National Diabetes Audit 2010-2011

Report 2: Complications and Mortality
The Healthcare Quality Improvement Partnership (HQIP) promotes quality in healthcare. HQIP holds commissioning and funding responsibility for the National Diabetes Audit and other national clinical audits.

The National Diabetes Audit is commissioned by:

The National Diabetes Audit is delivered by:

The Health and Social Care Information Centre (HSCIC) is England’s central, authoritative source of essential data and statistical information for frontline decision makers in health and social care. The HSCIC manages the publication of the 2010-2011 reports.

Diabetes UK is the largest organisation in the UK working for people with diabetes, funding research, campaigning and helping people live with the condition.

Diabetes Health Intelligence is a strategic programme within Yorkshire and Humber Public Health Observatory (YHPHO). It is committed to supporting the diabetes community by providing timely, quality-assured national health intelligence. YHPHO is part of a network of nine public health observatories in England.

The National Diabetes Audit is supported by:

NHS Diabetes works to raise the quality of diabetes care in England by supporting and working with the healthcare community and people with diabetes. NHS Diabetes helps develop and support new guidelines, standards and systems and encourage their widespread implementation.

The National Diabetes Information Service (NDIS) provides the NHS with streamlined access to a suite of diabetes information products, datasets and tools oriented to commissioners, providers and people with diabetes. Information is focussed on service improvement at local and national levels.
Key findings about the outcomes for people with diabetes in England and Wales
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This national report of diabetes related complications and mortality from the National Diabetes Audit (NDA) has a number of enhancements from previous reports.

Firstly, the analyses have endeavoured, by appropriate standardisation, to minimise the influence of local demographic differences (e.g. age and sex) on prevalence and rates. Accordingly, the true, independent impact of diabetes is revealed so that local variations can be more confidently interpreted as variations due to the effect of diabetes rather than demographic differences.

Secondly, the analyses have endeavoured to identify specific risk factors and determine areas that should be prioritised for improvement.

Because of the many database and analysis changes introduced, this report does not look at trends over time. Long term trends will be reported in the future. Meanwhile, we hope that the changes to the analyses and presentation will appreciably advance the capability of the NDA to support improvement in the care and outcomes of people with diabetes.

The results in this report:

• Are comprehensive - they include 85 per cent of the people with diabetes in England and 54 per cent in Wales;
• Combine for the first time ‘complications’ associated with diabetes and additional deaths in people with diabetes;
• Present findings standardised to local health statistics i.e. comparing people with diabetes with the background population to eliminate known geographical health variation and expose genuine diabetes related differences;
• Sections of this publication using multivariate analysis have been updated on 14 June 2013, these include bullet points in the executive summary, paragraphs throughout the main report and the entirety of Appendix 3; Odds ratios for diabetic complications. A full list of the sections that have been amended is available via the following link: www.ic.nhs.uk/catalogue/PUB06325 This is because of errors in the categorisation and modelling of these statistics.

The HSCIC apologise for any inconvenience caused.
Introduction

Diabetes is a chronic condition affecting over 2 million people in England and Wales. It is caused by an inability to use or produce the hormone insulin which leads to a rise in blood glucose. If treatment does not keep blood glucose within target ranges, people with diabetes develop disabling and life threatening long term complications.

The National Diabetes Audit (NDA) is considered to be the largest annual clinical audit in the world. It provides an infrastructure for the collation, analysis, benchmarking and feedback of local clinical data to support effective clinical audit across the NHS.

The NDA is commissioned and sponsored by the Healthcare Quality Improvement Partnership (HQIP) following advice to the Department of Health from the National Advisory Group on Clinical Audit and Enquiries (NAGCAE).

The NDA includes patient level data from primary and secondary care participants. It provides overall, sequential and comparative information to GP practices, hospitals, Primary Care Trusts (PCT)/Local Health Boards (LHB) and nationally.

This national report from the eighth year of the NDA, presents key findings on complications in 2010–2011 and deaths in 2011 for all age groups. The care processes and treatment target standards as specified in NICE (National Institute for Health and Clinical Excellence) Clinical Guidelines (CG), including CG15, CG10, CG66 and CG87 and the NICE Diabetes in Adults Quality Standards were reported in June 2012. This report presents statistics about diabetic ketoacidosis (DKA), chronic kidney disease including renal replacement therapy (RRT), lower limb amputations, retinopathy treatment, heart disease, stroke and mortality. PCTs/LHBs will receive individual benchmarked reports in January 2013 which will allow them to compare themselves against national results.

Quality information is essential to any organisation responsible for implementing the many evidence based national diabetes policies such as the Diabetes National Service Framework (NSF), NICE Clinical Guidelines for diabetes and the NICE Diabetes in Adults Quality Standards. The NDA supports care quality improvement by enabling NHS organisations to:

- Compare the NICE specified processes and outcomes of care with similar NHS organisations.
- Provide a local health economy view of the care and outcomes delivered jointly by primary and secondary care organisations.
- Monitor progress towards delivering evidence based care standards (Diabetes NSF and NICE guidelines).
- Identify and share good practice.
- Identify gaps or shortfalls in commissioned services.
Executive Summary

Complications

• The on-going rise in diabetic ketoacidosis (DKA) is a major concern; the number of people in England and Wales who were admitted to hospital at least once for DKA during 2010–2011 was 8,472.

• DKA is associated with social deprivation, being young and being female.

National Recommendation: Clinical services and commissioners should investigate innovative approaches to reverse this trend.

• This analysis highlights the impact of heart failure in people with diabetes, which is more than double that for myocardial infarction (MI) or stroke. From April 2010 to March 2011, 45,001 (2.27 per cent) people with diabetes were admitted at least once for heart failure meaning they were 64.9 per cent more likely to be admitted to hospital with heart failure than the general population (a greater additional risk than for myocardial infarction which was 48.0 per cent). Because the NDA uses hospital admission data to identify heart failure, people with heart failure who were managed solely on an outpatient basis will not be included, so the numbers reported probably underestimate the true burden of heart failure. In addition:

• Heart failure is the complication that confers the highest risk of death in the short term. People with diabetes who have been admitted to hospital with heart failure have a 359 per cent greater risk of dying in the next year than their peers who have not been admitted for heart failure.

National Recommendation: Clinical services for diabetes and vascular disease need to co-operate in seeking new approaches to better manage this large disease burden.

Mortality

• The high number of additional deaths associated with diabetes is confirmed with estimates of 22,200 additional deaths in England and 1,920 additional deaths in Wales.

• The years of life lost are especially notable in people with Type 1 diabetes.

National Recommendation: Preventing Type 2 diabetes and reducing diabetic complications by improving the delivery of preventive diabetes care in people diagnosed with both Type 1 and Type 2 diabetes would appreciably reduce diabetes related premature mortality.

Action for All

There is a substantial variation in the risks of diabetic complications and death between different PCTs/ LHBs. This year these differences have been standardised to the local non-diabetic population. We recommend that every local health economy use these results to prioritise and target improvement efforts. This will benefit people with diabetes as well as promote more effective use of health services.
Diabetes care aims to minimise complications (the acute and long term diseases and premature death) caused by diabetes. Diabetes complications incur the greatest costs of diabetes to the patient and the health service. The risk of complications is reduced if the appropriate NICE recommended care processes are completed and treatment targets are achieved. The NDA published a report on NICE recommended care processes and treatment targets in June 2012.

Apart from diabetic ketoacidosis (DKA) in Type 1 diabetes, which is an immediate consequence of treatment failure, the other complications arise only after many years of exposure to high blood glucose, high blood pressure and high cholesterol compounded by age, inactivity, obesity and smoking. They can be considered the ‘final outcomes’ of diabetes care.

The NDA reports on nine complications:

- **Angina** – is chest pain due to temporary restriction in blood supply to the heart muscle.
- **Myocardial Infarction (MI)** – commonly known as a heart attack, results from the interruption of blood supply to a part of the heart, causing heart cells to die.
- **Heart Failure** – occurs when the heart pump cannot maintain blood flow sufficient to meet the needs of the body.
- **Stroke** – is the rapid, permanent loss of brain function following disturbance in blood supply to the brain.
- **Renal Replacement Therapy (RRT)** – is a term used for life-supporting treatments (dialysis and transplantation) required to treat end stage kidney disease (ESKD); it is therefore a marker of the most severe diabetic kidney disease.
- **Minor Amputation** – surgical removal of toes or a part of the foot below the ankle.
- **Major Amputation** – surgical removal of the leg above the ankle (usually below, through or above the knee).
- **Diabetic Ketoacidosis (DKA)** – is a potentially life-threatening complication in people with diabetes and is predominant in people with Type 1 diabetes. DKA results from a very severe shortage of insulin.
- **Retinopathy Treatment** – is treatment for sight threatening diabetic damage to the back of the eye (the retina); it is therefore a marker of severe diabetic eye disease.

**Approach to analysis**

Data from people with diabetes submitted to the 2009–2010 NDA and still alive on 31st March 2010 were matched to Hospital Episodes Statistics (HES), a record of every hospital admission in England, and Patient Episode Data for Wales (PEDW), a record of every hospital admission in Wales, for the period 1st April 2010 to 31st March 2011. The prevalence of each complication was calculated as the number of people alive on 31st March 2010 who had one or more hospital admissions with the relevant complication between 1st April 2010 and 31st March 2011.

Many complications of diabetes are more common in males and older people. As a result, the age and sex structure of the population with diabetes will influence the number of people with complications. The impact of the age and sex structure of the population can be removed by standardisation, so allowing robust comparisons between different populations (e.g. different PCTs/LHBs).

Multivariate analysis assesses the relative association between two or more factors on a particular event. For example, it allows assessment of the independent impact of age, sex, deprivation, ethnic group and body mass index (BMI) on the prevalence of diabetic complications. So if a particular event was more common among older people and in deprived areas but people living in deprived areas were younger than average then examining the association between the complication and deprivation without taking age into account would underestimate the impact of deprivation. Multivariate analysis in the example given reveals the impact of deprivation after taking account of age.

For definitions on ethnic groups and logistic regression analysis, please refer to the glossary.
Complications of Diabetes in England and Wales

A total of 1,982,370 people with diabetes included in the 2009–2010 NDA were still alive on 31st March 2010 and therefore included in the analyses of diabetic complications. Table 1 shows the one year prevalence of complications recorded between 1st April 2010 and 31st March 2011 in HES and PEDW for the 1,982,370 people with diabetes included in these analyses.

These results illustrate the on-going impact of diabetic complications on people with diabetes and the NHS. Notable are: the high number of people with diabetes admitted with heart failure, stroke and MI; the high prevalence of DKA described here was also found in the recently published National Paediatric Diabetes Audit.

Acute Complications - Diabetic Ketoacidosis (DKA)

Between 1st April 2010 and 31st March 2011, 8,472 people included in the NDA were admitted to hospital for DKA at least once. This equates to 0.427 per cent of all people with diabetes included in the analysis. Among people with Type 1 diabetes, the prevalence of one or more hospital admission for DKA was 3.32 per cent (6,141 people).

Figure 1 shows the pattern of the prevalence of DKA across England and Wales. These figures have been adjusted to reflect the local age and sex distribution of people with diabetes. Areas with a significantly (p<0.05) higher prevalence of DKA, after adjustment for the age and sex of the local population than England and Wales, are shown in dark green and those with a significantly lower prevalence of DKA after adjustment are highlighted in light green.

There is an imperative to reduce DKA everywhere. PCTs/LHBs with significantly higher prevalence should make this a priority while those with significantly lower prevalence might consider sharing any notably successful interventions.

Multivariate analysis showed that young people, females and those living in deprived areas were most likely to be admitted for DKA; people with a higher BMI (25kgm$^{-2}$) were significantly less likely to have experienced DKA; White ethnic groups were over twice as likely as people from South Asian ethnic groups to have been admitted to hospital for DKA.

### Table 1

<table>
<thead>
<tr>
<th>Complication</th>
<th>Number of people with diabetes experiencing the complication</th>
<th>Crude prevalence (not adjusted for the age and sex structure of the population)</th>
<th>Age and sex standardised prevalence (to reflect national population)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angina</td>
<td>69,957</td>
<td>3.53%</td>
<td>1.38%</td>
</tr>
<tr>
<td>Myocardial Infarction</td>
<td>14,476</td>
<td>0.730%</td>
<td>1.54%</td>
</tr>
<tr>
<td>Heart Failure</td>
<td>45,001</td>
<td>2.27%</td>
<td>0.560%</td>
</tr>
<tr>
<td>Stroke</td>
<td>17,892</td>
<td>0.903%</td>
<td>0.036%</td>
</tr>
<tr>
<td>Renal Replacement Therapy</td>
<td>9,753</td>
<td>0.492%</td>
<td>0.074%</td>
</tr>
<tr>
<td>Minor Amputation</td>
<td>3,042</td>
<td>0.153%</td>
<td>0.230%</td>
</tr>
<tr>
<td>Major Amputation</td>
<td>1,731</td>
<td>0.087%</td>
<td>0.291%</td>
</tr>
<tr>
<td>DKA</td>
<td>8,472</td>
<td>0.427%</td>
<td>0.421%</td>
</tr>
<tr>
<td>Retinopathy Treatment</td>
<td>9,501</td>
<td>0.479%</td>
<td>0.261%</td>
</tr>
</tbody>
</table>

*One year prevalence is the number of people with one or more complication event during the year of the audit.
Figure 1
DKA prevalence across England and Wales compared to national rate in people with diabetes

- Above expected
- As expected
- Below expected
- Suppressed due to small numbers

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**Long Term Complication Ratios**

These standardised ratios present the additional risk due to diabetes. The calculations compare the prevalence for people with diabetes with the prevalence in the general population in the same PCT or LHB during the audit year.

Table 2 shows that people with diabetes are significantly more likely than the general population to experience myocardial infarction, angina, heart failure, stroke and to have renal replacement therapy or a lower limb amputation. Across England and Wales people with diabetes have a 64.9 per cent greater risk of a hospital admission related to heart failure. The risk of being admitted to hospital for a myocardial infarction (heart attack) is 48.0 per cent greater than among the general population, whilst the risk for stroke is 24.9 per cent higher. They also have a 210 per cent higher risk of a major amputation (above the ankle) and a 331 per cent greater risk of a minor amputation (below the ankle). The chance of receiving renal replacement therapy for people with diabetes is 144 per cent higher than their peers in the general population. The PCT/LHB level analysis has been used to construct the maps (see Appendix 1) that illustrate how additional risk rates or local variations in the impact of diabetic complications are distributed unevenly. The following funnel chart (Figure 2) illustrates how the areas where the PCT/LHB complication ratio for heart failure is significantly above, below or within the expected range when compared to the whole of England and Wales ratio of heart failure. The distribution is also displayed in an accompanying map (Figure 3).

### Table 2

<table>
<thead>
<tr>
<th>Complication</th>
<th>Total expected</th>
<th>Observed</th>
<th>Standardised ratio</th>
<th>95% CI Limits* Additional risk of complication among people with diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>England</td>
<td>Wales</td>
<td>England and Wales</td>
<td>Lower</td>
</tr>
<tr>
<td><strong>Angina</strong></td>
<td>39,554</td>
<td>2,169</td>
<td>40,840</td>
<td>171</td>
</tr>
<tr>
<td><strong>Myocardial Infarction</strong></td>
<td>9,456</td>
<td>1,405</td>
<td>11,861</td>
<td>148</td>
</tr>
<tr>
<td>(heart attack)</td>
<td>326</td>
<td>471</td>
<td>363</td>
<td>144</td>
</tr>
<tr>
<td><strong>England and Wales</strong></td>
<td>9,782</td>
<td>14,476</td>
<td>24,268</td>
<td>148</td>
</tr>
<tr>
<td><strong>Heart Failure</strong></td>
<td>26,310</td>
<td>43,446</td>
<td>69,757</td>
<td>165</td>
</tr>
<tr>
<td><strong>England</strong></td>
<td>981</td>
<td>1,555</td>
<td>2,536</td>
<td>159</td>
</tr>
<tr>
<td><strong>Wales</strong></td>
<td>27,291</td>
<td>45,001</td>
<td>72,296</td>
<td>165</td>
</tr>
<tr>
<td><strong>England and Wales</strong></td>
<td>14,327</td>
<td>17,892</td>
<td>32,219</td>
<td>125</td>
</tr>
<tr>
<td><strong>Stroke</strong></td>
<td>13,806</td>
<td>17,243</td>
<td>31,049</td>
<td>125</td>
</tr>
<tr>
<td><strong>England</strong></td>
<td>981</td>
<td>1,555</td>
<td>2,536</td>
<td>159</td>
</tr>
<tr>
<td><strong>Wales</strong></td>
<td>27,291</td>
<td>45,001</td>
<td>72,296</td>
<td>165</td>
</tr>
<tr>
<td><strong>England and Wales</strong></td>
<td>14,327</td>
<td>17,892</td>
<td>32,219</td>
<td>125</td>
</tr>
<tr>
<td><strong>Renal Replacement Therapy (ESKD)</strong></td>
<td>3,868</td>
<td>9,456</td>
<td>13,324</td>
<td>244</td>
</tr>
<tr>
<td><strong>England</strong></td>
<td>124</td>
<td>297</td>
<td>421</td>
<td>239</td>
</tr>
<tr>
<td><strong>Wales</strong></td>
<td>3,993</td>
<td>9,753</td>
<td>13,746</td>
<td>244</td>
</tr>
<tr>
<td><strong>England and Wales</strong></td>
<td>14,327</td>
<td>17,892</td>
<td>32,219</td>
<td>125</td>
</tr>
<tr>
<td><strong>Minor Amputation (below the ankle)</strong></td>
<td>685</td>
<td>2,939</td>
<td>3,624</td>
<td>429</td>
</tr>
<tr>
<td><strong>England</strong></td>
<td>21</td>
<td>103</td>
<td>134</td>
<td>488</td>
</tr>
<tr>
<td><strong>Wales</strong></td>
<td>706</td>
<td>3,042</td>
<td>3,748</td>
<td>431</td>
</tr>
<tr>
<td><strong>England and Wales</strong></td>
<td>541</td>
<td>1,680</td>
<td>2,221</td>
<td>311</td>
</tr>
<tr>
<td><strong>Major Amputation (above the ankle)</strong></td>
<td>18</td>
<td>51</td>
<td>68</td>
<td>286</td>
</tr>
<tr>
<td><strong>England and Wales</strong></td>
<td>559</td>
<td>1,731</td>
<td>2,291</td>
<td>310</td>
</tr>
</tbody>
</table>

* For definitions, please refer to the glossary

Note: DKA and Retinopathy Treatments have not been included as these only affect people with diabetes.
Figure 2
Funnel chart showing the spread of PCT/LHB standardised ratios for heart failure among people with diabetes

<table>
<thead>
<tr>
<th>Standardised Ratio (Logarithmic Scale)</th>
<th>Observed complications per PCT/LHB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower values</td>
<td>England &amp; Wales Ratio</td>
</tr>
<tr>
<td>As expected values</td>
<td>Upper 95% Limit</td>
</tr>
</tbody>
</table>

Lower 95% Limit

Higher values

400.0

200.0

100.0

0
Figure 3
Spread of complication ratios for heart failure in England and Wales compared to local complication rates

- Above expected
- As expected
- Below expected

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Cardio-vascular Complications - Multivariate Analysis

Multivariate analysis shows that in people with diabetes the risk of any cardio-vascular complication (MI, stroke, heart failure and angina) increases with age and being male. There is also a clear deprivation gradient of risk with people living in the most deprived fifth of areas being over 50 per cent more likely to experience cardio-vascular complications when compared with those living in the least deprived fifths of areas.

The analysis also highlights some significant differences related to ethnic group. People from South Asian ethnic groups had a greater risk of cardio-vascular disease compared to those from White ethnic groups; whilst people from Black ethnic groups showed a lower prevalence of MI, heart failure and angina than those in White ethnic groups. Those with a very high BMI (35+kgm$^{-2}$) were over twice as likely as those with a lower BMI to have had a hospital admission for heart failure.
Chronic Kidney Disease

Chronic kidney disease (CKD) is a long term complication of diabetes. CKD has five stages or levels of damage and reduced kidney function measured as GFR (Glomerular Filtration Rate – normal >90ml/min/1.73m²). Table 3 shows the percentage of people with diabetes at each CKD stage as well as those with no CKD. It is CKD5 (Kidney failure or End Stage Renal Failure, ESRF) that will cause death without Renal Replacement Therapy (RRT – dialysis or transplantation).

Renal Replacement Therapy prevalence increased in each of the last five NDA reporting periods. This section investigates the earlier stages of diabetic kidney disease and possible explanations.

### Table 3

<table>
<thead>
<tr>
<th>Stage &amp; Description</th>
<th>Proteinuria</th>
<th>GFR (ml/min/1.73m²)</th>
<th>Number of people with diabetes experiencing CKD stage</th>
<th>Percentage of people with diabetes experiencing CKD stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>No CKD</td>
<td>–</td>
<td>–</td>
<td>520,677</td>
<td>23.3%</td>
</tr>
<tr>
<td>CKD1</td>
<td>Kidney damage with normal/increased GFR</td>
<td>Microalbuminuria</td>
<td>&gt;90</td>
<td>90,089</td>
</tr>
<tr>
<td>CKD2</td>
<td>Kidney damage with mild reduction GFR</td>
<td>Micro/Macroproteinuria</td>
<td>60–90</td>
<td>975,209</td>
</tr>
<tr>
<td>CKD3a</td>
<td>Moderate reduction GFR</td>
<td>Micro/Macroproteinuria</td>
<td>45–59</td>
<td>269,736</td>
</tr>
<tr>
<td>CKD3b</td>
<td>Worsening reduction GFR</td>
<td>Micro/Macroproteinuria</td>
<td>30–44</td>
<td>116,642</td>
</tr>
<tr>
<td>CKD4</td>
<td>Severe reduction GFR</td>
<td>Micro/Macroproteinuria</td>
<td>15–29</td>
<td>30,142</td>
</tr>
<tr>
<td>CKD5</td>
<td>Kidney failure or ESRF</td>
<td>Micro/Macroproteinuria</td>
<td>&lt;15</td>
<td>11,273</td>
</tr>
<tr>
<td>Unknown</td>
<td>–</td>
<td>–</td>
<td>222,042</td>
<td>9.93%</td>
</tr>
</tbody>
</table>

Note: The NDA collects data on serum creatinine (mmol/l), age, sex and ethnicity which permits eGFR (estimated GFR) to be calculated. Only patients in whom all four variables were present have been included in the analysis summarised in Table 3.
Mortality

Data from people who were included in the 2009–2010 NDA and still alive on 31st December 2010 were linked to data from the Medical Research Information Service (MRIS) to identify those who died between 1st January 2011 and 31st December 2011. This gives data on mortality in people with diabetes over a one year period.

Between 1st January 2011 and 31st December 2011 people with all types of diabetes were 39.8 per cent more likely to die than their peers in the general population. Among those with Type 1 diabetes, mortality was 135 per cent greater than would be expected if they had the same mortality rates as the general population in England and Wales. People with Type 2 diabetes were 36.4 per cent more likely to die.

Comparison with the population of people with diagnosed diabetes reported to the 2009-2010 Quality and Outcomes Framework (QOF) shows that the 2009-2010 NDA included 81.1 per cent of people with diagnosed diabetes in England and 34.5 per cent of people with diagnosed diabetes in Wales. Extrapolating from the data on mortality shown in Table 4 allows us to estimate that there were 22,200 additional deaths in England and 1,920 additional deaths in Wales due to diabetes.

If we consider only people included in the NDA who died before their 75th birthday there were 1,784 people with Type 1 diabetes and 19,224 people with Type 2 diabetes, which is respectively 1,175 and 7,145 more than would be expected in the general population.

### Table 4

<table>
<thead>
<tr>
<th>Mortality in people with diabetes in England and Wales</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PYaR</strong></td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>All diabetes types</td>
</tr>
<tr>
<td>Persons</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Type 1 diabetes</td>
</tr>
<tr>
<td>Persons</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Type 2 diabetes</td>
</tr>
<tr>
<td>Persons</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
</tbody>
</table>

*For definitions, please refer to the glossary

### Multivariate Analysis

As is true for the general population, older age and male sex increases the risk of death in people with diabetes. Deprivation also increased the risk of one year mortality with people from the most deprived fifth of areas being 36 per cent more likely to die than those in the least deprived fifth of areas. People from Black and South Asian ethnic groups were less likely to die than people from White ethnic groups.

When looking at the short term complications and death, an admission to hospital with heart failure was the strongest predictor of mortality in our model. For people with diabetes who are admitted to hospital for heart failure, the risk of mortality within the next year increased by 359 per cent when compared to people with no such complication. A major amputation increased the risk of dying by 228 per cent whilst a stroke increased the risk of dying by 244 per cent and an MI by 99 per cent. Treatment with RRT was associated with an increase in the risk of dying in the next year of 163 per cent.

Figure 4 shows the additional risk of death among people with diabetes compared to the local population by PCT/LHB. Areas shown in darker green have a significantly higher additional risk of dying among people with diabetes whilst PCTs/LHBs highlighted in lighter green have a significantly lower additional risk of dying among people with diabetes, but still an additional risk.
Figure 4
Additional risk of death among people with diabetes compared to the local population by PCT/LHB

- Above expected
- As expected
- Below expected

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Further Information

For further information, including NDA methodology and national summary reports, please visit the website for the National Diabetes Audit.

References

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   http://guidance.nice.org.uk/Topic/EndocrineNutritionMetabolic/Diabetes

2. NICE Clinical Guidelines – CG15: Type 1 diabetes: Diagnosis and management of type 1 diabetes in children, young people and adults.
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3. NICE Clinical Guidelines – CG10: Type 2 diabetes – Foot care
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6. NICE – Diabetes in Adults Quality Standard
   http://www.nice.org.uk/guidance/qualitystandards/diabetesinadults/diabetesinadultsqualitystandard.jsp

7. National Paediatric Diabetes Audit
   http://www.rcpch.ac.uk/npda
Ethnic Groups
Ethnic groups used in the multivariate analyses as defined by the NHS Data Dictionary:
http://www.datadictionary.nhs.uk/data_dictionary/attributes/enh/ethnic_category_code_de.asp?shownav=1

White Ethnic Group
A British
B Irish
C Any other White background

South Asian Ethnic Group
H Indian
J Pakistani
K Bangladeshi

Black Ethnic Group
M Caribbean
N African
P Any other Black background

Other Ethnic Group
D White and Black Caribbean
E White and Black African
F White and Asian
G Any other mixed background
L Any other Asian background
R Chinese
S Any other ethnic group

Expected deaths
The expected death count is that which would occur if the observed subject population experienced the standard population’s age-specific mortality rates.

Confidence Interval (CI)
A confidence interval is a range of values that quantifies the imprecision in the estimate of a statistic. Specifically it quantifies the imprecision that results from random variation in the estimation of the value; it does not include imprecision resulting from systematic error (bias). In public health many indicators are based on what can be considered to be complete data sets and not samples, e.g. mortality rates based on death registers. In these instances the imprecision arises not as a result of sampling variation but of ‘natural’ variation. The indicator is considered to be the outcome of a stochastic process, i.e. one which can be influenced by the random occurrences that are inherent in the world around us. In such instances the value actually observed is only one of the set that could occur under the same circumstances. Generally in public health, it is the underlying circumstances or process that is of interest and the actual value observed gives only an imprecise estimate of this ‘underlying risk’.

The width of the confidence interval depends on three things:

- The sample or population size from which the estimate is derived.
- The degree of variability in the phenomenon being measured.
- The required level of confidence – this is an arbitrary value set to give the desired probability that the interval includes the true value. In medicine and public health the conventional practice is to use 95 per cent confidence.

For a given level of confidence, the wider the confidence interval, the greater the uncertainty in the estimate.

Population-years-at-risk (PYaR)
The population-years-at-risk is the total amount of time during which the population is exposed to a risk. For example, during the one-year mortality follow-up period a person who survives the whole year contributes one year to the total PYaR; a person who dies after 3 months contributes only 0.25 years to the total.

Standardised mortality ratio (SMR)
The SMR is a form of indirect standardisation. The age specific mortality rates of a chosen standard population (usually the relevant national or study aggregate population) are applied to the age structure of the subject population to give an expected number of deaths. The observed number of events is then compared to the expected and is usually expressed as a ratio (observed/expected). For presentation purposes, the SMR is usually expressed per 100. By definition, the standard population will have a SMR of 100. SMRs above 100 indicate that the death count observed was greater than that expected from the standard mortality rates and SMRs below 100 that it was lower.
Regression Analysis

Logistic regression modeling has been used as the multivariate statistical technique throughout this report. The results of the logistic regression analyses are presented in Appendix 3.

A logistic regression model was used to explore which person and environmental variables were associated with having a complication or dying. The model allows each variable to be considered independently by controlling for the effects of other, sometimes related, factors. The model allows an evaluation of the strength of the relationship between each of the variables and the complication.

The variables included in the models for diabetic complications were: age, gender, ethnicity, body mass index (BMI), type of diabetes and Index of Multiple Deprivation (IMD). The variables included in the model for mortality were: age, gender, ethnicity, BMI, type of diabetes, IMD, HbA1c, cholesterol, chronic kidney disease stage and diabetic complications. These explanatory variables include categorical variables, which group cases into a number of discrete categories (for example IMD is grouped into 5 categories or quintiles) and continuous variables (for example age). Missing values for explanatory variables were not included in the models. Excluding missing values for explanatory variables can cause significant sample attrition, since cases are lost if they have a missing value for any one of the relevant variables. This reduces precision of estimates and may introduce bias.

The model identifies associations, not causes; in other words, factors which identify individuals with an increased or decreased risk of having a complication in the follow up period. These variations in risk are expressed as odds ratios and expressed relative to a reference category, with is given a value of 1. Odds ratios greater than 1 indicate increased risk and odds ratios less than 1 indicate decreased risk of the complication. Also provided are the 95% confidence intervals for the odds ratio. Where the interval does not include 1, the category is significantly different (P<0.05) from the reference category. For continuous variables there is a single odds ratio and confidence limit; the odds ratio represents the change in odds associated with each additional point in the range (for example with each extra year of age). As with the categorical variables, the 95% confidence interval is provided and the odds ratio is significant where the confidence interval does not include 1.
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