is more likely to be influenced by lifestyle factors.[3] Type II diabetes is socially patterned, with prevalence approximately 50% higher in the most deprived compared with the least deprived quintile group.[4] Both types of diabetes have potentially serious complications decreasing both quality and length of life.[3] The NHS in England spent £3.9 million on diabetes services in 2009-10, approximately 4% of the NHS budget. [5] One important aspect of diabetes management is the control of HbA1c (glycated haemoglobin) levels, which reduces the risk of complications, hospitalisation and mortality. [6]

In 2003, the UK Government made reducing health inequality a key priority of national health policy. [7, 8] This was supported by several major investments with potential impact on reducing inequalities. Firstly, the Quality and Outcomes Framework (QOF) pay-for-performance programme introduced in 2004.[9] The QOF contains financial incentives for achieving clinical targets in controlling glycaemia, cholesterol levels, and blood pressure; and also for the recording of retinal screening, foot examination, neuropathy testing, and urine examination for microalbuminuria. Secondly, the ‘Equitable Access to Primary Care’ programme rolled out in 2008 invested £250 million in the 25% most under doctored primary care trusts (PCTs), providing over 100 new general practices and an additional GP-led health centre in each PCT.[10, 11] Thirdly, targeted support for effective primary care interventions for chronic conditions (including diabetes) in disadvantaged adults from 2007 to 2009.[12] In 2012, the NHS Health and Social Care Act gave the NHS an explicit duty to consider reducing inequalities in healthcare outcomes.[13] In this study we examine NHS equity performance in tackling inequalities in diabetes outcomes during this key period.

**Methods**

We identified three indicators to track socioeconomic inequality in the outcomes of care for diabetes along the patient pathway. These indicators were developed using an iterative process involving the public, public health experts and NHS experts including those from primary and secondary care. [8]

The first indicator was the achievement of good glycaemic control in patients with diabetes using the lower threshold target for HbA1c from QOF. We compared the number of people achieving this threshold with the number of people registered as having diabetes at GP practice level. The threshold has changed on various occasions since the inception of QOF in 2004/5 as detailed in Table 1 and we used the relevant threshold for each period.

The second indicator was preventable emergency hospitalisation for diabetes. We counted the number of people per 100,000 population having one or more emergency hospitalisations for those diabetes complications that are defined as being preventable by the NHS outcomes framework. [14] The ICD-codes for these complications are listed in Table 2.

The final indicator was amenable mortality from diabetes related causes. This was defined as the number of deaths in a given year per 100,000 population under the age of 75 from diabetes related causes considered amenable to health care by the ONS (primary cause of death ICD-10 codes E10 to E14).[15]

For glycaemic control, we started with QOF achievement data which was available at GP practice-level. We then used the ‘NHS Attribution Data Set’ of GP-registered populations to attribute glycaemic control data from practice to neighbourhood level using lower layer super output areas (LSOAs). Where LSOAs were attributed to more than one practice a population weighted average of glycaemic control scores from the relevant practices were used, assuming that the same level of glycaemic control was achieved across all practice patients independent of their LSOA of residence. There are 32,482 LSOAs in England each consisting of approximately 1,500 people (minimum 1,000, maximum 3,000). The index of multiple deprivation (IMD 2010) overall rank was used to assign deprivation ranks to LSOAs. Each indicator was calculated at LSOA level for each period between 2004/5 and 2011/12 inclusive with each period running from the beginning of April to the end of March the following year.

For the emergency hospitalisation outcome we used the Hospital Episodes Statistics (HES) dataset provided by the Health and Social Care Information Centre (HSCIC). For the amenable mortality outcome we used the Office of National Statistics (ONS) mortality dataset. These outcomes are available at LSOA-level and were indirectly standardised for age and sex at small area level.

We measured absolute and relative inequality in these indicators using the slope index of inequality (SII) and relative index of inequality (RII) respectively. The SII was computed for each year by estimating an ordinary least squares regression of the LSOA level indicator value against the LSOA level deprivation fractional rank (measured on a 0-1 scale where 0 is the least deprived neighbourhood and 1 is the most deprived). The RII was calculated by expressing the SII as a proportion of the national mean level of the indicator. The SII can be interpreted as the modelled difference in event count between the least deprived and most deprived LSOAs in the country, taking into account the distribution of event counts across the deprivation range. The RII can be interpreted as the proportional gap between the most and least deprived areas. For emergency hospitalisation and amenable mortality, where “more is worse”, a positive association implies “pro-rich” inequality whilst a negative association implies “pro-poor” inequality. To ease comparison with the glycaemic control indicator, where “more is better”, we multiplied the SII by minus one, so that a positive sign also indicates “pro-rich” inequality. The area under the SII line was used to estimate the excess number of people experiencing the outcome measured by the indicator associated with socio-economic inequality – the “real inequality gap”. The assumption being that the level of the outcome observed in the least deprived area was the optimal level of the outcome and anything above this level for bad outcomes and below this level for good outcomes represented the excess associated with socio-economic inequality.

Linear regression models were computed using pooled data for the first and last years, including interaction terms between year and deprivation, to determine the magnitude and statistical significance of changes in inequality between the beginning and end of the analysis period. All statistical analysis was carried out using R (version 3.2.3).

**Results**

In 2004/5 there were substantial socioeconomic gradients in both mortality and preventable hospitalisation for diabetes, and a smaller socioeconomic gradient in glycaemic control, with outcomes less favourable in more deprived neighbourhoods (figure 1). Figure 2 displays the trends from 2004/5 to 2011/12 comparing the most deprived (Q1) and least deprived (Q5) quintile groups of small areas in England. By 2011/12 substantial inequalities still remained and were associated with a deficit of 1.90 (95% CI 1.74 to 2.06) percentage points in diabetes related primary care quality (table 3), 22,189 (95% CI 21,498 to 22,881) excess preventable hospitalisations for diabetes related causes and 582 (95% CI 478 to 687) excess avoidable deaths due to diabetes related causes.

*Glycaemic control (table 3)*

In 2004/5 mean glycaemic control performance in England was 58.64% (95% CI 58.63 to 68.64). The SII was 3.76 (95% CI 3.40 to 4.11) indicating that the most deprived patients are nearly four percentage points less likely to achieve good glycaemic control than the least deprived patients. Between 2004/5 to 2011/12 there was an improvement in mean glycaemic control performance of 3.72 percentage points (95% CI 3.72 to 3.72). However, inequality in glycaemic control was unchanged over the period according to both absolute and relative indices of inequality (SII difference 0.04, 95% CI -0.43 to 0.52). There was an improvement in primary care quality in between 2010/11 and 2011/12 which may be the result of change in the HbA1C target from <7 to <7.5 that year. This also may have reduced hospitalisation (especially hypoglycaemia) due to less intensive treatment.

*Emergency hospitalisation (Table 3 and appendix 1)*

In 2004/5 the mean rate of preventable hospitalisation for diabetes was 59.84 (95% CI: 59.83 to 59.85) admissions per 100,000 population. The SII was 64.66 (95% CI: 62.22 to 67.11) and socioeconomic inequality was associated with an excess of 16,199 (95% CI: 15,587 to 16,810) admissions. Between 2004/5 and 2011/12 admissions increased by 11.4 (95% CI 11.38 to 11.41) per 100,000 population. The socioeconomic gradient also widened in both absolute and relative terms, with the SII widening by 19.59 admissions for diabetes per 100,000 (95% CI 16.00 to 23.17) resulting in an increase in excess admissions associated with socioeconomic inequality of 5,991 (95% CI 5,084 to 6,899) compared to 2004/5. There was a fall in admissions between 2010/11 and 2011/12 which may be the result of change in the HbA1C target from <7 to <7.5 that year leading to less hypoglycaemia.

The largest increases in numbers of admissions were for unspecified hypoglycaemia (from 7476 to 11564), type 2 diabetes without complications (from 6662 to 8401), type 1 diabetes with ketoacidosis without coma (from 6271 to 8841) and type 2 diabetes with ketoacidosis (from 1342 to 2278).

*Diabetes mortality (Table 3 and appendix 2)*

In 2004/5 the mean rate of mortality from diabetes-related causes was 3.62 (95% CI 3.57 to 3.67) deaths per 100,000 population. The SII was 5.10 (95% CI 4.49 to 5.71) and socioeconomic inequality was associated with an excess of 1,176 (95% CI 1,036 to 1,306) deaths. The most common causes of mortality were unspecified diabetes without complications, and unspecified diabetes mellitus with peripheral circulatory complications.

Between 2004/5 and 2011/12 average mortality fell by 1.57 (95% CI 1.49 to 1.65) deaths per 100,000 population. Inequality in diabetes mortality as measured by the SII also improved, falling by 2.68 (95% CI 1.93 to 3.43) resulting in 594 (95% CI 420 to 767) fewer deaths. The main sub-categories of mortality reduction were unspecified diabetes without complications which fell from 810 to 320 deaths, and unspecified diabetes mellitus with peripheral circulatory complications which fell from 257 to 139 deaths. In contrast, there was a rise in deaths in unspecified diabetes with ketoacidosis from 84 to 155 deaths.

**Discussion**

*Summary*

This is the first study to examine how the NHS performed in reducing socioeconomic inequalities in diabetes outcomes from 2004/5 to 2011/12. During this period, healthcare outcomes improved in all social groups for glycaemic control and mortality from diabetes, with larger and faster mortality reductions in more deprived social groups. By contrast, both average outcomes and inequalities deteriorated in relation to preventable emergency hospitalisation for diabetes-related complications. The fall in diabetes-related mortality is a remarkable achievement, given that diabetes prevalence is rising and the targeting of NHS resources often does not promote health equity. [16] This finding is consistent with other UK literature and a sign of NHS success with improving the quality of healthcare for diabetes, and more importantly improving the quality of healthcare for coronary heart disease and other co-morbidities which contribute to diabetic mortality.[17] Falling mortality may be partly due to the increase in prescribing of statins in diabetes patients and more aggressive control of blood pressure, lipid levels and hyperglycaemia, which has been shown to reduce morbidity and mortality.[18] By contrast, the growth in emergency admissions for diabetes is worrying. It is partly explained by better disease detection by the recent addition of the HbA1c test to diagnose diabetes, and increasing prevalence of diabetes rising from 3.3% in 2004/5 to 5.8% in 2011/12. [19,20,21] There will also be an “unhealthy survivor” effect, whereby people with diabetes no longer die prematurely but instead survive long enough to have additional admissions for diabetes complications.[22]

It is also possible that over-use of glucose control medication may be leading to more preventable hospitalisation with hypoglycaemic attacks, which have increased by 50% over this time period. Data from randomised clinical trials report that intensive glycaemic control immediately increases the risk of severe hypoglycaemia 1.5- to 3-fold. [23] Financial incentives in primary care for reaching targets for HbA1c have increased from 27 points in 2004/5 to 35 points in 2011/12, the target for one indicator has been lowered from HbA1C <10 to HbA1C <9, and an additional indicator has been introduced with a target of HbA1c <8.

*Strengths and limitations*

This study used ten years of data including outcome data on virtually all individuals with diabetes in England, although the findings are limited to the period of this study. It examined three important outcome of diabetes care at different stages of the patient pathway. It also used both absolute and relative inequality measures based on the entire socioeconomic gradient of all 32,482 LSOAs in England. There were changes in the definition of the indicator of good glycaemic control over time, especially for the two years 2009/10 and 2010/11, which complicate the interpretation of trends in this indicator. However, there is no particular reason to think this would impact on the relative differences between deprived and affluent neighbourhoods, and so the relative index of inequality (RII) remains a fairly robust indicator of inequality trends in glycaemic control.

*Comparison with existing literature*

Our findings of an increase in preventable hospitalisations for diabetes complications concur with and extend those of Dusheiko and colleagues, who reported an increasing trend in all English GP practices from 2004/5 to 2006/7.[24] Calderón-Larrañaga however, reported a fall in diabetes related preventable hospitalisation in the years 2004 to 2009.[25] These differences may be explained by the fact that Calderón-Larrañaga adjusted the rate of preventable hospitalisation for the prevalence of diabetes, whereas Dusheiko adjusted the rate of preventable hospitalisation by population count, age and sex alone as we have done in our analysis. Both approaches have their merits, since although diabetes is becoming more common the increase in prevalence may be over-estimated due to better case finding. [19] Our findings of an increase in the proportion of patients meeting targets for HbA1c are similar to findings in Australia, however contrast with findings in the USA where no significant change occurred between 2007 and 2012. [26, 27] Our findings of a fall in mortality for diabetes are similar to the USA, but contrast with findings in Australia where mortality rates have been unchanged from 1997 to 2012. [27, 28] Our findings of increased admissions are similar to both Australia and the USA. [27, 29] The increasing admissions for diabetic ketoacidosis in type 2 diabetes may be a side effect of newer diabetic drugs. [30]

*Implications for research and practice*

The causes of the increase in preventable admissions for hypoglycaemia and ketoacidosis in both type I and type II diabetes and increasing inequalities need further research. [31] Reducing inequalities in diabetes is likely to require complex interventions to improve the coordination of care between multiple providers of care both within and outside the healthcare system. GPs need to be aware of socioeconomic inequalities in diabetes care. NICE should review the current target HbA1C of 7.0 mmol in light of increasing emergency admissions with hypoglycaemia. GPs should follow NICE recommendations in patients who have experienced hypoglycaemia and have an individualised HbA1C target for these patients. [2] GPs need to be alert to the risk of DKA in patients taking SGLT2 inhibitors. [30]

Ethical approval: not required.

Competing interests: none

Acknowledgements: NHS Attribution Data Set data on GP-registered populations was obtained under license from the Department of Health; GMS statistics data on GP supply and hospital episode statistics data were obtained under license from the Health and Social Care Information Centre, and mortality data were obtained under license from the Office of National Statistics. Richard Cookson and Miqdad Asaria are supported by the National Institute for Health Research (Senior Research Fellowship, Dr Richard Cookson, SRF-2013-06-015). The views expressed in this publication are those of the author(s) and not necessarily those of the NHS, the National Institute for Health Research or the Department

**References**

1. Health and Social Care Information Centre: Quality and Outcomes Framework (QOF) for April 2012 - March 2013, England. In. Leeds; 2013.

2. National institute for Health and Care Excellence: Type 1 diabetes in adults: diagnosis and management. In. London: National institute for Health and Care Excellence; 2015.

3. National Institute for Health and Care Excellence: Type 2 diabetes in adults: management. In. London: NICE; 2015.

4. Connolly V, Unwin N, Sherriff P, et al: Diabetes prevalence and socioeconomic status: a population based study showing increased prevalence of type 2 diabetes mellitus in deprived areas. Journal of epidemiology and community health 2000, 54(3):173-177.

5. Department of Health: The management of adult diabetes services in the NHS. In.: The Stationery Office; 2012.

6. UK Prospective Diabetes Study (UKPDS) Group: Effect of intensive blood-glucose control with metformin on complications in overweight patients with type 2 diabetes (UKPDS 34). Lancet 1998, 352(9131):854-865.

7. Department of Health: Tackling Health Inequalities: a Programme for Action. In. London; 2003.

8. Asaria M, Ali S, Doran T, et al: How a universal health system reduces inequalities: lessons from England. Journal of epidemiology and community health 2016.

9. NHS Employers: Introducing QOF 2004. In. Leeds: NHS Employers; 2010.

10. Department of Health: Equitable Access to Primary Medical Care services. In. London: Department of Health; 2007.

11. Asaria M, Cookson R, Fleetcroft R, Ali S: Unequal socioeconomic distribution of the primary care workforce: whole-population small area longitudinal study. BMJ open 2016, 6(1):e008783.

12. The National Audit Office: Tackling inequalities in life expectancy in areas with the worst health and deprivation. In. London: The Stationery Offi ce; 2010.

13. HM Government: Health and Social Care Act 2012. In. London: The Stationary Office; 2012.

14. Health and Social Care Information Centre: NHS Outcomes Framework: Domain 2 Enhancing quality of life for people with long-term conditions—Indicator specifications version 1.5. 2015. In. Leeds: HSCIC; 2015.

15. Health and Social Care Information Centre: NHS Outcomes Framework: Domain 1 Preventing people from dying prematurely—Indicator specifications version 1.5. In. Leeds: HSCIC; 2015.

16. Asthana S, Gibson S, Halliday J. The medicalisation of health inequalities and the English NHS: the role of resource allocation. Health Economics, Policy and Law, 2012. pp 1 17

17. Lind M, Garcia-Rodriguez LA, Booth GL, et al: Mortality trends in patients with and without diabetes in Ontario, Canada and the UK from 1996 to 2009: a population-based study. Diabetologia 2013, 56(12):2601-2608.

18. Cholesterol Treatment Trialists Collaboration: Efficacy of cholesterol-lowering therapy in 18,686 people with diabetes in 14 randomised trials of statins: a meta-analysis. Lancet 2008, 371(9607):117-125.

19. Jeon JY, Ko SH, Kwon HS, et al: Prevalence of Diabetes and Prediabetes according to Fasting Plasma Glucose and HbA1c. Diabetes & metabolism journal 2013, 37(5):349-357.

20. Department of Health: Quality and Outcomes Framework Statistics - England, 2004-05. In. Leeds; 2005.

21. Department of Health: Quality and Outcomes Framework 2011-2012. In. Leeds: Health & Social Care Information Centre; 2012.

22. Laudicella M, Li Donni P, Smith PC: Hospital readmission rates: signal of failure or success? Journal of health economics 2013, 32(5):909-921.

23. Lipska K, Krumholz H, Soones T, Lee SJ. Polypharmacy in the Aging Patient: A review of glycaemic control in older patients with Type 2 Diabetes. JAMA. 2016 March 8; 315(10): 1034–1045

24. Dusheiko M, Doran T, Gravelle H, et al: Does higher quality of diabetes management in family practice reduce unplanned hospital admissions? Health services research 2011, 46(1 Pt 1):27-46.

25. Calderon-Larranaga A, Soljak M, Cecil E, et al: Does higher quality of primary healthcare reduce hospital admissions for diabetes complications? A national observational study. Diabet Med 2014, 31(6):657-665.

26. Carrington MJ, Stewart S, Gerber T and Cohen N. Bittersweet findings of blood glucose levels in 467,955 patients in primary care. June 2015, Baker IDI Heart and Diabetes Institute, Melbourne.

27. Lipska K, Rosss J, Wang Y, Inucchi S, Minges K, Karter A et al. National Trends in US Hospital Admissions for Hyperglycemia and Hypoglycemia Among Medicare Beneficiaries, 1999 to 2011. JAMA Intern Med. 2014 July; 174(7): 1116–1124.

28. Australian Institute of Health and Welfare. Deaths from Diabetes. 2016. Australian Government available at <http://www.aihw.gov.au/diabetes/deaths/> accessed 25 July 2016

29. Venkatesh B, Pilcher D, Prins J, Bellomo R, Morgan TJ, Bailey M. Incidence and outcome of adults with diabetic ketoacidosis admitted to ICUs in Australia and New Zealand. Critical Care 2015, 19:451

30. Medicines and Healthcare products Regulatory Agency. SGLT2 inhibitors: updated advice on the risk of diabetic ketoacidosis GOV.UK 2016 available at <https://www.gov.uk/drug-safety-update/sglt2-inhibitors-updated-advice-on-the-risk-of-diabetic-ketoacidosis> accessed 25 July 2016.

31. Misra S, Oliver N, Dornhorst A: Diabetic ketoacidosis: not always due to type 1 diabetes. BMJ 2013,344 346:f3501.

**Table 1** **QOF target for glycated haemoglobin (HbA1c) level [**[**9**](#_ENREF_9)**]**

|  |  |  |
| --- | --- | --- |
| **Indicator name in QOF** | **Years** | **Glycated haemoglobin (HbA1c) threshold** |
| DM6 | 2004/5; 2005/6 | ≤ 7.4% |
| DM20 | 2006/7; 2007/8; 2008/9  (replaced DM6) | ≤ 7.5% |
| DM23 | 2009/10; 2010/11  (replaced DM20) | ≤ 7% |
| DM26 | 2011/12 onward  (replaced DM23) | ≤ 7.5% |

**Table 2** **Office for National Statistics classification of preventable diabetes admissions (all codes) and amenable deaths**

|  |  |
| --- | --- |
| **Type of complication** | **ICD-10** |
| Preventable admissions codes | E100, E101, E107, E108, E109,E110, E111, E117, E118,E119, E120, E121, E127, E128, E129, E130, E131, E137, E138, E139, E140, E141,  E147, E148, E149, E162, |
| Amenable mortality codes | All ICD-10 codes E10 to E14 |
| **Code type** | **Definition** |
| **ICD-10 codes** | E10: Insulin-dependent diabetes mellitus  E11: Non-insulin-dependent diabetes mellitus  E13: Other specified diabetes mellitus  E14: Unspecified diabetes mellitus |
| **ICD-10 extension** | 0: With coma  1: With ketoacidosis  7: With multiple complications  8: With unspecified complications  9: Without complications |

**Table 3 Socioeconomic healthcare inequalities in England, comparing 2004/2005 with 2011/2012**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Indicator** | **England Mean (95% CI)** | | | **SII (95% CI)** | | | **RII (95% CI)** | | | **Real Inequality Gap (95% CI)** | | |
|  | **2004** | **2011** | **Change** | **2004** | **2011** | **Change** | **2004** | **2011** | **Change** | **2004** | **2011** | **Change** |
| **Diabetes Primary Care Quality** | 58.64 (58.63 to 58.64) | 62.36 (62.35 to 62.36) | 3.72  (3.72 to 3.72) | 3.76  (3.4 to 4.11) | 3.8  (3.48 to 4.11) | 0.04  (-0.43 to 0.52) | 0.06  (0.06 to 0.07) | 0.06  (0.06 to 0.07) | 0  (-0.01 to 0) | 1.88  (1.7 to 2.05) | 1.9  (1.74 to 2.06) | 0.02  (-0.21 to 0.25) |
| **Preventable Emergency Hospitalisation for diabetes** | 59.84 (59.83 to 59.85) | 71.23 (71.22 to 71.25) | 11.4 (11.38 to 11.41) | 64.66 (62.22 to 67.11) | 84.25 (81.62 to 86.88) | 19.59 (16.00 to 23.17) | 1.08  (1.04 to  1.12) | 1.18  (1.15 to 1.22) | 0.1  (0.05 to 0.16) | 16199 (15587 to  16810) | 22189 (21498 to 22881) | 5991 (5084 to 6899) |
| **Amenable Mortality from diabetes** | 3.62 (3.57 to 3.67) | 2.04 (1.98 to 2.11) | -1.57  (-1.65 to  -1.49) | 5.1  (4.49 to 5.71) | 2.42  (1.98 to 2.85) | -2.68  (-3.43 to  -1.93) | 1.41 (1.24 to 1.58) | 1.18  (0.97 to 1.39) | -0.23  (-0.5 to 0.04) | 1176 (1036 to 1316) | 582  (478 to 687) | -594  (-767 to  -420) |

*The England means and the SII indices are measured in terms of average primary care quality, preventable hospitalisation per 100,000, and amenable mortality per 100,000. The RII indices are the SII indices as a proportion of the England means. The inequality gaps refer to the average quality loss attributable to inequality, the total excess hospitalisations attributable to inequality, and the total excess mortality attributable to inequality. (RII, relative index of inequality; SII, slope index of inequality.)*





**Appendix 1: preventable emergency hospitalisation for diabetes**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ICD-10 code** | **Q1 (most deprived); % of total admissions for ICD-10 code** | | | **Q5 (most affluent): % of total admissions for that ICD-10** | | | **Overall numbers of admissions for ICD-10 code** | | |
|  | 2004/5 | 2011/12 | Change | 2004/5 | 2011/12 | Change | 2004/5 | 2011/12 | Change |
| **E100** type 1 diabetes with coma | 27% | 28% | 1% | 14% | 16% | 2% | 640 | 313 | -327 |
| **E101** type 1 diabetes with ketoacidosis without coma | 31% | 31% | 0% | 13% | 12% | -1% | 6271 | 8841 | 2570 |
| **E107** type 1 diabetes, multiple complications | 34% | 0% | -34% | 21% | 42% | 21% | 53 | 12 | -41 |
| **E108** type 1 diabetes with unspecified complications | 28% | 21% | -7% | 14% | \* | \* | 310 | 39 | -271 |
| **E109** type 1 diabetes without complications | 26% | 28% | 2% | 16% | 15% | -1% | 6831 | 6527 | -304 |
| **E110** type 2 diabetes with coma | 29% | 32% | 3% | 12% | 12% | 0% | 828 | 774 | -54 |
| **E111** type 2 diabetes with ketoacidosis | 32% | 32% | 0% | 11% | 12% | 1% | 1342 | 2278 | 936 |
| **E117** type 2 diabetes with multiple complications | 14% | \* | \* | \* | \* | \* | 37 | 9 | -28 |
| **E118** type 2 diabetes with unspecified complications | 32% | 34% | 2% | 8% | 11% | 3% | 220 | 76 | -144 |
| **E119** type 2 diabetes without complications | 32% | 32% | 0% | 12% | 12% | 0% | 6662 | 8401 | 1739 |
| **E121** malnutrition related diabetes with ketoacidosis | 0% | 0% | 0% | \* | 0% | \* | \* | 0 | \* |
| **E129** malnutrition related diabetes no complications | \* | \* | \* | \* | \* | \* | \* | \* | 0 |
| **E130** other specified diabetes with coma | \* | \* | \* | \* | \* | \* | 6 | 10 | \* |
| **E131** other specified diabetes with ketoacidosis | \* | 47% | \* | 0% | 12% | 12% | 13 | 43 | 30 |
| **E137** other specified diabetes, multiple complications | 0% | 0% | 0% | 0% | 0% | 0% | 0 | \* | \* |
| **E138** other specified diabetes, unspecified complications | \* | 0% | \* | \* | \* | \* | \* | \* | \* |
| **E139** other specified diabetes without complications | 24% | 22% | -2% | 18% | 16% | -2% | 134 | 225 | 91 |
| **E140** unspecified diabetes with coma | 26% | 24% | -2% | 12% | 32% | 20% | 91 | 25 | -66 |
| **E141** unspecified diabetes with ketoacidosis | 28% | 32% | 4% | 13% | 19% | 6% | 432 | 209 | -223 |
| **E147** unspecified diabetes with multiple complications | \* | \* | \* | 0% | \* | \* | \* | \* | 0 |
| **E148** unspecified diabetes with unspecified complications | 40% | \* | \* | 20% | \* | \* | 30 | 6 | -24 |
| **E149** unspecified diabetes without complications | 29% | 31% | 2% | 16% | 12% | -4% | 657 | 443 | -214 |
| **E162** hypoglycaemia, unspecified | 30% | 30% | 0% | 12% | 13% | 1% | 7476 | 11564 | 4088 |

**Notes: All numbers are presented as a percentage of the total overall hospitalisations for that ICD-10 code**

**Data derived from patient numbers between 1 and 4 are omitted for confidentiality purposes, and displayed as \***

**Appendix 2: Amenable deaths from diabetes**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ICD Code | Q1 (most deprived); % of total deaths for that ICD-10 | | | Q5 (most affluent): % of total deaths for that ICD-10 | | | Overall numbers of deaths for that ICD-`10 | | |
| 2004/5 | 2011/12 | Change | 2004/5 | 2011/12 | Change | 2004/5 | 2011/12 | Change |
| **E100** type 1 diabetes with coma | 0% | \* | \* | \* | 0% | \* | 6 | \* | \* |
| **E101** type 1 diabetes with ketoacidosis without coma | 56% | 40% | -16% | 13% | \* | \* | 16 | 30 | 14 |
| **E102** type 1 diabetes with renal complications | \* | \* | \* | \* | 0% | \* | 13 | 11 | -2 |
| **E104** type 1 diabetes with neurological complications | \* | 0% | \* | 0% | 0% | 0% | \* | \* | \* |
| **E105** type 1 diabetes with peripheral circulatory complications | 33% | \* | \* | 0% | \* | \* | 18 | 18 | 0 |
| **E106** type 1 diabetes with other specified complications | 0% | 0% | 0% | 0% | \* | \* | 0 | \* | \* |
| **E107** type 1 diabetes, multiple complications | \* | \* | \* | \* | \* | \* | \* | 6 | \* |
| **E109** type 1 diabetes without complications | 31% | 30% | -1% | 15% | 17% | 2% | 102 | 64 | -38 |
| **E110** type 2 diabetes with coma | 0% | \* | \* | 0% | 0% | 0% | \* | 5 | \* |
| **E111** type 2 diabetes with ketoacidosis | \* | 60% | \* | 0% | 0% | 0% | \* | 10 | \* |
| **E112** type 2 diabetes with renal complications | 42% | 28% | -14% | 0% | \* | \* | 19 | 39 | 20 |
| **E114** type 2 diabetes with neurological complications | \* | \* | \* | 0% | \* | \* | \* | 6 | \* |
| **E115** type 2 diabetes, peripheral circulatory complications | 25% | 34% | 9% | \* | 13% | \* | 61 | 83 | 22 |
| **E116** type 2 diabetes with other specified complications | 0% | 0% | 0% | 0% | \* | \* | 0 | \* | \* |
| **E117** type 2 diabetes with multiple complications | 36% | 29% | -7% | 0% | 0% | 0% | 14 | 17 | 3 |
| **E119** type 2 diabetes without complications | 32% | 23% | -9% | 10% | 12% | 2% | 188 | 146 | -42 |
| **E140** unspecified diabetes with coma | 37% | \* | \* | 0% | 0% | 0% | 27 | 15 | -12 |
| **E141** unspecified diabetes with ketoacidosis | 36% | 42% | 6% | 0% | 0% | 0% | 84 | 155 | 71 |
| **E142** unspecified diabetes, renal complications | 28% | 21% | -7% | 13% | 14% | 1% | 92 | 91 | -1 |
| **E144** unspecified diabetes, neurological complications | \* | 0% | \* | \* | 0% | \* | 6 | \* | \* |
| **E145** unspecified diabetes, peripheral circulatory comps. | 36% | 29% | -7% | 11% | 13% | 2% | 257 | 139 | -118 |
| **E146** unspecified diabetes, other specified complications | 0% | 0% | 0% | 0% | 0% | 0% | \* | 0 | \* |
| **E147** unspecified diabetes with multiple complications | 24% | \* | \* | 15% | \* | \* | 46 | 32 | -14 |
| **E149** unspecified diabetes without complications | 32% | 39% | 7% | 12% | 10% | -2% | 810 | 320 | -490 |

**Notes: All numbers are presented as a percentage of the total overall deaths for that ICD-10 code**

**Data derived from patient numbers between 1 and 4 are omitted for confidentiality purposes, and displayed as \***