The latest National Diabetes Audit report sheds light on complications and mortality rates

The latest report from the National Diabetes Audit is another first – an analysis of the relationship between diabetes care delivered to NHS patients in England and Wales and the prevalence of complications and mortality rates. Steve Chaplin here examines the audit’s key findings of direct relevance to the care of diabetes patients.

The latest report from the National Diabetes Audit (NDA) is divided into two parts. The first covers the prevalence of complications in the year 2015/16 in 171,678 people with type 1 diabetes (T1D) and 1,863,871 people with type 2 (T2D) and other diabetes. The second examines the relationships between delivering care processes and achieving treatment targets with cardiovascular outcomes, renal replacement therapy (dialysis, haemofiltration, haemodiafiltration, kidney transplantation) and mortality.

Prevalence of complications in 2015/16

Cardiovascular

The rates of angina (3.1%), myocardial infarction (0.8%), heart failure (3.2%) and stroke (1.1%), unadjusted for age and sex, are higher in people with T2D than in those with T1D (1.3%, 0.5%, 1.3% and 0.5%, respectively). Compared with controls without diabetes (defined as never having appeared in the diabetes register), the risk of cardiovascular complications is 3.5–4.5 times greater for people with T1D and 2–2.5 times greater for those with T2D. The NDA changed its methodology for estimating rate ratios and the current figures cannot be compared with previous analyses; however, it is clear that recent years have seen a trend for the risk of cardiovascular complications to increase (Figure 1; note that the figure cites additional risk, not standardised ratio). As is the case in many aspects of diabetes care, there is substantial geographical variation in the standardised ratios for cardiovascular complications (and this is also true for diabetes-specific complications).

People with diabetes make up about 5% of the adult population but account for 25–30% of hospital admissions for cardiovascular complications. Compared with controls, the age distribution among people with T2D who are admitted is similar but the proportion of under-70s with T1D admitted is higher. People with diabetes account for 22–30% of bed-days after non-emergency admissions and 24–33% following emergency admissions.

Figure 1. Additional risk of cardiovascular complications: patients with diabetes vs controls;* 2010–11 to 2014–15 audits, England and Wales.† (Copyright © 2017 the Healthcare Quality Improvement Partnership)

*Figures for 2015–16 are not directly comparable with earlier data due to a change in methodology.
**Chronic kidney disease**

Recent years have seen a decline in the numbers of people with diabetes with end-stage kidney disease and an increase in those with early-stage chronic kidney disease (CKD), suggesting that early detection and intervention may be having an impact. Only a minority of people have no CKD (T1D 35%; T2D 21%) and most of the remainder have mild CKD (36% and 46%, respectively). Absolute numbers of people with end-stage CKD or requirement for renal replacement therapy are low (about 6000) but increasing as the prevalence of diabetes rises; the excess risk is 19 for T1D and 4.5 for T2D. People with diabetes who need a kidney transplant tend to be younger than those without diabetes.

**Amputation**

People with diabetes make up about half of admissions for amputation, with 0.07–0.09% undergoing major amputation and 0.17–0.18% having minor amputations. Over 40% of all admissions for major amputations and 73% of all emergency admissions for minor amputations are in people with diagnosed diabetes. Duration of diabetes is a more important determinant of risk than age, with prevalence increasing 7–13-fold for duration up to 40 years for major procedures and by a factor of 8–14 for minor amputations.

**Mortality**

People with diabetes have an increased risk of death, the greatest effect occurring in young people (Figure 2). In the general population, vascular death is becoming less frequent (29% of all deaths in 2015) and cancer death is slowly increasing (28%). Vascular death is also declining among people with diabetes (33%) but it is still more common than death from cancer (24%). As Figure 3 shows, coronary heart disease is a more frequent cause of vascular death in people with diabetes. These differences are largely confined to people aged under 80 and have persisted since 2005; in the over-80s, rates are similar among people with diabetes and controls.

**Associations between outcomes and preceding care**

This part of the NDA report looks at how the care delivered affected short-term (one year) and long-term (seven years) outcomes. It has two sections based on different cohorts.

The first is a longitudinal analysis of associations between heart failure, kidney disease and mortality and the delivery of care between 2006/07 and 2012/13. Three care processes were assessed: measurement of HbA1c, blood pressure and serum cholesterol. These are the processes that are delivered best of the eight recommended by NICE, with uptake rates of 80–90% for T1D and 93–96% for T2D. Two cohorts of people with diabetes aged at least 20 were compared: those who had received all 21 recommended checks for the selected care processes (‘complete’) and those who had received 12 or fewer (‘incomplete’).

The second analysis included people with diabetes who were part of the 2006/07 NDA cohort and aged at least 20 in 2012/13. The cohort was divided into quintiles (by volume of data rather than clinically-significant categories; thresholds differed between T1D and T2D) for each of three treatment targets (measurements of HbA1c, systolic blood pressure and cholesterol). Outcomes were measured at one and seven years.

The report repeatedly qualifies its findings with the caution that the relationship between interventions and outcomes is not straightforward. The phenomenon of reverse causality means that increased treatment and changes in risk factors during the years leading up to a severe event can make it appear that more health interventions (e.g. statin treatment) and better outcomes (lower cholesterol levels) are associated with increased risk.

**Care processes and outcomes**

Complete care delivery was associated with a lower incidence of heart failure admission in people with T1D or T2D aged under 64 compared with incomplete care. In older people, admission rates are similar...
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for the two groups until age 80, after which admission rates increase by more among those with complete care. This difference is attributed to higher attendance rates among elderly people who are developing heart failure or lower survival for the full follow-up period.

The proportion of people progressing to renal transplantation was lower with complete care up to age 64 for both T1D and T2D, but the difference was smaller among older people with T2D and non-existent in older people with T1D. At best, the gap between the two groups was small, with marked variation between age categories in the young T1D complete care group (e.g. 0.5% vs 1.4% at 45–49 years and 1.0% vs 1.1% at 50–54 years).

By contrast, there was a >2-fold difference in mortality between the complete and incomplete care groups for both T1D and T2D, clearly established by the mid-40s (1.4% vs 3.9%) and persisting well into advanced age (24% vs 38% at age 80–84).

Treatment and outcomes

Heart failure

Admission rates for heart failure were greatest among people with highest blood pressure, the correlation holding true for both types of diabetes, though less strongly for T2D. By contrast, there were fewer heart failure admissions among individuals with high cholesterol levels – the effect of reverse causality.

In people with T1D, heart failure rates were paradoxically greatest for both the 20% with lowest HbA1c (up to 54mmol/mol) and the 40% with highest HbA1c (≥75mmol/mol). This was true for both one-year and seven-year follow up. There was a small but consistent trend over seven years for increased heart failure rates with worsening glycaemic control in people with T2D but this was not evident over a one-year period. The difference in short-term outcome may once again be due to treatment intensification in response to deteriorating health.

The impact of consistently low or high attainment of treatment targets (i.e. the bottom vs the top 20% of the population) was analysed in people with T2D (there were insufficient numbers for T1D). Maintaining good glycaemic control was associated with a lower rate of heart failure for all ages. This was not evident for blood pressure and the impact of lower cholesterol was apparent only after age 60, probably due to increasing use of statins with age.

Renal replacement therapy

There was a clear association between progression to renal replacement therapy and increasing blood pressure during both short- and long-term follow up; the trend was similar but rates were slightly lower for T2D than T1D. The relationship with glycaemic control was more complex. For people with T1D, progression was stable – or even decreased – as HbA1c increased to 72mmol/mol. Thereafter, the proportion of people with progression increased markedly, particularly with longer follow up, rising from 1.2% at HbA1c 73–94 mmol/mol to 3% at ≥95mmol/mol. For those with T2D, the trend for increased progression was clearer (though peaking lower at 1.4%) in the longer term but there was no correlation over one year. Once more, cholesterol levels did not distinguish between high and low risk of progression.

Analysis of target attainment consistency shows that progression to renal replacement therapy was three times more frequent with poor glycaemic control (HbA1c ≥75 vs ≤45mmol/mol) in all age groups. There was a similar difference for blood pressure, though in this case the difference was greatest below the mid-40s (about 5-fold) and diminished with age (to about double by the mid-60s). The picture was confusing with cholesterol, as the progression rate was higher with consistently low cholesterol in the over 60s, though not in younger people.

Mortality

During long-term follow up, increasing blood pressure was associated with an incrementally greater risk of mortality. For people with T1D, this increased from about 3% with systolic pressure ≤118mmHg to 6% at 134–140mmHg and 7–8% at ≥141mmHg. The same trend was apparent with T2D, though the difference in mortality between lowest and highest pressure was smaller (about 8% vs 11%). There was no clear trend during one-year follow up due to confounding by treatment and changes in blood pressure with illness severity.

The relationship between glycaemic control and outcomes raises only uncertainty. In people with T1D, mortality was greatest with lowest and highest HbA1c, in both the short and long term. The NDA report speculates that death in people with low HbA1c may have been due to severe hypoglycaemia, which was not measured in the audit. In people with
T2D, mortality was lower in those with worse glycaemic control after one and seven years. Low HbA1c may be hazardous in some people with T2D, the report suggests, pointing out that participants in clinical trials do not have HbA1c as low as some of the NDA population (20% with ≤45mmol/mol).

Reverse causality rears its head once again with cholesterol, showing a clear association between increasing cholesterol levels and decreasing mortality. Looking at mortality from a different angle yields results more in line with expectations for glycaemic control (Figure 4). Consistently high HbA1c is associated with higher mortality at all ages from 50 onwards compared with low HbA1c, and the rate at which risk increases steepens sharply after each decade. But there is more confounding with blood pressure and cholesterol levels, probably due to a decline in blood pressure in untreated older people for at least five years before death, greater use of statins in patients with greater cardiovascular risk, and the reduction in cholesterol due to inflammation associated with vascular and other serious disease.

Summary
This NDA report confirms that people with T1D or T2D are at increased risk from cardiovascular disease and account for a disproportionate share of admissions to hospital, both elective and emergency, amputations and kidney disease. They face an increased risk of death compared with people who don’t have diabetes, a challenge that has persisted for years and one that particularly affects younger people.

The analyses confirm expectations that complete uptake of care processes improves outcomes compared with patchy adherence, with mortality differences emerging as early as the mid-40s. Conversely, where randomised trials predict long-term benefits from better glycaemic control, lower blood pressure and lower cholesterol levels, the data do not always show that this is happening in practice. The supposition is that the conflict is due to confounding by reverse causality rather than a problem with service delivery, suggesting a more detailed analysis is required (this report was constrained by limited time and resources). It also means the findings cannot easily be deployed to bring about change in diabetes care.

Steve Chaplin, BPharm, MSc, Medical Correspondent

References