The Effects of The Quality of Primary Care on Diabetes Outcomes

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Submitted for the degree of Doctor of Philosophy

September 2015

Abstract

Background

Diabetes mellitus is a chronic condition primarily characterised by elevated levels of plasma glucose due to a lack of insulin. Diabetes is a risk factor for a number of acute and chronic complications and is associated with significant morbidity and mortality, the risks and impact of which may be modifiable through high-quality primary care. This thesis examines the relationship between the quality of primary care and emergency admissions, readmissions and mortality.

Methodology

Associations between primary care quality and clinical outcomes for people with diabetes were assessed at the practice and patient level. Practice-level analyses, utilising Quality and Outcomes Framework (QOF) and Hospital Episodes Statistics (HES) data, modelled the impact of practice achievement of thematically-grouped QOF indicators on standardised emergency admission rates, controlling for characteristics of the practice, the socioeconomic environment and the patient population. Patient-level analyses utilised a Clinical Practice Research Datalink (CPRD-HES) dataset linking primary care activity with hospitalisations. Modelling examined associations between QOF target-based indicators and National Diabetes Audit (NDA) care processes and rates of emergency admissions, readmissions and the odds of death.

Results

In practice-level analyses, QOF indicators pertaining to processes of care and availability of appointments were most consistently associated with reduced emergency admission rates. For patient-level analyses, a number of NDA processes were consistently associated with reduced emergency admission and readmission rates and reduced odds of death across follow-up periods ranging from one to five years. Associations with QOF targets were less consistent. Across all practice- and patient-level analyses, deprivation was strongly associated with changes in admission rates and odds of death.

Conclusions

High-quality primary care has the potential to meaningfully improve outcomes for people with diabetes; the effects of socio-economic deprivation remain sizeable even after adjustment for primary care quality.

Declaration of Originality

I hereby declare that this submission is my own work and, to the best of my knowledge, it contains no materials previously published or written by another person, or substantial proportions of material which have been accepted for the award of any other degree or diploma at Imperial College London or any other educational institution.

Any contribution made to the research by others, with whom I have worked at Imperial College London or elsewhere, is explicitly acknowledged in the thesis. I also declare that the intellectual content of this thesis is the product of my own work.



Daniel C Gibbons

6th September 2015

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Acknowledgements

First and foremost, I would like to thank the NHS National Institute for Health Research for their generous research grant (DRF-2011-04-054) without which I would not have been able to embark upon my Doctoral studies.

Whilst monetary support was much needed and appreciated for my studies, a number of individuals truly went above and beyond with the levels of support that they offered me during my research programme.

I humbly thank the members of my supervision team – Dr Chris Millett, Professor Azeem Majeed and Dr Michael Soljak – for their support, patience, friendship and guidance over the period of my Doctoral studies. I am also grateful for the statistical signposting provided to me by Dr Hilary Watt and for the database support provided by Veronika Valovicova.

I would also like to extend my gratitude to Dr Angela Bhan, Head of School of the London, Kent, Surrey and Sussex Public Health Training Scheme, and Dr Jean Chapple, my Training Programme Director, for the flexibility and support that they offered with regards to arranging my Specialty Training around the demands associated with the frenetic final months of PhD studentship.

Last, but by no means least, I would be remiss not to acknowledge the unending, unstinting and unconditional support of my fiancée, Sarah Bennett, and my father, Dave Gibbons, who truly led me through the woods when I couldn't see the trees.

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Abbreviations

A&E	Accident and Emergency
ACEi(s)	Angiotensin Converting Enzyme inhibitor(s)
ACSC	Ambulatory Care Sensitive Condition
ARB(s)	Angiotensin (II) Receptor Blocker(s)
BP	Blood Pressure
CCG	Clinical Commissioning Group
CHD	Coronary Heart Disease
CKD	Chronic Kidney Disease
CQC	Care Quality Commission
DKA	Diabetic Ketoacidosis
eGFR	Estimated Glomerular Filtration Rate
ESRF	End-Stage Renal Failure
FFA(s)	Free Fatty Acid(s)
FTE(s)	Full-Time Equivalent(s)
HES	Hospital Episode Statistics
HHS	Hyperosmolar Hyperglycaemic State
HR	Hazard Ratio
HRG(s)	Health Resource Group(s)
HSCIC	Health & Social Care Information Centre
ICD-10	International Statistical Classification of Diseases and Related Health Problems, 10th Revision
IDDM	Insulin-Dependent Diabetes Mellitus
IMD	Index of Multiple Deprivation
IoM	Institute of Medicine
IRR(s)	Incidence Rate Ratio(s)
LSOA(s)	Lower Super Output Area(s)
MHRA	Medicines & Healthcare Products Regulatory Agency
NDA	National Diabetes Audit
NHS	National Health Service
NIDDM	Non-Insulin-Dependent Diabetes Mellitus
NIHR	National Institute for Health Research
OECD	Organisation for Economic Co-operation and Development
ONS	Office for National Statistics
OR	Odds Ratio
PAD	Peripheral arterial disease
PbR	Payment by Results
PCT	Primary Care Trust
QOF	Quality and Outcomes Framework
RRT	Renal Replacement Therapy
T1DM	Type 1 Diabetes Mellitus
T2DM	Type 2 Diabetes Mellitus
TIA(s)	Transient Ischaemic Attack(s)
WHO	World Health Organisation

Introduction

In the coming years, the National Health Service (NHS) stands to face considerably increased demand for its services, largely due to an increasingly co-morbid and ageing population.[1, 2] Over 300 million patient consultations, representing 70–90% of all patient contacts in the English NHS, take place in primary care.[3] Primary care consultation rates have been increasing year-on-year, with an average number of consultations per patient rising from 3.9 per year in 1995 to 5.4 per year in 2008 (Figure 1).[3]



Figure 1. Crude consultation rates and estimated number of primary care consultations in England (reproduced from Hippisley-Cox & Vinogradova, 2009).

Many chronic conditions, such as diabetes, are often termed 'ambulatory care sensitive conditions' (ACSCs).[4, 5] ACSCs are considered conditions for which high quality primary care – the key components of which include person-centeredness, provision of comprehensive care and continuity of care[6] – can reduce the need for hospitalisation or for which early intervention can prevent disease complications or progression.[4, 7] ACSCs are generally grouped into three categories – vaccine-preventable, acute and chronic conditions (Table 1).[8]

Vaccine-Preventable	Acute	Chronic
Influenza and pneumonia	Dehydration and Gastroenteritis	Asthma
Other vaccine-preventable conditions	Pyelonephritis	Congestive heart failure
	Perforated/bleeding ulcer	Diabetes complications
	Cellulitis	Chronic obstructive pulmonary disease
	Pelvic inflammatory disease	Angina
	Ear, nose and throat infections	Iron-deficiency Anaemia
	Dental conditions	Hypertension
	Convulsions and epilepsy	Nutritional Deficiencies
	Gangrene	

Table 1. The 19 Conditions Considered as ACSCs in The NHS.

Emergency admissions for ACSCs are gaining popularity as an indicator of the quality of primary care on the assumption that the provision of timely, appropriate, comprehensive and effective care in the community for these conditions should reduce the risk of unexpected and potentially preventable complications.[7,9] Clinical care is only one aspect of providing high-quality primary care; access to provided services is key, as evidenced by an inverse relationship between accessibility of primary care and the risk of hospitalisation due to ACSCs.[10-12]

The use and interpretation of emergency admission rates for ACSCs as an indicator of primary care quality, whilst both logical and intuitive, does imply that primary care is considered a closed system. It is likely that primary care is not able exert complete control over many of the myriad factors, be they cultural, financial or sociopolitical, influencing the interactions between patients and the healthcare system. Many of these factors are arguably outside of the sphere of influence of medicine, yet can exert a profound effect on an individual's health and their health outcomes.[7] Such factors, to a certain degree, may explain the considerable variation in emergency admission rates for ACSCs observed between general practices in England.[13,14]

In the period covering 1st April 2009 to March 31st 2010, 15.9% of all emergency hospital admissions (816,433 of 5,135,974) in England were attributable to ACSCs; of these, 30% occurred in patients aged 75 years or older, in whom emergency admissions for chronic conditions were more common.[14] The associated costs of these admissions is considerable; of the £20.5b spent on inpatient admissions in England in 2009/10, emergency admissions accounted for £12.2b of which the estimated cost of emergency admissions for ACSCs was £1.42b.[14-16] The cost of these emergency admissions for ACSCs was also associated with patient age, with individuals aged 75 years or older accounting for 40% of expenditure (£563m of £1.42b).[14]

In light of the marked variation between general practices in emergency admission rates for ACSCs observed in England[14], there is considerable potential to reduce the burden of opportunity costs associated with unscheduled care for ACSCs. A recent King's Fund report[14] estimated that the number of emergency admissions for ACSCs could be reduced by between 8% (63,214 admissions) to 18% (150,373 admissions), equating to savings of £96m and £238m respectively, if poorer performing Local Authorities reduced their emergency admission rates to those of the best performing Local Authorities.

The restructuring of NHS England in 2013 saw the responsibilities for the planning and commissioning of services for local populations move from Primary Care Trusts (PCTs) to Clinical Commissioning Groups (CCGs). CCGs are clinically-led consortia of general practices that provide primary care services for a defined area and are responsible for the purchasing of urgent and emergency care, elective hospital care, community health services, maternity and newborn services and mental health services for the population that they serve.[17]

The new structure of NHS England, and the resultant shift in commissioning duties, poses a clear opportunity for primary care to remodel the way in which care is delivered so as to maximise outcomes, cost-efficiency and patient access in a way that closely reflects the evolving needs of local populations. In light of the projected demand for the care of older, more co-morbid individuals, significant headway towards these aims may be made through a renewed focus on diseases that are particularly suited to management in primary care, albeit subject to the impact of external sociopolitical factors discussed above in addition to the need for adequate resourcing of primary care.[18,19]

Diabetes Mellitus

Diabetes mellitus is a chronic condition that is primarily characterised by elevated levels of plasma glucose due to an absolute or relative lack of the pancreatic hormone insulin.[20] Diabetes is associated with a number of acute and chronic complications and is associated with significant morbidity and mortality.[21-25]

In health, insulin is one of the principle hormones that regulates glucose homeostasis and, in broad terms, acts to promote storage of energy. Insulin is secreted by the β-cells of the pancreas in response to elevated plasma glucose concentrations; the primary functions of insulin are to promote glucose uptake by cells, promote glucose storage in the liver through its conversion to glycogen, promote lipid formation and storage in adipocytes, inhibition of lipolysis and proteolysis within cells and inhibition of gluconeogenesis (Figure 2).

The other key hormone in glucose homeostasis is glucagon, secreted by the α-cells of the pancreas in response to low plasma glucose concentrations. Glucagon acts to liberate energy from stores via promotion of the conversion of glycogen to glucose in the liver, promotion of lipolysis and proteolysis in cells and promotion of gluconeogenesis. Lipolysis yields free fatty acids (FFAs), which are metabolised to ketones by the liver for use as an alternative energy source for the heart and brain; proteolysis produces lactate, pyruvate and amino acids, all of which are substrates for gluconeogenesis (Figure 2).

In diabetes, insulin insufficiency (be it relative or absolute) ultimately leads to deranged glucose homeostasis. A lack of circulating insulin means that there is no stimulus to promote the storage of glucose and the inhibition of gluconeogenesis, glycolysis, lipolysis and proteolysis, leading to the production of glucose and, in the absolute absence of insulin, FFAs and ketone bodies despite physiologically adequate concentrations of plasma glucose.

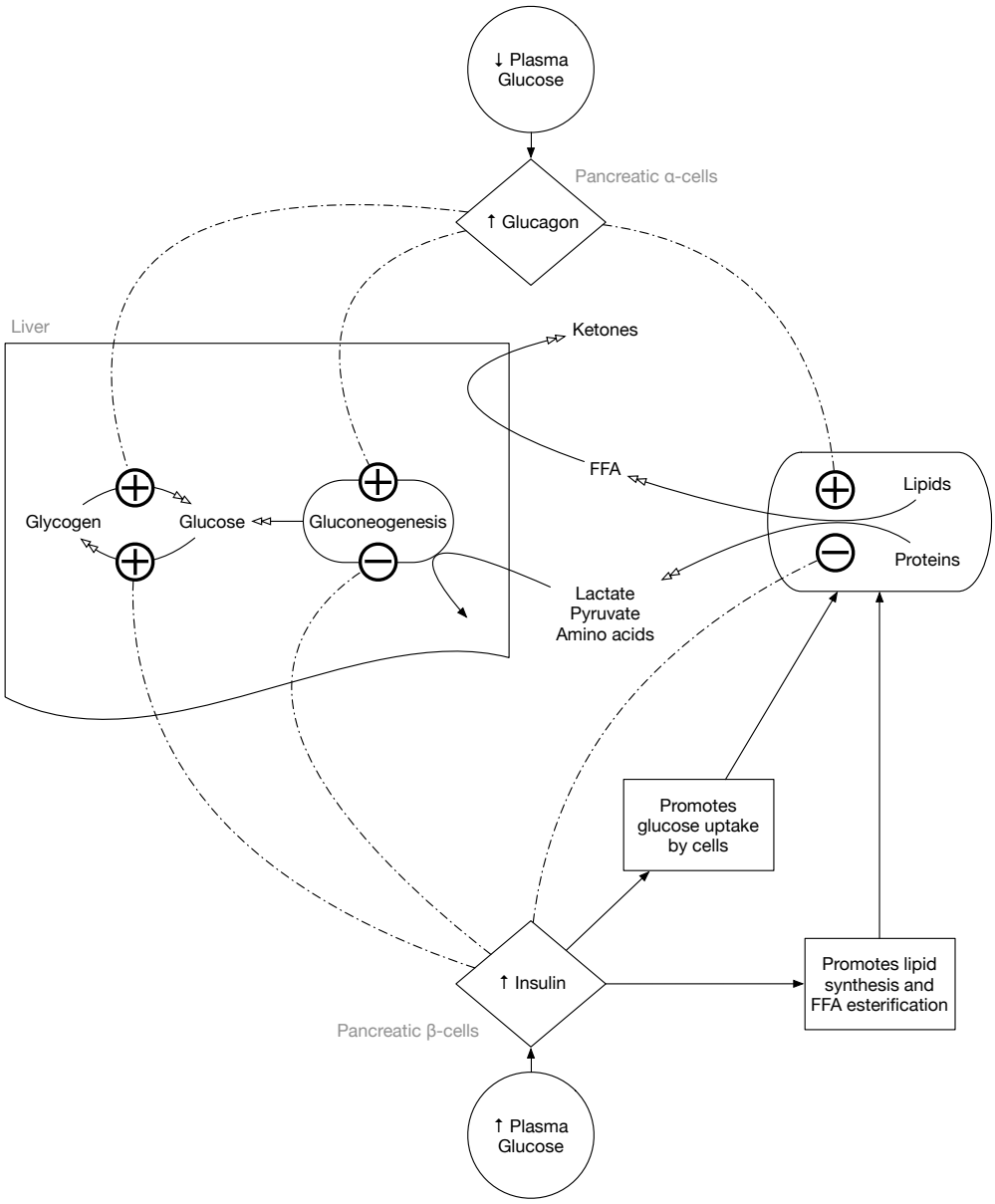


Figure 2. Overview of Glucose Homeostasis.

Types and Epidemiology of Diabetes Mellitus

Diabetes mellitus is an increasingly common chronic disease in England, characterised by chronically elevated levels of blood glucose. In 2009, the estimated prevalence of diabetes mellitus – both diagnosed and undiagnosed – was approximately 3.1m (7.4% of the population) and has been projected to rise to 4.6m (9.5%) by 2030.[26] The crude prevalence of diabetes mellitus differs by age, sex and ethnicity, with the highest prevalences observed in men, South Asian and Black ethnic groups and with increasing age (Figure 3).[26-29]

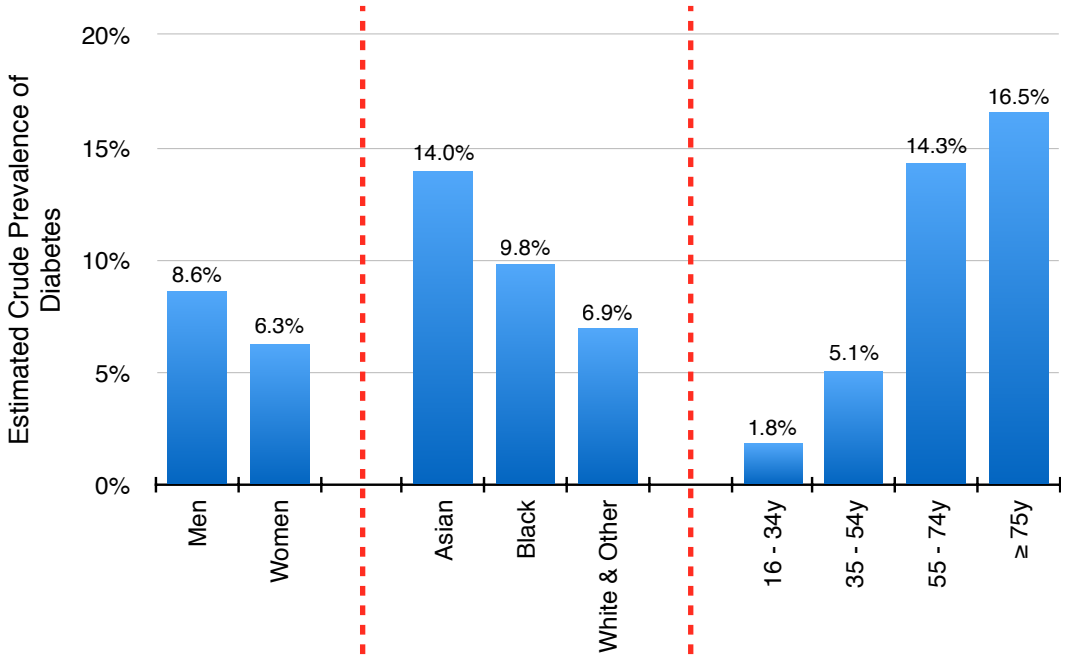


Figure 3. Estimated Crude Prevalence of Diabetes Mellitus by Gender, Ethnicity and Age.[26]

In addition to the demographic differences observed in the prevalence of diabetes mellitus, there are considerable geographic differences in diabetes prevalence across Strategic Health Authorities in England, with estimated prevalence ranging from 6.6% in South Central England to 8.1% in the West Midlands.[26,29] Deprivation is also strongly associated with diabetes prevalence[28,30], with the most affluent areas exhibiting between 33% to 57% fewer cases of diabetes in comparison to the poorest areas.[28,30]

The two most common forms of diabetes encountered in clinical practice are type 1 diabetes mellitus (T1DM) and type 2 diabetes mellitus (T2DM). Other, markedly less common, types of diabetes, such as gestational diabetes mellitus and malnutrition-related diabetes mellitus also exist but are outside of the scope of this thesis.

Diabetes of either type is associated with considerable morbidity and mortality. Individuals diagnosed with diabetes were nearly 35% more likely to die than their peers in the general population during 2013; excess mortality in T1DM and T2DM was 131% and 32% respectively during this period, with approximately 22,000 deaths due to diabetes during this period.[21] Although diabetes confers an excess risk of mortality across all age groups, the relative risks are greatest for females, at younger ages and in T1DM – females with T1DM aged 15-34 years are 6.6 times more likely to die than non-diabetic females in this age group.[21]

Regardless of diabetes type, the core therapeutic goal in the management of diabetes is control of blood glucose concentrations. Persistently elevated blood glucose levels are associated with poorer outcomes in diabetes[31-33] and adequacy of glucose control can be routinely and easily assessed through measurement of the relative concentration of glycated haemoglobin (HbA1c).

Glucose in the blood stream attaches to haemoglobin molecules in concentration-dependent manner; persistently high concentrations of blood glucose causes more glucose molecules to bind to haemoglobin, thereby leading to the increased formation of glycated haemoglobin. Binding of glucose to haemoglobin is permanent, meaning that glycated haemoglobin can only be cleared from the blood stream upon destruction of red blood cells, the normal lifespan of which is approximately 120 days. The ratio of glycated haemoglobin (HbA1c) to normal, unglycated haemoglobin therefore provides an estimate of the adequacy of blood glucose control over the previous 1-3 months. HbA1c is commonly reported according to International Federation of Clinical Chemistry (IFCC) or Diabetes Control and Complications Trial (DCCT) guidelines, which express the relative amount of HbA1c to unglycated haemoglobin as mmol/mol or % respectively.

Whilst control of blood glucose concentrations is a core therapeutic goal in diabetes, patients on intensive hypoglycaemic therapy (be it subcutaneous insulin or oral hypoglycaemic agents) are at risk of hypoglycaemia as a result of their treatment. Hypoglycaemia is a serious complication of diabetes treatment, with an estimated annual cost of emergency calls of £13.6m in England[34] and is associated with decreased quality of life[35], increased hospital length of stay[36] and both all-cause[36,37] and cardiovascular mortality.[38]

Type 1 Diabetes Mellitus

T1DM, also known as juvenile-onset diabetes mellitus or insulin-dependent diabetes mellitus (IDDM), is a subtype of diabetes mellitus, most commonly resulting from an absolute lack of insulin secondary to autoimmune destruction of the β-cells in the pancreas; a minority of cases of T1DM are due to idiopathic destruction or failure of β-cells.[39] It has been hypothesised that such destruction may be triggered by environmental exposures.[40]

An absolute lack of insulin leads to a profound disruption of glucose homeostasis, resulting in hyperglycaemia, a lack of inhibition of gluconeogenesis, a lack of stimulus to store glucose within the liver and peripheral cells and an increase in proteolysis and lipolysis, leading to an increase in FFAs and ketone bodies that, in turn, can lead to metabolic acidosis (Figure 2).

T1DM predominantly occurs in younger individuals, with a peak age of onset of 10 - 19 years of age; however, T1DM can occur at any age and up to 10% of adults initially diagnosed with T2DM are subsequently found to have autoantibodies associated with T1DM.[27,39] Of people with diabetes aged 19 years old or younger, 96% have T1DM; however, only 9% of all people with diabetes (adults and children) have T1DM.[27] Unlike many other autoimmune conditions, which tend to disproportionately affect females, there is an over-representation of males in incident and prevalent T1DM in England and wales, with males comprising approximately 60% and 57% of cases respectively.

Despite the fact that over 85% of incident T1DM cases have no family history of the condition, there is evidence of a genetic predisposition to T1DM, with first-degree relatives of patients with T1DM exhibiting a 15-fold increase in risk of developing the disease.[41]

Diagnosis of Type 1 Diabetes Mellitus

The WHO diagnostic criteria for T1DM[42], published in 2006 and currently recommended by NICE[43,·44], are largely based upon the symptoms and signs that result from the grossly impaired glucose homeostasis which is pathognomic of T1DM in the presence of hyperglycaemia (defined as a random blood glucose of ≥ 11.1 mmol/L), namely:

- Polyuria
- Polydipsia
- Marked weight loss

The presence of ketonuria in the context of hyperglycaemia is also strongly suggestive of T1DM as opposed to other types of diabetes mellitus. Measurement of HbA1c has largely supplanted blood glucose measurements in the diagnosis of diabetes, with an HbA1c ≥ 6.5% / 47.5 mmol/mol considered compatible with a diagnosis of diabetes.[45,·46] Some individuals may present with diabetic ketoacidosis (DKA), an acute complication of T1DM that is discussed in greater detail below.

Treatment of Type 1 Diabetes Mellitus

As there is an absence of endogenous insulin secretion in T1DM, the primary goal of treatment is to provide exogenous insulin in the form of regular subcutaneous injections. Insulin is available in a number of forms (rapid-, short-, intermediate- and long-acting) and the exact regimen prescribed to achieve glycaemic control will depend on an individual patient's needs and lifestyle.[43]

In addition to the prescription of insulin, patient education on how diabetes interacts with their diet, intercurrent infections and exercise are essential cornerstones of the holistic package of care necessary for effective management of T1DM.[43] Additionally, proactive surveillance and, where appropriate, initiation of treatment for the chronic complications of diabetes will maximise outcomes in patients with T1DM.

Diabetic Ketoacidosis

Diabetic ketoacidosis (DKA) is characterised by ketonaemia (ketosis), hyperglycaemia and acidosis. DKA is a life-threatening emergency, necessitating urgent medical care. DKA is commonly precipitated by infection, but can also result from other acute systemic diseases such as myocardial infarction, pancreatitis, poor compliance with or inadequate insulin regimens or may be the presenting condition in individuals not previously know to have T1DM.[47-49]

The crude prevalence of DKA in people with T1DM was 3.57% in England and Wales during 2012/13[21]; mortality rates for DKA have fallen over the past 2 decades from 7.96% to 0.67%, but remains high in non-hospitalised patients and the elderly and is the leading cause of death in young people with T1DM.[48,-50]

In T1DM, the characteristics of DKA are a direct result of a lack of insulin, leading to lack of suppression of gluconeogenesis, lack of suppression of lipolysis and proteolysis, enhancement of glycogenolysis – the net result of these disturbances is severe hyperglycaemia and the release of large quantities of ketone bodies which, in turn, leads to acidosis.

In addition to the metabolic disturbances discussed above, DKA also leads to profound fluid depletion as a result of osmotic diuresis secondary to severe hyperglycaemia and ketosis, fluid loss due to vomiting and, in severe episodes of DKA, inability to take in fluid due to reduced consciousness and coma. This loss of fluid and, to a certain degree, the lack of action of insulin, can lead to disturbances in electrolyte balance and, in particular, hyper- or hypokalaemia.[49,-50]

Overt DKA tends to develop rapidly, usually over a period less than a day; however, antecedent polyuria and polydipsia may be present over the previous few days prior to onset of DKA. Vomiting and abdominal pain are common presenting symptoms of DKA; levels of consciousness can vary from full alertness to lethargy to loss of consciousness.

On examination, patients presenting with DKA are often tachycardic and hypotensive as a result of fluid depletion; severe acidosis is associated with the presence of deep, laboured breathing (referred to as Kussmaul respiration), a physiological response that is attempting to correct metabolic acidosis.

The aims of DKA treatment are to restore fluid balance, reduce acidosis through clearance of ketone bodies, restore normoglycaemia and to correct electrolyte imbalances. Treatment of DKA usually consists of administration of intravenous fluids, to which electrolytes are added in order to correct any detected electrolyte imbalances, and an insulin infusion. In addition to restoring normoglycaemia, an infusion of insulin acts to suppress ketogenesis and aids the correction of electrolyte disturbances.

As DKA infers a disturbance of the normal management of a patient's diabetes, it is essential that diabetes specialist teams are involved in the care of all patients presenting with DKA. Involvement of such teams ensures that precipitating factors are assessed, appropriate acute management is undertaken, follow-up is arranged and structured education provided.[50]

Type 2 Diabetes Mellitus

T2DM, also referred to as adult-onset diabetes mellitus or non-insulin-dependent diabetes mellitus (NIDDM), is a sub-type of diabetes mellitus chiefly associated with hyperglycaemia in the context of insulin resistance (or relative insulin insufficiency); this contrasts with T1DM, where an absolute deficiency of insulin results in hyperglycaemia. Accordingly, excess production of ketone bodies is considerably less common in T2DM in comparison to T1DM as despite the fact that there is, in relative terms, insufficient insulin to ensure adequate glucose homeostasis, circulating levels of insulin are sufficient to suppress gluconeogenesis and widespread proteolysis and lipolysis (Figure 2).

The primary pathophysiological mechanism leading to hyperglycaemia in T2DM is resistance of peripheral tissues to insulin, a phenomenon observed in obesity. At the onset of insulin resistance, pancreatic β-cells may be able to increase insulin production to a level that maintains glucose homeostasis; however, as insulin resistance increases – for example, in conditions of increasing adiposity – β-cells may no longer be able to produce sufficient quantities of insulin to correct for insulin resistance and maintenance of normoglycaemia.[51]

T2DM is the most common form of diabetes mellitus, comprising over 90% of all cases of diabetes in England and Wales.[27] T2DM most commonly occurs in middle-aged to older adults, most commonly between 60-69 years of age in England and Wales[27], although T2DM is being increasingly diagnosed in younger, obese individuals and tends to affect individuals of black and asian ethnicity at a younger age compared to caucasians.[52] T2DM arises through a complex interplay of environmental and genetic factors, as borne out by local, national and international differences in incidence and evidence of familial clustering.[51-53]

Increases in the incidence of T2DM have driven the considerable expansion of numbers of people with diabetes both in England and worldwide. Although population ageing accounts for some of the observed increase in T2DM prevalence, obesity is responsible for the vast majority of new diagnoses of T2DM; 80-85% of the risk of developing T2DM is attributable to obesity.[54] In addition to the underlying trends of increased caloric intake and reductions in physical activity, increased amounts of dietary fat – specifically saturated fats – are particularly linked to the development of obesity and insulin resistance.[51]

In the vast majority of cases, development of T2DM is preceded by onset of one or more components of the metabolic syndrome, characterised by abdominal obesity, glucose intolerance, dyslipidaemia and hypertension.[55] The notion of a 'pre-diabetic' state allows for derivation of risk scores for T2DM, which would potentially allow for individuals who have undiagnosed T2DM to be identified and offered treatment at an earlier stage of the disease.[56,·57] The prevalence of 'pre-diabetes' is estimated to have risen considerably over the past decade, with a prevalence of over 50% in obese adults aged 40 years or older.[58]

A number of studies have demonstrated that instigation of lifestyle measures, particularly exercise and weight loss, can reduce the risk of progression from pre-diabetes to T2DM by up to 60%; however, whether the efficacy of such interventions would translate to tangible, cost-effective public health benefits when implemented outside of the context of a clinical study has been called into question.[59-69]

It should be noted that whilst these risk scores have demonstrated efficacy in the context of cohort studies, real-world effectiveness would depend upon adequate resourcing of primary care to allow for regular, systematic surveillance of individuals deemed to be at potentially increased risk.

Diagnosis of Type 2 Diabetes Mellitus

Patients with T2DM may present with classical symptoms of diabetes, namely polydipsia and polyuria, or may be identified as high risk individuals as a result of their lifestyle, family history or weight. T2DM is primarily diagnosed through demonstration of glucose intolerance or through measurement of HbA1c as per the 2011 recommendations of the World Health Organisation (WHO).[45]

HbA1c ≥ 6.5% (47.5 mmol/mol) is considered diagnostic of diabetes; however, HbA1c values less than 6.5% (47.5 mmol/mol) cannot exclude T2DM diagnosed using glucose tolerance tests. As with T1DM, some individuals with previously undiagnosed T2DM may present with acute metabolic complications of diabetes or acute complications related to micro- or macrovascular disease such as myocardial infarctions or stroke. Hyperosmolar hyperglycaemic state (HHS) is the most common acute metabolic disturbance observed in T2DM, although a small proportion of patients may present with DKA under conditions of catabolic stress associated with other acute illnesses.[48]

Treatment of Type 2 Diabetes Mellitus[70,71]

Unlike those with T1DM, individuals diagnosed with T2DM continue to secrete insulin, albeit at physiologically insufficient levels. As T2DM is tightly linked to insulin resistance, a major determinant of which is obesity, initial management of T2DM may consist of dietary and lifestyle advice to achieve normoglycaemia and reduce the risk of chronic complications of diabetes; weight loss is of particular importance.

In individuals who cannot achieve adequate glucose control – generally defined as an HbA1c ≥ 6.5% (48 mmol/mol) after 3 - 6 months of intervention – through diet and lifestyle modifications, commencement of oral hypoglycaemic agents may need to be considered. In the NHS, metformin is the most commonly used first-line agent in T2DM; however, dual or triple oral hypoglycaemic therapy (through addition of medications such as sulfonylurea, DPP-4 inhibitors or pioglitazone) may need to be considered if adequate glycaemic control cannot be achieved. If oral therapy fails, individuals with T2DM may need to be commenced on subcutaneous insulin in order to control blood glucose.

Regardless of the necessary treatment regimen required for glycaemic control for an individual with T2DM, regular clinical review, patient education, assessment of risk of chronic complications of diabetes and provision of appropriate primary, secondary and tertiary prevention is essential to maximise clinical outcomes.

Hyperosmolar Hyperglycaemic State

HHS is a profound metabolic disturbance associated with T2DM, characterised by severe hyperglycaemia, severe dehydration and hyperosmolality. Unlike DKA, which tends to present within hours of onset, HHS follows a more indolent and gradual course over a period of several days; as a result, the metabolic disturbances and dehydration associated with HHS can be considerably more severe than DKA.[72] The mortality of HHS is much higher than that of DKA, and is estimated to have a case fatality rate approaching 5-10%.[48]

The primary goals of management of HHS are to aggressively rehydrate the patient through administration of intravenous fluids, normalisation of osmolality and reversal of any electrolyte disturbances; insulin infusion is not usually initially indicated unless significant ketonaemia is present and may increase the risk of cardiovascular collapse.[72] The severe dehydration and hyperosmolality associated with HHS also increase the risk of additional complications such as arterial or venous thrombosis, cerebral oedema or central pontine myelinolysis; as such, all patients admitted with HHS require intensive monitoring and may require transfer to high dependency or intensive care for stabilisation.

In HHS, restoration of euvolaemia and electrolyte balance must be done gradually as rapid correction of these abnormalities may be harmful to the patient, increasing the risk of cerebral oedema.[48] Insulin is often started following initial fluid resuscitation and, in the case of previously undiagnosed individuals with T2DM or those previously managed on oral agents, may be switched to oral agents after a period of demonstrable stability over weeks and months.[72] Other supportive measures, such as anticoagulation and nutritional support are also recommended.[72]

Referral to a specialist diabetes team as soon as is practicable after admission is essential to ensure a through review of precipitating factors, delivery of patient education and establishment of adequate follow-up.

Chronic Complications of Diabetes

The physiological aberrations associated with the dysfunction of glucose homeostasis in diabetes lead to a number of signs, symptoms and acute and chronic complications.

The acute complications most commonly associated with specific types of diabetes mellitus have been discussed in previous sections (see pages 10 and 15); there are, however, a number of complications and symptoms that directly or indirectly result from chronic hypoglycaemia that are common to all types of diabetes (Table 2).

Microvascular	Macrovascular	Other
Nephropathy	Coronary heart disease	Cataracts
Neuropathy	Peripheral arterial disease	Infection and Immunity
Retinopathy	Myonecrosis	
	Cerebrovascular disease and stroke	

Table 2. Chronic, Non-Acute, Complications of Diabetes .

The chronic complications of diabetes can be broadly classified into the groups described in Table 2. The hyperglycaemia, increased FFA release and insulin insufficiency observed in diabetes promotes vascular damage and formation of atherosclerotic plaques via impaired function of vascular endothelial cells, vasoconstriction, inflammation, thickening of vascular smooth muscle and increased thrombosis.[22] The net result of atherosclerotic plaque formation is narrowing of arterial blood vessels throughout the body, impairing the delivery of blood and oxygen; rupture of these plaques leads to acute interruption of distal blood flow and subsequent tissue infarction.

Vascular damage occurs in both large and small blood vessels (termed macro- and microvascular damage respectively) and, ultimately, the tissues and organs that they supply.

The risk of vascular injury, and the significant morbidity and mortality associated with it, in diabetes mellitus can be greatly reduced by adequate control of serum glucose concentration in addition to common interventions and treatments that aim to reduce the cardiovascular risk profile of patients through control of factors such as blood pressure and cholesterol.[33,73-76]

Microvascular Complications of Diabetes

Diabetic Retinopathy

Diabetic retinopathy is a common complication of diabetes and a leading cause of preventable blindness in England, accounting for 7% of individuals registered as blind in England.[77] Diabetic retinopathy results from vascular injury to the blood vessels supplying the retina, leading to retinal hypoxia, and progresses from background retinopathy to proliferative retinopathy.

Background retinopathy is considered an early stage of diabetic retinopathy, where damage to retinal blood vessels have become clinically detectable. Features of background retinopathy include localised haemorrhage within the middle layer of the retina, deposition of lipids within the retina ('hard exudates'), microaneurysm formation due to weakening of blood vessel walls and vascular leakage within the retina, which can lead to retinal oedema and visual disturbance.

Proliferative retinopathy generally occurs once retinal hypoxia has become established due to vascular damage, with overtly ischaemic areas of the retina visible on fundoscopy as diffuse white patches ('cotton wool spots'). Retinal hypoxia drives the formation of new blood vessels on the surface of the retina and within the vitreous humour within the eye in an attempt to restore adequate perfusion. These new, fragile blood vessels are liable to rupture, resulting in vitreous haemorrhage and visual loss; blindness can also occur as a result of the fibrovascular growth associated with proliferative retinopathy, leading to tractional retinal detachment.

The incidence and risk of progression of diabetic retinopathy can be reduced through control of serum glucose, blood pressure and cholesterol levels[73, 78], but despite advances in the management of diabetes and cardiovascular risk factors over the past few decades, most patients with T1DM develop retinopathy within 20 years of diagnosis and may develop in individuals with T2DM 7 years prior to being diagnosed with diabetes.[79, 80]

Aside from the benefits of secondary and tertiary prevention as discussed above, ablation of new, potentially sight-threatening retinal blood vessels through use of laser photocoagulation is a mainstay of treatment for established diabetic retinopathy.[78]

Early detection of diabetic retinopathy is key to reduce the risk of sight loss in people who have been diagnosed with diabetes; to this end, the NHS operates a diabetic eye screening programme that is delivered through locally commissioned programmes. The current recommendations for retinal screening are that all adults with diabetes should be screened upon diagnosis and every year thereafter.[81] In 2011/12, the screening programme covered (i.e. offered screening to) 73.9% of the adult diabetic population, with 80.9% of these individuals taking up the offer of screening offered to them.[82] Levels of coverage of the programme were, however, highly variable across the country, ranging from 52% to 95%.[82]

Diabetic Nephropathy

Diabetic nephropathy results from damage to the microvasculature of glomeruli, consequently inhibiting the ability of the kidney to filter blood, leading to chronic kidney disease (CKD) and, potentially, end-stage renal failure (ESRF) requiring renal replacement therapy (RRT).

Diabetes is the leading cause of CKD in the developed world[83, 84], with diabetes being associated with an odds ratio (OR) of developing CKD of 2.60.[84] Furthermore, the presence of severe CKD (stages 4 - 5) and ESRF denote relative risks of death due to cardiovascular complications of approximately 2 - 4 and 100 respectively over a 10-year period. In the context of diabetes, a disorder that confers additional risk of cardiovascular events due to the effects of chronic hyperglycaemia on blood vessels, CKD and its sequelae pose a significant risk to people with diabetes.

In health, the kidneys act to filter the blood through filtration and selective reabsorption of ions, amino acids and glucose that is primarily mediated by the renin-angiotensin-aldosterone system, the hormone feedback loop that controls blood pressure and fluid balance within the body. In diabetes, microvascular damage affects filtration within the kidneys, allowing larger molecules such as proteins, which would usually be retained in the blood, to pass through glomeruli and be excreted in urine. Additionally, damage to the microvasculature of the kidney leads to tubulointerstitial fibrosis, impairing selective reabsorption of nutrients and increasing the pressure within the glomerulus, leading to further vascular damage.[85]

In time, the microvascular damage to the kidney progresses to ESRF, where renal function has been completely compromised, leading to further complications such as hypertension, fluid overload, heart failure and ionic disturbances such as hyperkalaemia. The onset of ESRF necessitates RRT, generally peritoneal or haemodialysis, to normalise body fluid balance and ionic imbalances.

As with diabetic retinopathy, the progress of diabetic nephropathy can be slowed through early diagnosis and treatment. As alluded to above, one of the early stages of diabetic nephropathy is the appearance of protein in urine. This can be easily tested for, and is referred to as either micro- or macroalbuminuria according to the amount of albumin relative to the amount of creatinine, a normal waste product of muscle metabolism; the urinary albumin:creatinine ratio (ACR).

Current guidelines specify that people with diabetes should receive annual checks for albuminuria and renal function, quantified as an estimated glomerular filtration rate that is calculated based on age, ethnicity, sex and serum creatinine concentration, should be checked annually in people with diabetes.[70] An annual check should allow for early diagnosis, treatment and monitoring of diabetic nephropathy.

Treatment for diabetic nephropathy is primarily aimed at reducing the pressure of blood passing through the glomeruli, thereby reducing the amount of stress that they are put under. Two classes of drugs – angiotensin converting enzyme inhibitors (ACEis) and angiotensin receptor blockers (ARBs) – act via the renin-angiotensin-aldosterone system, preferentially dilating the vessel that leaves each glomerulus and thereby reducing the blood pressure within it. Consequently, as the renin-angiotensin-aldosterone system is being inhibited, systemic blood pressure should also drop, placing reduced stress on systemic blood vessels and the heart. In order to further minimise glomerular damage in those with diabetic nephropathy, it is further recommended that people with diabetes who have an abnormal ACR should maintain a blood pressure of 130/80 mmHg or less.[71] However, some individuals may experience worsening of their renal function despite optimal therapy in primary care and should be considered for early referral to specialist renal services for additional input and, if required, consideration of RRT.[71]

Diabetic Neuropathy

Diabetic neuropathy results from damage to the microvasculature supplying the peripheral nerves of the body, known as *vasa nervorum*.

Diabetic neuropathy is a common complication of diabetes, estimated to affect 60 - 70% of people with diabetes[86], but may be asymptomatic in up to 50% and potentially remain undiagnosed unless regular and thorough assessment for diabetic neuropathy is performed.[87] The risk factors for diabetic neuropathy are similar to any other micro- or macrovascular complication of diabetes, namely hypertension, poor glucose control, hypercholesterolaemia, duration or diabetes in addition to body mass index (BMI).[88]

All types of nerves – sensory, motor and autonomic – can be affected, leading to a relatively broad range of signs and symptoms. The lower limbs are most commonly affected, but diabetic neuropathy can be defined as a clinical or subclinical neuropathy affecting one or more nerves in the context of diabetes and in the absence of any other cause of peripheral neuropathy.[89]

Diabetic neuropathy can present with variety of symptoms according to the pattern of nerve damage that a given patient has sustained as a result of microvascular injury.

Peripheral sensorimotor neuropathy is arguably the most common manifestation of symptomatic diabetic neuropathy[87]; sensory nerve fibres are generally affected more then motor nerve fibres. The longest nerves in the body are typically affected first, meaning that symptoms commonly begin in the toes and gradually ascend the legs and can involve the fingers and hands, leading to the classical ‘glove and stocking’ distribution of sensory impairment. The severity of sensory symptoms can vary, ranging from numbness and ‘pins and needles’ to pain that is burning or lancing in nature. Proprioception (perception of joint or limb position) can also be affected, potentially leading to disturbances of gait, weakness and deformity.

The symptoms of peripheral sensorimotor neuropathy can also present acutely, albeit predominantly with severe burning pain affecting the feet and lower limbs rather than motor deficits, as acute peripheral neuritis. Acute peripheral neuritis is generally associated with newly diagnosed diabetes or in individuals with poor glycaemic control, but can paradoxically occur following establishment of improved glycaemic controls. Unlike peripheral sensorimotor neuropathy, acute peripheral neuritis can resolve completely, with symptoms responsive to improvements in glycaemic control.

Individuals with diabetes are also prone to injury to single nerves, known as mononeuropathies. A wide variety of nerves can be affected, with symptoms usually related to external compression or nerve entrapment – in diabetes, the relative under-perfusion of nerve fibres likely renders them more susceptible to dysfunction as a result of external force.[87] Presentations of mononeuropathies include carpal tunnel syndrome or wasting of the muscles of the hand (median nerve), foot drop (peroneal nerve), ophthalmoplegia (cranial nerves III, IV or VI), Bell's palsy (cranial nerve VII) and wasting of the quadriceps muscle (femoral nerve). Patients may experience concurrent mononeuropathies in disparate, anatomically unrelated nerves – this simply reflects the same pathological process occurring in two or more nerves at the same time, and is referred to as mononeuritis multiplex.

Damage to the nerve fibres that form part of the autonomic nervous system leads to autonomic neuropathy. A number of signs and symptoms can result from disruption of the autonomic nervous system in diabetes:

- Vascular dysfunction
  - Lack of innervation to the smooth muscle of peripheral vasculature leads to vasodilation and ateriovenous shunting; veins, particularly in the feet, become engorged, resulting in peripheral oedema resistant to diuretic therapy[87]
  - A loss of reflexive constriction of blood vessels on standing, resulting in postural hypotension

- Cardiac autonomic neuropathy
  - A lack of autonomic nervous signalling to the heart can lead to a range of signs and symptoms that include tachy- or bradycardia, intolerance of exercise, impairment of baroreceptor sensitivity and resultant cardiovascular lability, increased incidence of asymptomatic myocardial ischaemia and infarction and congestive heart failure
- Genitourinary and gastrointestinal
  - The autonomic nervous system plays a key role in the normal functioning of the bladder, the gastrointestinal tract and in male sexual function. Autonomic neuropathy can lead to urinary hesitancy or incontinence, dysphagia, nausea, vomiting, diarrhoea erectile dysfunction and retrograde ejaculation
- Lack of sweating
  - Denervation of sweat glands can lead to anhidrosis, particularly affecting the feet, which can lead to dry, fissured skin that is prone to infection

In addition to dysfunction of peripheral sensorimotor and autonomic nerve fibres, people with diabetes may also experience diabetic amyotrophy, where the spinal nerve roots that innervate the upper part of the lower limb – L2, L3 and L4 – become inflamed. Such patients tend to have a history of T2DM and be in their fifties or sixties and present with severe unilateral thigh pain associated with paraesthesia that progresses to muscle weakness and wasting.[87] Diabetic amyotrophy generally resolves over the period of 6 - 12 months.

The treatment of many forms of established diabetic neuropathy are largely supportive, with a particular focus on relieving patients from neuropathic pain (e.g. anti-inflammatories, amitriptyline, topical capsaicin cream). However, attaining and maintaining adequate glucose control is key to delaying the onset and progression of diabetic neuropathy, but may not be effective in reversing pre-existing diabetic neuropathy.[87,90,91]

The importance of diabetic neuropathy should not be understated, as it is associated with significantly elevated levels of morbidity and mortality within the diabetic population, through the potentially debilitating nature of its symptoms, the elevated risk of injury, burns and foot ulceration as a result of sensory loss and the dysfunction it exerts on many tissues and organ systems within the body.[87,92,93]

Macrovascular Complications of Diabetes

Coronary Heart Disease

Atherosclerosis of the coronary arteries supplying the heart can lead to myocardial ischaemia and myocardial infarction which, in turn, can lead to subsequent heart dysfunction, heart failure or death depending on the nature of the myocardial injury sustained.

Diabetes is a major risk factor for the development of and death from coronary heart disease (CHD); Individuals with diabetes are almost twice as likely to develop CHD, 131% more likely to die from CHD and 82% more likely to experience a non-fatal myocardial infarction than individuals without diabetes.[76] The proportion of CHD deaths that can be attributed to diabetes varies by age and sex, but has been estimated as 77% in men and 89% in women across all ages, with a greater proportion of CHD deaths at younger ages attributable to diabetes.[94]

The increased risks of CHD and CHD-related death in diabetes mean that adequate control of serum glucose and early primary and/or secondary prevention of CHD are of key importance in reducing morbidity and mortality within the diabetic population.

Glycaemic control has been shown to reduce the risk of cardiovascular and CHD events. Intensive control of diabetes in patients with T1DM is estimated to reduce cardiovascular event rates by 42%[95] and fasting blood glucose concentrations of ≥ 7 mmol/L and 5.6 - 7 mmol/L have been shown to confer a 136% and 61% excess hazard of CHD respectively in comparison to individuals with diabetes with fasting blood glucose concentrations of 5.0 - 5.5 mmol/L.[76]

Risk of CHD is amenable to lifestyle changes and control of known cardiovascular risk factors such as hypertension and hypercholesterolaemia, both of which are of particular importance in the increased atherogenic state associated with diabetes.[76] Control of blood pressure has been shown to be protective of CHD[76, 96, 97], with ACEis and ARBs conferring additional levels of protection in comparison to other antihypertensive agents[22, 98, 99] likely as a result of the beneficial effects on the risks of progression of diabetic nephropathy associated with these classes of drugs.[73] However, some degree of care is required when commencing patients with diabetes on ACEis and ARBs, as these classes of drugs can lead to a worsening of renal function in patients with renal artery stenosis (RAS). Patients with RAS have suboptimal renal perfusion pressures due to the restriction on arterial renal blood flow; the introduction of ACEis or ARBs will reduce intra-glomerular blood pressure and, in the context of RAS, consequently degrade glomerular filtration even further. It is therefore recommended that all patients with diabetes who are commenced on ACEis or ARBs have their renal function closely monitored and should be switched to another class of antihypertensive agent should renal function deteriorate.[70]

It should be noted that the relationship between blood pressure and risk of CHD events is continuous and non-linear, exhibiting a U-shaped relationship between systolic and diastolic blood pressure and mortality in patients with diabetes, with both extremes of blood pressure exhibiting increased hazards of death.[100, 101] Management of blood pressure can also be more difficult in individuals with diabetes as a result of impaired renal function, which may entail the use of multiple antihypertensive agents to adequately control blood pressure.[70, 76]

Cerebrovascular Disease

The underlying pathogenic mechanisms of cerebrovascular disease in diabetes are similar to those for CHD, namely the promotion of atherogenesis as a result of the metabolic disturbances associated with diabetes.

The presence of diabetes is associated with an increase in atherosclerosis affecting the extra-cranial arteries supplying the brain[102,·103], thereby restricting blood flow. As with coronary heart disease, this can lead to a transient insufficiency of blood flow, resulting in transient ischaemic attacks (TIAs), or infarction of tissues distal to an atherosclerotic plaque should it rupture, leading to a stroke; accordingly, strokes in patients with diabetes tend to be of the ischaemic rather than haemorrhagic type. The signs and symptoms associated with TIAs and strokes are dependent on which area of the brain has been subjected to ischaemia or infarction.

Diabetes is a major risk factor for the occurrence of stroke, with men and women exhibiting a 83% and 128% excess risk of stroke respectively compared to individuals without diabetes[104]; as with other vascular complications of diabetes, the quality of glycaemic control is also associated with increased stroke risk.[22]

The increased risk of stroke associated with diabetes is particularly evident in groups who would otherwise be considered at a low risk of cerebrovascular events. The presence of diabetes can increase the odds of stroke by more than 10-fold in individuals younger than 55 years of age[105] and has been associated with an increase in the odds of stroke in individuals aged 18-44 years with ORs ranging from 3.3 in black females to 22.9 in caucasian males.[106]

In addition to the excess risk of experiencing a stroke, people with diabetes also experience worse outcomes following a stroke, associated with a relative risk of 3.4 for stroke-related dementia[107], a hazard ratio of 2.1 for experiencing recurrent strokes[108] and a relative risk of death following a stroke of 4.84.[109] Additionally, diabetes is associated with an twofold increase in the incidence of dementia, Alzheimer's-type dementia and vascular dementia.[110]

Peripheral Arterial Disease

Peripheral arterial disease (PAD) is disorder that primarily manifests as an insufficiency of blood supply to the lower limb, that can result in intermittent claudication, indicating ischaemia of leg muscles during exertion, increased susceptibility to foot ulcers and subsequent infection that can progress to gangrene and osteomyelitis and an increased risk of non-traumatic lower limb amputation.

People with diabetes are more likely to develop PAD than people without diabetes, exhibiting a relative risk of PAD between 2.6-2.9[111], tend to have more severe PAD than people without diabetes and are 5 times as likely to require an amputation due to PAD than people without diabetes with PAD.[112] Prognosis for diabetics with PAD with foot ulcers or previous amputations are also poor, with high rates of revision amputations and increased mortality.[23,113]

For people with diabetes, the lifetime risk of developing a foot ulcer can approach 25%.[114] In the context of concomitant neuropathy and impaired wound healing secondary to poor vascular supply of the lower limb and resultant peripheral oedema, foot ulcers can progress to limb and life-threatening infection if not appropriately managed; approximately 85% of lower limb amputations in people with diabetes are preceded by a foot ulcer that has failed to heal and deteriorated to the stage of either severe infection or gangrene.[115]

The risks of both foot ulcers and lower limb amputation in diabetes increase with both the duration of diabetes and the presence of other complications of diabetes[23], indicating that surveillance for foot ulcers in those with long-standing or complicated diabetes mellitus is key to reducing the morbidity and mortality associated with PAD.

As with other vascular complications of diabetes, optimisation of glycaemic control, hypertension and hyperlipidaemia are of importance with respect to reducing the risk of onset or progression of PAD.[113] In the case of an established foot ulcer, management should focus on eradication of infection and maximising the chance of healing. This may be achieved through a mixture of medical and surgical approaches, such as broad-spectrum antibiotics, orthotic devices to reduce weight-bearing on the affected limb, stenting or bypass of proximal lower limb arteries affected by PAD, wound debridement or, as a last resort, amputation.[22,·113]

Early detection of foot ulcers is of great importance for the maximisation of outcomes in diabetes and may reduce the incidence of limb- or life-threatening PAD.[116] Systematic surveillance of all people with diabetes who, by the atherogenic nature of the disease, are at risk of foot ulcer development allows for opportunities to deliver primary and secondary preventative care and to prompt referral to specialist services should additional medical or surgical input be required.

Achieving the best outcomes for PAD in the context of diabetes mellitus requires a systematic approach, and it has been suggested that the amputation rate in people with diabetes can be reduced by between 49-85% through implementation of the following strategies:[115,·117]

- Inspection of foot and footwear during routine reviews
- Preventative foot and shoe care in high-risk feet
- Structured education for patients, carers and healthcare providers
- A multifactorial and multidisciplinary approach to established foot ulcers
- Early diagnosis of and vascular intervention for PAD
- Continuous follow-up of patients with a history of foot ulcers
- Registration of amputations and foot ulcers

Other Chronic Complications of Diabetes

Cataracts

Cataracts are considered a major cause of visual impairment in people with diabetes; diabetes is associated with increased incidence, progression and earlier age of onset of cataracts.[118-120] The 10-year cumulative incidence of cataracts in people with diabetes has been estimated at 8.3% for T1DM and 24.9% in T2DM.[118,120]

Cataracts result from the progressive thickening and opacification of the ocular lens due to glycation of and oxidative stress incurred by its proteins.[120] Individuals without diabetes may develop cataracts with age; in diabetes, chronic hyperglycaemia results in sorbitol accumulation within and subsequent osmotic changes of the lens, leading to denaturing of lens proteins, lens opacification and visual loss.[120,121]

Although the procedure most commonly used for cataract removal – phaeoemulsification – does not differ between people with and without diabetes, people with diabetes may experience poorer visual outcomes post-surgery than people without diabetes. Cataract surgery may induce a rapid acceleration of diabetic retinopathy or may precipitate macular oedema, both of which may impair or further threaten sight.[120]

There is some evidence that the incidence and progression of cataracts in people with diabetes can be reduced through optimisation of glucose control,[119,120],however, with the sole exception of some juvenile cataracts observed in young patients with T1DM, surgical cataract removal is currently the only approved therapy to restore sight.[120,121]

Infection and Immunity

Certain infections are more common in people with diabetes and can occur with increased severity and risk of complications.[122] Certain aspects of the immune response to infection – particularly cell-mediated immunity – may be depressed in diabetes as a result of prevailing hyperglycaemia, however response to vaccines appears to be largely normal in people with diabetes.[122]

Infection	Characteristics of Note
Community-acquired pneumonia	Pneumococcal infection associated with increased risk of death in people with diabetes
Influenza	Increased mortality, risk of bacterial superinfection and ketoacidosis in diabetic patients
Acute bacterial cystitis	Bacteriuria more common in diabetic vs. non-diabetic women
Acute pyelonephritis	May become complicated by emphysematous infection or perinephric abscess formation
Fungal cystitis	Colonisation may be indistinguishable from infection
Necrotising fasciitis	Very high mortality, requires urgent surgical debridement
Invasive otitis externa	Prompt ear, nose and throat review recommended
Emphysematous cholecystitis	High mortality, emergency cystectomy required

Table 3. Features of Selected Infections in the Context of Diabetes (after Joshi et al., 1999).[122]

Prompt diagnosis and treatment of infection is essential to maximising outcomes in patients with diabetes and, where appropriate, vaccination should be offered to minimise the risk of infection; in the UK, annual vaccinations for seasonal influenza and pneumococcus are offered to people with diabetes[123] in light of the increased risks of severe disease and mortality that they face should they become infected.

Primary Care Quality

Diabetes Mellitus as an Ambulatory Care Sensitive Condition

ACSCs are defined as conditions for which primary care can reduce the risk of hospitalisations, complications or more severe disease.[4] The risk of these outcomes in patients with diabetes mellitus are modifiable through control of blood glucose concentrations, blood pressure and serum cholesterol in addition to lifestyle and diet modifications and structured patient education.[33,·71,·73,·73-76,·78,·87,·88,·90,·91,·113]

Furthermore, regular, scheduled review of diabetic patients enables early detection of and timely commencement of therapy for chronic complications of diabetes, slowing the progression of end-organ disease, ensuring specialist review when appropriate and reducing morbidity, mortality and potentially avoidable healthcare resource use related to chronic complications.[76,·76,·87,·95-97,·113,·115-117,·119,·120]

Glycaemic control, blood pressure management, lowering of serum cholesterol, weight checks, foot checks, immunisations and determining eligibility for retinopathy screening are all achievable through high quality primary care. Quality primary care, as opposed to predominantly specialist-driven secondary and tertiary care, should take a 'person-centred' approach, providing holistic, continuous personalised health care rather than delivery of problem-based episodic care (Table 4).[6]

Clinic or Outpatient-Based Ambulatory Care	People-Centred Primary Care
Focus on illness and cure	Focus on health needs
Relationship limited to moment of consultation	Enduring personal relationship
Episodic curative care	Comprehensive, continuous and person-centred care
Responsibility to the patient limited to moment of consultation	Responsibility for health along the life cycle and tackling determinants of ill-health
Patients are users and consumers of the care they purchase	People are partners in managing their own health

Table 4. Comparison of conventional health care from people-centred primary care (after WHO, 2008).[6·]

Many of the key aspects of quality primary care as defined by the WHO[6] align closely with what would be desired for high-quality diabetes care. Diabetes, although broadly categorised into sub-types, is a condition that exhibits a certain degree of heterogeneity insofar as individual risks, responses to treatment and health care needs are concerned, necessitating an individualised, yet evidence-based and clinically sound, approach to the delivery of diabetes care.[124]

Measurement of Primary Care Quality

Ensuring that a health care system, or the quality of the services delivered by health care institutions or organisations within that system, delivers high quality care is central to ensuring that the care delivered is both clinically and cost effective. However, what defines quality in health care depends on the role that a given stakeholder plays within that system. For example, a clinician may define quality in terms of speed of access to diagnostic services or referrals to secondary or tertiary care, a patient may define quality in terms of appointment availability and continuity of care and commissioners of health care may define quality in terms of cost-effectiveness.

In a health care system such as the NHS, what defines quality and how it is measured is tempered by the wider socio-political and economic contexts in which the system exists. Financial constraints, particularly for publicly-funded systems, may mean that certain aspects of quality have to be prioritised over others. Furthermore, the perceived importance and public visibility of certain aspects of care quality also need to be taken into account – those which are easily recognisable and tangible to end-users of the service, such as waiting times, are likely to remain a priority on political grounds.[125]

A reductionist view of quality measurement, whereby clinical outcomes are the sole metric of interest, could be argued to be appropriate on the grounds that patient outcomes summate the effectiveness of services across all its component parts for a given condition. Indeed, as discussed on page 2, emergency admission rates for ACSCs are increasingly considered an outcome reflective of primary care quality, under the prior assumption that such admissions would be predominantly

driven by factors solely related to the quality of delivered care. However, such approaches sideline many aspects of high quality care, such as assessing whether the right action is being taken for the right person at the right time, ensuring equity of services offered and completely ignores the wider context in which a health service itself exists.

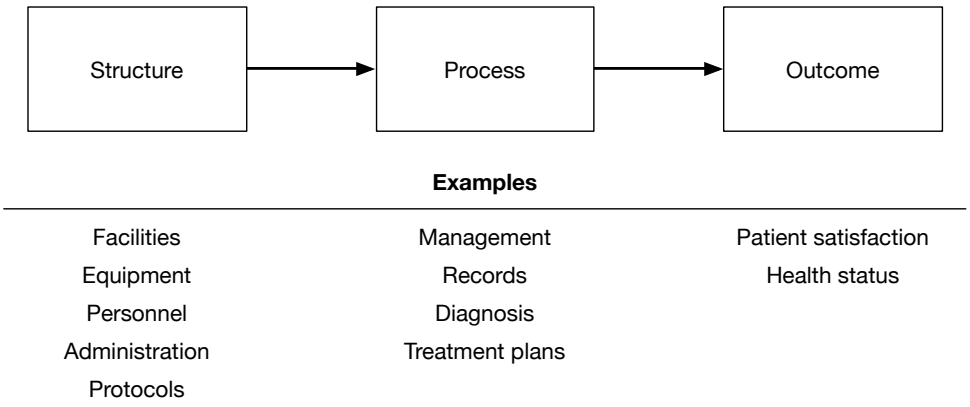


Figure 4. The Donabedian model of health services and evaluation of health care quality. Adapted from Donabedian (1966)[126].

The Donabedian framework[126] (Figure 4) is a widely accepted approach to the assessment of health care quality, considering a health care system in terms of its structure, its processes and its outcomes. This framework is hierarchical in nature, meaning that distal components can be affected by proximal ones; for example, a health care system that lacks appropriate equipment is likely to have suboptimal processes and outcomes.

The conceptual framework proposed by Donabedian has been expanded upon by a number of individuals and organisations since its publication in 1966, identifying myriad domains across which the quality of care could be assessed (Table 5). There is considerable variation between frameworks as to which domains of patient care are considered measurable components of high-quality care, with patient-centeredness or patient experience being the sole domain present in all of the commonly utilised quality assessment frameworks.

Domains	IoM	OECD	Quest for Quality	Performance Assessment Framework	NHS Next Stage Review	CQC
Safety	•	•	•		•	•
Effectiveness	•	•	•	•	•	
Outcomes of care				•		•
Patient-centred / experience	•	•	•	•	•	•
Timely	•		•			
Access			•	•		•
Efficient	•			•		
Value for money						•
Capacity			•			
Equity	•		•			
Healthy, independent living						•
Health improvement				•		

Table 5. Summary of quality domains utilised across various quality assessment frameworks. After Goodwin *et al*. (2011)[125] and Raleigh & Foot (2010)[127].

CQC = Care Quality Commission; IoM = Institute of Medicine; OECD = Organisation for Economic Co-operation and Development

The way in which quality of a health care system can or should be measured is highly dependent on the context in which that information will be used. Different audiences for quality information are likely to have differing opinions on both how quality should be measured and even what they consider quality to be.

Furthermore, the data that is readily available from a healthcare provider is likely to differ according to its function within the health system as a whole – for example, providers of primary care tend to record symptoms, diagnoses and treatments, whereas secondary and tertiary care providers tend to primarily focus on clinical outcomes.[125] There may also be elements of high-quality care, such as the doctor-patient relationship, that are not amenable to quantification despite their perceived importance in promoting favourable health care outcomes.

Defining and measuring quality can become even more problematic for individuals with chronic diseases, such as diabetes, as their care is delivered across multiple providers, necessitating co-ordinated responses with respect to disease management.[128] Additional difficulties in determining what represents quality for such patients may also arise from the impact that external factors and co-morbidities may have on outcomes; certain aspects of high-quality care, such as patient education and support of self-management may also be challenging to reliably measure. In real terms, whilst quality indicators can useful information with regards to the relationship between their attainment and long-term outcomes, they may not encapsulate all aspects of what would be considered to be high-quality care.[125]

Quality of delivered primary care is routinely measured in England using completion rates of certain activities, either as part of a clinical incentive scheme, such as the Quality and Outcomes Framework (QOF), or for the purposes of clinical audit, such as the National Diabetes Audit (NDA). Whilst such quality targets have notional or biologically sound links to 'hard' clinical outcomes such as hospital admissions or mortality, explicit links between the two are seldom made for the purposes of remuneration or audit. As such, these notional measures of quality may be more accurately described as process or intermediate measures.

The data collected by QOF is primarily used for the purposes of rewarding practices for their performance; annual QOF attainment by practices is also nationally reported and utilised for benchmarking of primary care providers against their peers. Use of such data outside of these specific contexts requires explicit recognition of the implicit limitations and shortcomings that are likely to be present, such as the lack of correction for case-mix and population characteristics in the assessment of the performance of a specific practice and the potential of disease diagnosis and coding within and between practices, meaning that direct comparisons of practices without further adjustment would be inherently flawed.

The use of process measures – as is commonplace in QOF – as opposed to clinical outcomes for the assessment of quality of care confers a number of advantages and disadvantages that must be borne in mind when reviewing, analysing and comparing data pertaining to quality of care (Table 6).[129]

Advantages	Disadvantages
• Provide actionable data for quality improvement initiatives	• In order to be valid, must be strong evidence that links the process to an outcome
• Data can often be obtained from existing electronic patient records, reducing need for additional data collection	• Where an explicit link between process and outcome is missing, demonstration of such a link is often difficult and expensive
• Majority of process measures, especially if they are applied to an eligible subset of patients, tend to require minimal risk adjustment	• Lack of relevance in comparison to outcome measures to patients and non-clinicians
• Data on process measures can be collected quickly, avoiding issues associated with data collection for outcomes that are rare or measure status over a protracted period of time	• Majority of feasible process measures provide information on a specific component of care delivery rather than reporting a comprehensive measure of how well care is delivered

Table 6. Summary of advantages and disadvantages of process measures for the assessment of healthcare quality.
After Rubin *et al.* (2001)[129].

In addition to the points discussed above, process measures can be subject to confounding by indication, whereby paradoxical associations of good care with poorer outcomes are observed.[129] Such a phenomenon arises as a result of more unwell patients – who have an increased likelihood of poorer outcomes – are more likely to seek or receive care in comparison to those who are relatively well.

There is also potential for the adoption of new process measures to be based on the availability of data within patient records as opposed to their clinical importance, a possibility that is of particular relevance to a publicly-funded health system such as the NHS. Development of new process measures that require collection of additional information from and potential redesign of electronic patient records could be prohibitively expensive, especially when compared to an alternative that utilises existing data.[129]

Accordingly, the bank of indicators utilised to judge quality of care is likely to have been tempered by a degree of pragmatism and feasibility. In short, this may mean that a given suite of process measures may not comprehensively cover all the component processes that could affect outcomes – meaning that considerable care must be taken in how they are interpreted and how they are reported to the general public.

In terms of relevance to the care of individuals with diabetes, the Quality and Outcomes Framework (QOF) and the National Diabetes Audit (NDA) both describe the quality of care delivered through a selection of process measures and are discussed in greater detail below.

The Quality and Outcomes Framework

The Quality and Outcomes Framework (QOF) is a voluntary incentivisation scheme offered under the General Medical Services contract held between the NHS and general practices. Since its introduction in 2004, QOF has incentivised a range of general practice activities considered to be reflective of high quality primary care, remunerating practices according to how well these activities were performed. In QOF, performance is assessed according to a series of indicators that are grouped into domains, originally clinical, organisational, patient experience and additional services, considered to be reflective of a particular aspect of the functioning of a general practice.[130] For the 2015/16 QOF, the number of domains has been reduced to two – clinical and public health.[131]

QOF indicators are ideally designed in a manner that reflects contemporaneous, evidence-based practice. Since 2008, the National Institute for Health and Care Excellence (NICE) has been charged with the development and maintenance of QOF indicators. New QOF indicators are proposed by NICE as part of an indicator 'menu' which are presented to NHS England on an annual basis. The final list of

QOF indicators for that year are decided upon through negotiation between NHS England and the General Practitioners' Committee of the British Medical Association; this process not only reviewed proposals for new indicators, but also considers whether existing indicators should be adjusted or removed from QOF entirely.[132]

Prior to 2014/15, the indicator domains for QOF were clinical, public health, patient experience and quality and productivity; the domains for patient experience and quality and productivity, and the indicators within these domains, have since been removed from QOF. The domains for 2014/15 and the indicator groupings within them are presented in Table 7.

Clinical Domain		**Public Health Domain**	
Asthma	Hypertension	Blood pressure	Contraception
Atrial fibrillation	Hypothyroidism	Cardiovascular disease - primary prevention	Obesity
Cancer	Learning disability	Cervical screening	Smoking
Chronic kidney disease	Mental health		
Chronic obstructive pulmonary disease	Osteoporosis		
Dementia	Palliative care		
Depression	Peripheral arterial disease		
Diabetes mellitus	Rheumatoid arthritis		
Epilepsy	Secondary prevention of coronary heart disease		
Heart failure	Stroke and transient ischaemic attack		

Table 7. Indicator domains for QOF 2014/15 for England.[130]

Each indicator group consists of a series of indicators that address separate aspects of care for a particular clinical issue or disease. The performance for indicators that pertain to treatment targets are calculated as the proportion of patients from the relevant eligible population who have achieved the target in question. Other indicators, such as those that require a practice to produce a disease register, merely require a task to be completed and therefore do not have achievement thresholds.

Target achievement is translated into points, the total number of which defines the QOF income for a practice for that year; the total number of points available across all QOF domains for 2014/15 was 559, each worth £156.92 and representing a maximum practice QOF income of £87,718.28.[133]

The points value of indicators varies, broadly reflecting the difficulty of achieving a specific indicator; for target-based indicators, points are awarded on a sliding scale, with maximum and minimum levels of achievement reflecting the thresholds for being awarded the maximum number of points and no points respectively (see Table 8 for the 2014/15 QOF diabetes mellitus indicators).

The maximum and minimum levels of achievement also vary by indicator, with the number of points awarded for that indicator calculated in the following manner, where A is the calculated proportion of eligible patients achieving the target, B is the minimum points threshold, C is the maximum points threshold and D is the total number of points available for that target:[134]

$$\frac{\text{Number achieving target}}{\text{Number eligible for target}} \times 100 = A$$

$$\text{Points awarded} = \frac{(A - B)}{(C - B)} \times D$$

Indicator	Description	Points	Achievement Thresholds
DM017	The contractor establishes and maintains a register of all patients aged 17 or over with diabetes mellitus, which specifies the type of diabetes where a diagnosis has been confirmed	6	N/A
DM002	he percentage of patients with diabetes, on the register, in whom the last blood pressure reading (measured in the preceding 12 months) is 150/90 mmHg or less	8	53-93%
DM003	The percentage of patients with diabetes, on the register, in whom the last blood pressure reading (measured in the preceding 12 months) is 140/80 mmHg or less	10	38-78%
DM004	The percentage of patients with diabetes, on the register, whose last measured total cholesterol (measured within the preceding 12 months) is 5 mmol/l or less	6	40-75%
DM006	The percentage of patients with diabetes, on the register, with a diagnosis of nephropathy (clinical proteinuria) or micro-albuminuria who are currently treated with an ACE-I (or ARBs)	3	57-97%
DM007	The percentage of patients with diabetes, on the register, in whom the last IFCC-HbA1c is 59 mmol/mol or less in the preceding 12 months	17	35-75%
DM008	The percentage of patients with diabetes, on the register, in whom the last IFCC-HbA1c is 64 mmol/mol or less in the preceding 12 months	8	43-83%
DM009	he percentage of patients with diabetes, on the register, in whom the last IFCC-HbA1c is 75 mmol/mol or less in the preceding 12 months	10	52-92%
DM012	The percentage of patients with diabetes, on the register, with a record of a foot examination and risk classification: 1) low risk (normal sensation, palpable pulses), 2) increased risk (neuropathy or absent pulses), 3) high risk (neuropathy or absent pulses plus deformity or skin changes in previous ulcer) or 4) ulcerated foot within the preceding 12 months	4	50-90%
DM014	The percentage of patients newly diagnosed with diabetes, on the register, in the preceding 1 April to 31 March who have a record of being referred to a structured education programme within 9 months after entry on to the diabetes register	11	40-90%
DM018	The percentage of patients with diabetes, on the register, who have had influenza immunisation in the preceding 1 August to 31 March	3	55-95%

Table 8. QOF indicators specific to diabetes mellitus, 2014/15.

Using indicator DM007 as an example, consider a hypothetical practice that has 5,000 people with diabetes cited as eligible for this target of whom 2,000 achieve an IFCC-HbA1c of 59 mmol/mol or less:

$$\frac{\text{Number achieving target}}{\text{Number eligible for target}} \times 100 = A$$

$$\text{Points awarded} = \frac{\left(A - B\right)}{\left(C - B\right)} \times D$$

$$\frac{2{,}000}{5{,}000} \times 100 = 40\%$$

$$\text{Points awarded} = \frac{\left(40\% - 35\%\right)}{\left(75\% - 35\%\right)} \times 17 = 2.125$$

For DM007, the hypothetical achievement of 40% would therefore be worth approximately £333.46. It should be noted that practices are not remunerated for achievement that exceeds the maximum points threshold – therefore, for DM007, a practice achieving 90% would not receive more income for this indicator than one who achieved 75%. Furthermore, the number of registered (and indicator-eligible) patients are not taken into account for the purposes of QOF calculation, meaning that a practice achieving DM007 for 20 of its 50 eligible patients would receive the same QOF income for this indicator as one achieving this target for 2,000 of its 5,000 eligible patients.

In addition to the restriction of some QOF indicators to certain patient groups practices can elect to exclude certain patients from the eligible population for QOF clinical indicators in a process termed exception reporting. Although declaration of a patient as an exception is at the discretion of practice, there are only a limited number of permitted reasons for a practice to do so:[135,·136]

- Refusing to attend review despite being invited on at least three occasions during the preceding twelve months
- Not appropriate to review the chronic disease parameters due to particular circumstances (e.g. terminal illness, extreme frailty)

- Diagnosed within the practice or have only registered with the practice in the preceding three months (for measurement indicators) or nine months (for treatment and outcomes indicators)
- On maximum tolerated doses of medication whose levels remain sub-optimal
- Where prescribing a medication is not clinically appropriate (e.g. allergy, other contraindication or adverse reaction)
- Where a given medication has not been tolerated
- The patient has exercised their right to informed dissent
- The patient has a supervening condition which makes treatment of their condition inappropriate
- Where an investigative service or secondary care service is unavailable

A number of the criteria above by which practices can declare an individual as an exception, in addition to setting the maximum threshold for indicator achievement at less than 100%, respects the rights of patients to decline treatment which their practice is financially incentivised to deliver. Despite the limited list of reasons by which practices can declare exceptions, there are concerns that excessive exception reporting may mask suboptimal care.[137-140]

The National Diabetes Audit

The National Diabetes Audit (NDA), whilst not part of a monetary incentivisation scheme, is a major national audit that measures the effectiveness of diabetes management in England and Wales, allowing for local benchmarking of performance and identification of best practice. In 2012/13, 70.6% of practices in England and Wales participated in the NDA (5,980 of 8,476), representing 2,058,321 registrations of patients with diabetes.

The NDA is primarily aimed at exploring four aspects of the diabetes National Service Framework (NSF):

- Is everyone with diabetes diagnosed and recorded on a practice diabetes register?
- What percentage of people registered with diabetes received the nine NICE key processes of diabetes care?
- What percentage of people registered with diabetes achieved NICE defined treatment targets for glucose control, blood pressure and blood cholesterol?
- For people with registered diabetes what are the rates of acute and long term complications (disease outcomes)?

Unlike QOF, which predominantly reports on intermediate targets for diabetes, the NDA links data pertaining to primary care performance at the level of practices with secondary care utilisation, allowing for the assessment of whether actions taken in primary care influence, for example, the risks of unscheduled hospitalisations and mortality.

The targets and care process recommendations for primary care in the NDA closely reflect NICE recommendations for diabetes; although many of these targets are submitted for consideration of inclusion of QOF, not all of them are included after the vetting process conducted by NHS Employers and the BMA General Practitioners' Committee. The NDA care processes and targets are described in Table 9.[27]

Care Processes	Treatment Targets	Patient Support
Blood pressure	BP ≤ 140/80	Delivery of structured education
BMI	Cholesterol < 4mmol/L	
Cholesterol	Cholesterol < 5mmol/L	
Foot surveillance	HbA1c < 48mmol/mol (6.5%)	
HbA1c[¶]	HbA1c ≤ 58mmol/mol (7.5%)	
Retinopathy screening[§]	HbA1c ≤ 86mmol/mol (10.0%)	
Serum creatinine		
Smoking		
Urine albumin		

Table 9. National Diabetes Audit recommendations for care processes, treatment targets and patient support.[27]

Compliance with all recommendations checked every 12 months. [¶] HbA1c is the only care process recommended for patients aged < 12 years; [§] Organised by NHS Diabetes Eye Screening rather than by the practice.

Primary Care Quality and Ambulatory Care Sensitive Conditions

The QOF clinical domain includes a number of the conditions cited as ACSCs by the NHS[8], allowing for assessment of the impact that quality of care – as measured by QOF – may have on a number of intermediate and hard clinical outcomes.

QOF, as currently reported, implies that the ability of general practices to deliver high quality primary care is not subject to external influences, thereby considering healthcare as a closed system. Socioeconomic factors such as population age, ethnicity and deprivation exert a considerable influence on the ability of local primary care services to maximise achievement of quality indicators and may influence the impact that delivered quality may have on their population for a number of ACSCs.[13, 141-145] Whilst a number of factors affecting demand and need for primary care services are taken into account for the calculation of the global sum allocated to individual practices[146], it is likely that practices located in the most deprived areas are likely to have to expend more resources in order to attain a comparable level of quality target achievement, raising the possibility that practices in areas with the highest needs are less likely to receive the highest levels of funding via QOF.[147]

The introduction of QOF has led to an increase in delivered care quality for the activities that it incentivises, albeit at the slight expense of non-incentivised activities.[148] The focused attention of practices as a result of the implementation of QOF is also evident in the way that practices are remunerated for their performance, with maximal pay for performance being delivered to a practice at achievement levels that are often considerably less than 100%.[130] This aspect of QOF leads to a 'ceiling effect' in achievement levels; once practices reach the proportion of patients achieving a specific target, there is no additional financial incentive to strive for higher levels of achievement, potentially reducing QOF's impact on improving health outcomes.[149] Exception reporting of patients could be argued to further compound the issue of the implicit acceptance of maximal rewards for sub-maximal delivery of quality care.[150]

Accordingly, for the purposes of analysing associations between primary care quality and outcomes, utilising practice QOF point scores as a metric of quality may mask the effect of performance levels that exceed the maximum points thresholds, as considerable variation in practice performance exists above this threshold (see Table 10 and Figure 5). Furthermore, in the context of generally high levels of QOF point achievement[149], usage of the underlying achievement for QOF indicators may provide a more appropriate metric of quality and avoid assumptions that performance of practices achieving the highest number of points for a given indicator is homogenous.

Indicator	Practices Achieving Max Points[¶]	% of Practices[§]	Underlying Achievement			
			Median	IQR	Mean	SD
DM23	6,054	73.4%	53.79%	10.10%	54.41%	9.49%
DM24	7,277	88.3%	78.69%	8.26%	77.58%	7.52%
DM25	3,842	46.6%	89.53%	6.30%	88.05%	6.11%

Table 10. Practices achieving maximum points for QOF indicators DM23 (HbA1c ≤ 7% / 53.0 mmol/mol), DM24 (HbA1c ≤ 8% / 63.1 mmol/mol) or DM25 (HbA1c ≤ 9% / 74.9% mmol/mol) in 2010/11.

[¶] Maximum points rounded down to integer; [§] Total number of practices participating in QOF for 2010/11 was 8,246, 1 practice had missing data and was not included in the denominator.

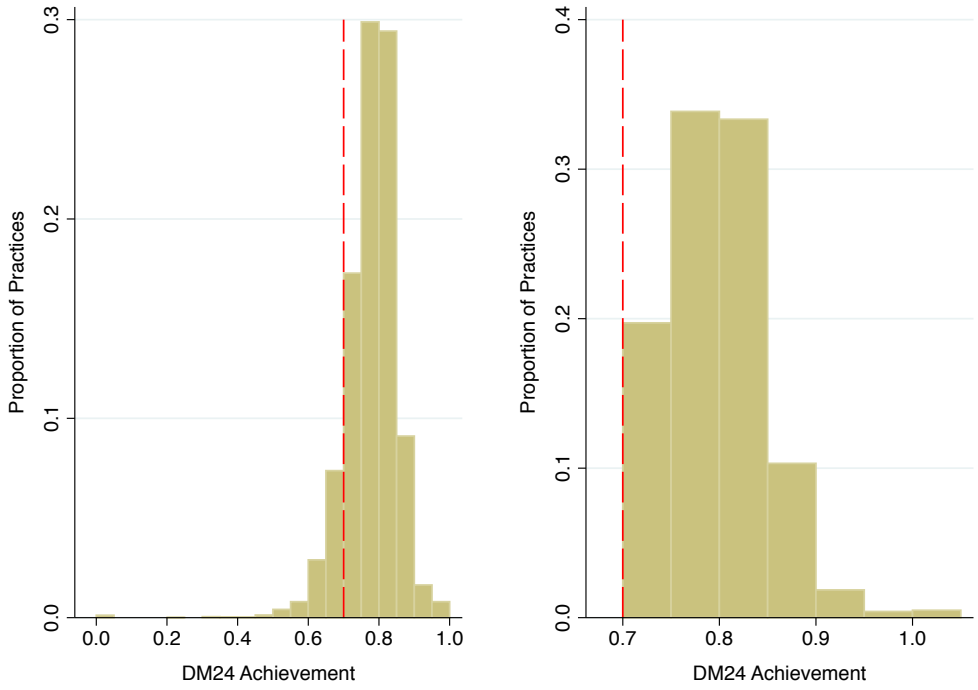


Figure 5. Distribution of practice achievement for QOF indicator DM24 for 2010/11.

Graph on left shows achievement for all practices in 2010/11; graph on right shows achievement for practices at maximum points threshold. Dotted red line denotes the maximum points threshold (70% for DM24 in 2010/11).

Concerns have also been raised regarding the predominantly process-focused nature of QOF and the use of intermediate outcomes as opposed to hard clinical outcomes; the only QOF indicator that utilised a hard clinical outcome (Epilepsy 8, recording as seizure-free for the past 12 months) is no longer part of QOF.[130,151] In general terms, the volume of evidence that evaluates the relationship between QOF performance and hard outcomes is limited and requires further evaluation to ensure clinical and cost-effectiveness.[143,149,152,153] There is also concern that the nature of incentivised activity in QOF scores may encourage practices to simply improve recording of patient activity as opposed to meaningfully improving their quality of care.[149]

Despite the debate regarding whether the measurement of quality in QOF is appropriate and represents an accurate estimate of the quality of care delivered by a practice, some aspects of QOF are desirable with respect to the management of chronic diseases such as diabetes, especially in the context of multi-morbidity.[154] The introduction of QOF also led to improvements in intermediate outcomes across all ethnic and deprivation groups, but may have increased inequality between strata of these groups.[150,152,155-157]

Two aspects of QOF may, to a degree, contribute to the widening inequality gap observed in a number of studies; awarding maximal pay for sub-maximal performance and the ability of practices to exclude patients from achievement calculations does pose the possibility of gaming that may bias against individuals from ethnic minorities and deprived backgrounds. These groups may experience a relative lack of accessibility to primary health care services or may perceive that such services do not cater to the prevalent societal barriers that preclude accessible and appropriate primary care.

To date, much of the existing literature discussing the relationship between measured quality of care and hard outcomes has generally found statistically significant but arguably clinically marginal benefits for some patient groups.[141,·145,·158·] Generally, other practice and population characteristics have stronger associations that measured primary care quality with health outcomes, particularly primary care access and deprivation – although the possibility of potential autocorrelation between deprivation, certain ethnic groups and age and QOF attainment cannot be excluded.[141,·142,·144,·159,·160]

Access to primary care is a particularly important aspect of effective, high-quality primary care, albeit an aspect of primary care that is no longer assessed in QOF. A lack of adequate patient access to services is associated with increased attendances at emergency departments[161], the incidence of ESRF in patients with diabetes[162], detection of chronic disease[163] and admission rates for ACSCs[144,·164,·165]; insufficient access to primary care may also exacerbate the effects of social inequality on health outcomes.[166]

Access to primary care may also decrease where there demand for it, such as deprived areas, areas with a high proportion of elderly residents and areas with a prevalence of chronic disease, is highest.[163] This may create a vicious cycle for many practices with high caseloads and objectively higher need for services are inadequately resourced to provided the highest levels of care quality and, as a result of suboptimal performance on incentivisation schemes such QOF receive less income than practices with lower demand for services. In turn, efforts to increase accessibility – and provide services that are appropriately tailored to specific groups[167] – may simply not be affordable and achievable.

The introduction of QOF has led to improved recording of disease prevalence and clinical activities and may indirectly inform practices of the needs of their population.[149] However, the manner of QOF incentivisation has been argued to promote high-workload activities of marginal effectiveness as opposed to encouraging practices to address the needs of their registered population and the provision of preventative services.[168]

Further research is needed to explore whether QOF, and schemes analogous to it, provide clinical and cost-effectiveness. Despite positive associations between incentivisation schemes and intermediate clinical outcomes,[157,169-171] performance in these schemes has been shown in some studies to only have, at best, modest associations with hospital admissions for diabetes mellitus[141,158,172], COPD[144] and epilepsy.[173] emergency department attendance rates[159], admissions for coronary heart disease[143], admissions for strokes[145] and admissions for primary care sensitive conditions.[174] A 2011 Cochrane review concluded that there was insufficient evidence to determine whether or not incentivisation schemes truly increased the quality of primary care[153] However, it should be noted that there is a lack of agreement as to what defines quality with respect to ongoing management of diabetes[175] and that the ability of practices to deliver care that is deemed to be of high quality is subject to external influences, particularly the levels of deprivation in the population that they serve.[142]

As demands on primary care stand to increase, through population ageing, changes in lifestyle and increased prevalence of chronic disease, incentivisation schemes must be reactive to the challenges faced by primary care and encourage delivery of effective, timely and accessible care to the whole population rather than to a subset of individuals who have the means and ability to avail themselves of primary care.

Research Aims and Objectives

As discussed above, whilst there is evidence supporting the positive effect that quality improvement schemes such as QOF have had on attainment of intermediate clinical outcomes, the effects of the quality of diabetes management in primary care have on 'hard' clinical outcomes require further exploration.

Whilst it is both logical and pathophysiologically sound to assume that attaining the myriad intermediate outcomes in QOF would lead to improved outcomes, there is relatively little evidence to support such an association; there is also the implicit assumption that QOF is a reliable instrument to measure and quantify quality.

In order to assess whether actions taken in primary care can affect the occurrence of outcomes such as unscheduled hospital admissions, a potential downstream marker of sub-optimal care, and mortality, this thesis will examine not only the quality of care delivered by practices to its patients, but also that which is received by patients themselves on these outcomes.

Practice-Level Analyses

The first series of analyses will concentrate on practice-level analyses and the count of emergency hospital admissions. Previous studies have tended to limit themselves to emergency admissions where diabetes is the direct cause of admission (i.e. the primary diagnosis). As diabetes is a chronic condition that can lead to dysfunction of a number of organ systems which may take priority in the description of presenting complaints and diagnoses, there is potential for this method of admission selection to grossly underestimate the true burden of emergency admissions arising from the population with diabetes.

Use of QOF points attained is also common in previous studies that aim to examine what associations may exist between primary care quality and outcomes. As the maximal levels of remuneration are awarded at sub-maximal levels of practice performance, utilisation of points attained may mask differences in the actual underlying achievement between practices. As such, the practice-level analyses presented in this thesis will utilise underlying achievement of QOF indicators. Furthermore, as there is potential for declared levels of performance under QOF to be confounded by exception reporting, the effects of exception reporting will also be investigated.

The main research aims of the practice-level analyses will be:

- To assess the degree to which reliance on the primary diagnosis field alone to identify admissions related to diabetes may underestimate the true burden of emergency admissions from the population with diabetes;

- To explore the associations between underlying achievement of selected QOF indicators – those that are diabetes-specific and those that describe aspects of practice accessibility – has on emergency admissions from the registered population with diabetes.

Patient-Level Analyses

Although practice-level analyses will enable exploration of the effect that the levels of primary care quality reported by general practices has on their registered population with diabetes, the nature of such analyses preclude inferring what the effects of quality may be at the individual level.

The second set of analyses in this thesis will be relatively unique through their utilisation of patient-level data that links primary care activity with age-sex standardised hospital admissions, examining the links between the quality of care received by a patient and the outcomes that they experience, allowing for direct assessment of the effectiveness of receiving high quality care with respect to emergency admissions, readmissions and mortality.

The metrics of quality to be assessed will include patient achievement of a number of diabetes-specific QOF intermediate outcome measures and receipt of the nine NDA care processes. In addition to the analyses of receipt of high-quality care, differences in the impact of co-morbidity between people with and without diabetes will also be examined.

The main research aims of the practice-level analyses will be to assess:

- Whether achievement of intermediate outcomes and receipt of care processes are associated with changes in emergency admission and readmission rates;

- Whether achievement of intermediate outcomes and receipt of care processes are associated with mortality and the likelihood of death resulting from a diabetes-related cause.

- Whether the presence and degree of co-morbidity presents differential levels of risk with respect to all-cause mortality according to whether a given patient has or does not have diabetes.

Practice-Level Analyses

Identification of Admissions from The Population With Diabetes

Background

Many existing studies that utilise Hospital Episode Statistics (HES) for examination of admission rates for ACSCs such as diabetes tend to identify such admissions from the first diagnosis field alone, under the assumption that this is the diagnosis directly precipitating the need for admission.[144,·145,·158]

As diabetes is a known risk factor for cardiovascular disease, cerebrovascular disease, peripheral arterial disease, visual loss and renal failure, it is likely that diabetes may be cited as a supporting diagnosis as opposed to the diagnosis that directly led to admission. For example, a person with diabetes who is admitted to hospital as a result of a myocardial infarction is more likely to (and, it could be argued, more appropriately) have myocardial infarction recorded as a primary diagnosis even though the diabetes is a likely precipitant of atherosclerotic coronary artery disease.

As such, quantifying hospital admissions due to diabetes through the primary diagnosis alone is likely to grossly underestimate the true burden of diabetes and its complications on secondary and tertiary care providers.

Methodology

Data Sources

Information on hospital admissions in England is available through Hospital Episode Statistics (HES). HES provides data on all admissions, outpatient and Accident and Emergency (A&E) attendances. As HES data has the potential to be patient-identifiable, only aggregate data pertaining to admissions and attendances across England is available to the public; data describing hospital-level activity is only available to approved individuals and institutions who are able to comply with Data Protection legislation.

With respect to hospital admissions, HES presents data as a series of episodes and spells. Episodes are defined as a period of contiguous care under the management of a single Consultant, whereas spells are a period spent within a single secondary or tertiary care provider. Thus, spells can be comprised of multiple episodes; admissions in which a patient is transferred from one provider for another are referred to as 'super-spells', where a single admission is comprised of multiple spells.

At the present time, little of the HES data pertaining to admissions is input automatically; information regarding diagnoses and procedures performed are retrospectively entered from the physical copy of patient notes by a team of Clinical Coders, administrators who have been trained on the processes and methods of coding (see Figure 6). Diagnoses for individual episodes, in addition to those recorded at admission, are recorded using the 10th Revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10).[176] Up to 20 diagnoses for each episode can be recorded, with the diagnoses assigned on admission considered representative of the presenting complaint(s) and current diagnoses that a patient has.

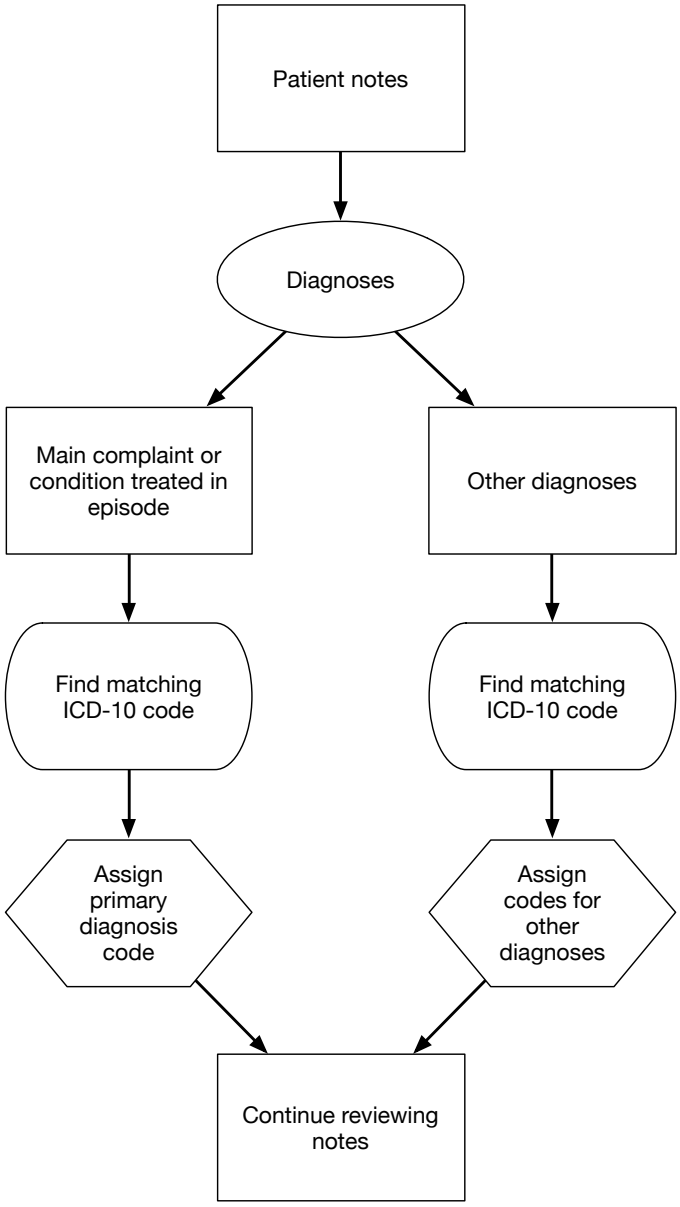


Figure 6. Overview of the clinical coding process.

Data pertaining to hospital admissions in England for the period 1st April 2005 to QOF, in and of itself, does not currently contain any 'hard' clinical outcomes in its assessment of the quality of delivered care, relying instead on intermediate outcomes that may reflect engagement with care (both on the part of the patient and the primary care team), recording of data to support efficient delivery of care and attainment of physiological goals, such as specific blood pressure and serum cholesterol targets, that imply effective treatment (HES field names are presented in italics):

- Citation of diabetes mellitus (ICD-10 codes E10, E11, E13 and E14 in line with WHO recommendations[177]) in any diagnosis field (*diag_01* to *diag_20* inclusive)
- Method of admission recorded as an emergency (*admimeth* = 21, 22, 23, 34 or 28)
- Age on admission (*startage*) ≥ 17 years and ≤ 120 years (as values > 120 are used to denote neonatal ages in HES)
- Admission date (*admidate*) in the range 1st April 2005 - 31st March 2011 inclusive

To take account of multiple-episode spells, only data pertaining to the first episode of any given spell (*epiorder* = 1) was utilised so as to capture the diagnoses on admission and to avoid double-counting of diagnoses. Admissions where the recorded discharge date (*disdate*) preceded the admission date (*admidate*) were excluded.

Admissions were classified according to the type of diabetes cited in any diagnosis position; ICD-10 codes of E10 and E11 were assumed to be analogous to T1DM and T2DM respectively; ICD-10 codes E13 (other specified diabetes mellitus) and E14 (unspecified diabetes mellitus) were grouped as 'other and unspecified diabetes mellitus.

For admissions that cited diabetes multiple times across diagnosis fields, those that utilised the same ICD-10 classification for diabetes type were classified accordingly (i.e. an admission that cited E10 twice would be classified as T1DM); admissions that cited different diabetes types were classified as 'other and unspecified diabetes mellitus'.

In addition to diabetes type, derived from the first three characters of the ICD-10 code, data on diabetes complications were also available. All diabetes types share a common suffix that denotes which complication was present at the time of diagnosis (see Table 11).

ICD-10 Suffix	Description
.0	With coma
.1	With ketoacidosis
.2	With renal complications
.3	With ophthalmic complications
.4	With neurological complications
.5	With peripheral circulatory complications
.6	With other specified complications
.7	With multiple complications
.8	With unspecified complications
.9	Without complications

Table 11. ICD-10 suffixes used to denote complications of diabetes mellitus.

For admissions where diabetes was cited multiple times, a similar approach to that used for classifying diabetes type was used for complications, whereby admissions with concordant complications were coded as such. For admissions with multiple citations of diabetes, a suffix of .9 was superseded by the first suffix that denoted a specific complication unless the only other suffix was also .9; those with multiple suffixes denoting specified complications were classified as 'mixed' complications.

Primary diagnoses for admissions citing diabetes were also determined and ranked according to their frequency. Descriptions for each ICD-10 code were incorporated into the dataset via a 1:1 merge. The ranking of diagnoses was performed twice; one ranking included ICD-10 symptom codes (Rxx.x) and the other excluded these codes. Data were cleaned, managed and tabulated in STATA IC version 12.1 (StataCorp, TX, USA) for Mac OS X.

Results

A total of 2,136,084 emergency admissions citing diabetes mellitus (E10, E11, E13 or E14) in any diagnosis position were identified in individuals aged ≥ 17 years and ≤ 120 years during the period 1st April 2005 – 31st March 2011 inclusive.

The maximum number of diagnoses used across all admissions was 14. Diabetes was most commonly cited first in the third diagnostic position (516,833 admissions / 24.20%) and was the first diagnosis in 6.26% (133,791) of admissions. The mean and median diagnostic positions were 3.860 and 4 respectively (see Figure 7 and Table 12).

	Diagnosis Position Diabetes First Cited
Minimum	1
p25	2
p50	4
p75	5
Maximum	14
Mean	3.860
SD	1.948
Variance	3.796

Table 12. Descriptive statistics of diagnosis position in which diabetes was first cited in HES emergency admissions, 2004/05-2010/11.

p25 = 25th centile; p50 = 50th centile; p75 = 75th centile; SD = standard deviation

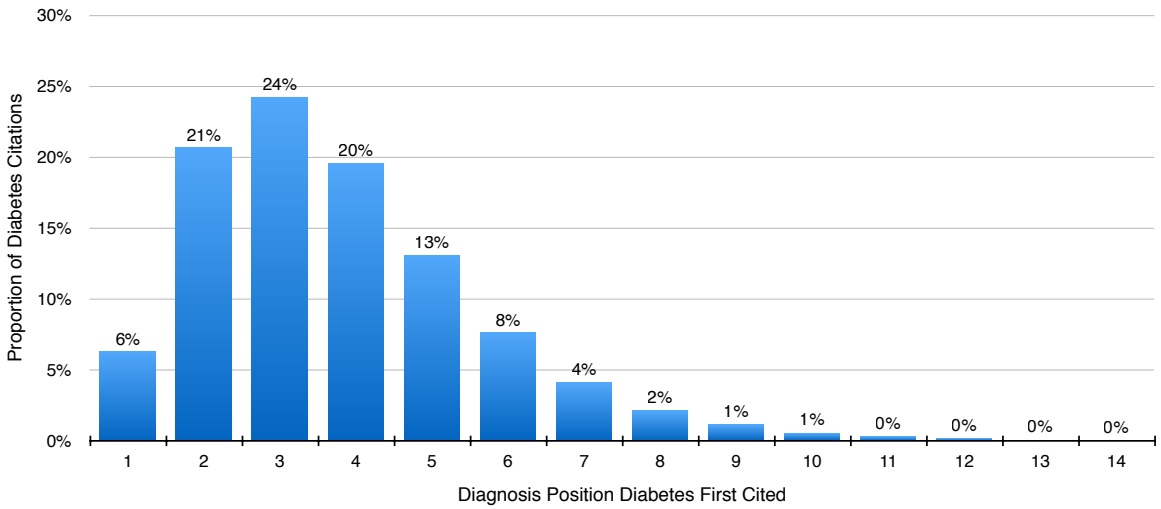


Figure 7. Distribution of diagnosis position in which diabetes was first cited in HES emergency admissions, 2004/05-2010/11.

The most common type of diabetes cited was T2DM (1,789,802 admissions / 83.79%); T1DM was the next most common (280,255 admissions / 13.12%) and other & unspecified diabetes comprised the remainder of admissions (66,027 admissions / 3.09%) (Table 13). T2DM was the most commonly cited diabetes type in all bar the first diagnosis position, where T1DM was marginally more common (47.10% *versus* 47.06%; 63,010 *versus* 62,962 admissions) (Figure 8). Diabetes was cited multiple times in 44,290 (2.07%) admissions; 41,973 (94.77%) of these did so in a concordant manner and 2,315 (5.23%) cited discordant diabetes types.

DM Type	n	%
T1DM	280,255	13.12%
T2DM	1,789,802	83.79%
Other & Unspecified	66,027	3.09%
TOTAL	**2,136,084**	**100.00%**

Table 13. Diabetes types cited in HES emergency admissions, 2005/06 - 2010/11.

T1DM = Type 1 diabetes mellitus; T2DM = Type 2 diabetes mellitus

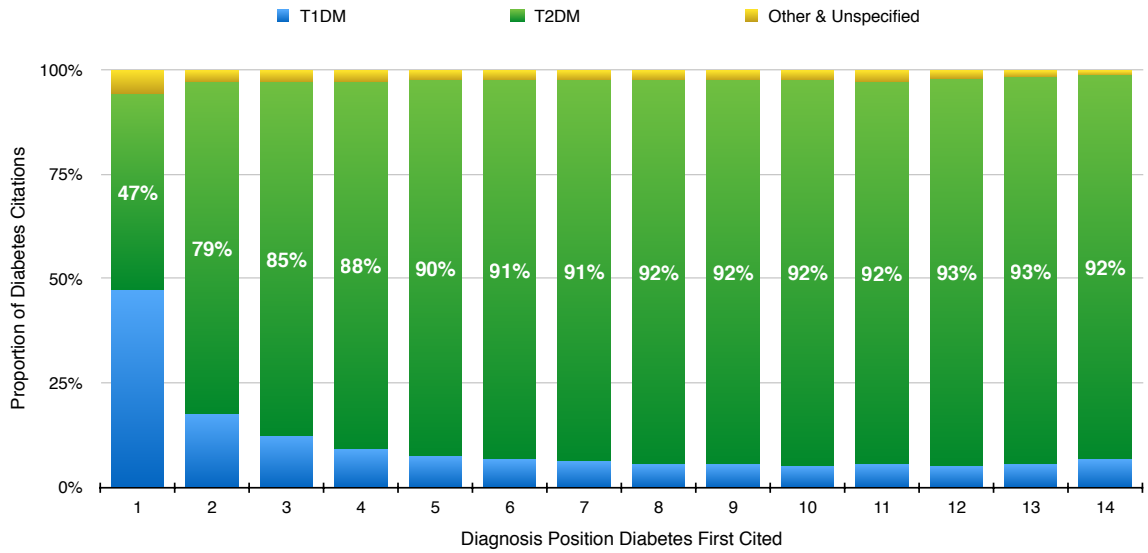


Figure 8. Diabetes types by diagnosis position in which diabetes was first cited in HES emergency admissions, 2005/06 - 2010/11.

Percentages shown are the proportion of diabetes citations declared as T2DM for a given diagnosis position.
T1DM = Type 1 diabetes mellitus; T2DM = Type 2 diabetes mellitus

The overwhelming majority of diabetes citations were made with the suffix .9 (1,918,633 admissions / 89.82%), denoting no complications (Table 14). Suffix .9 was the most common suffix used across all diagnostic positions where diabetes was first cited, although the greatest differentiation in suffixes was observed in diagnosis position 1, where suffix .9 accounted for 40.07% (53,613) of diabetes citations, suffix .1 (ketoacidosis) accounted for 31.09% (41,594) of diabetes citations and suffix .5 (peripheral circulatory) accounted for 12.82% (17,147) of diabetes citations (Figure 9).

	Diabetes Complication	n	%
x.0	**Coma**	7,654	0.4%
x.1	**Ketoacidosis**	47,794	2.2%
x.2	**Renal**	33,375	1.6%
x.3	**Ophthalmic**	44,260	2.1%
x.4	**Neurological**	24,172	1.1%
x.5	**Peripheral circulatory**	40,131	1.9%
x.6	**Other specified**	4,781	0.2%
x.7	**Multiple**	1,249	0.1%
x.8	**Unspecified**	4,328	0.2%
x.9	**No complications**	1,918,633	89.8%
	≥ 2 complications	9,707	0.5%
	TOTAL	**2,136,084**	**100.0%**

Table 14. Diabetes complications cited in HES emergency admissions, 2005/06 - 2010/11.

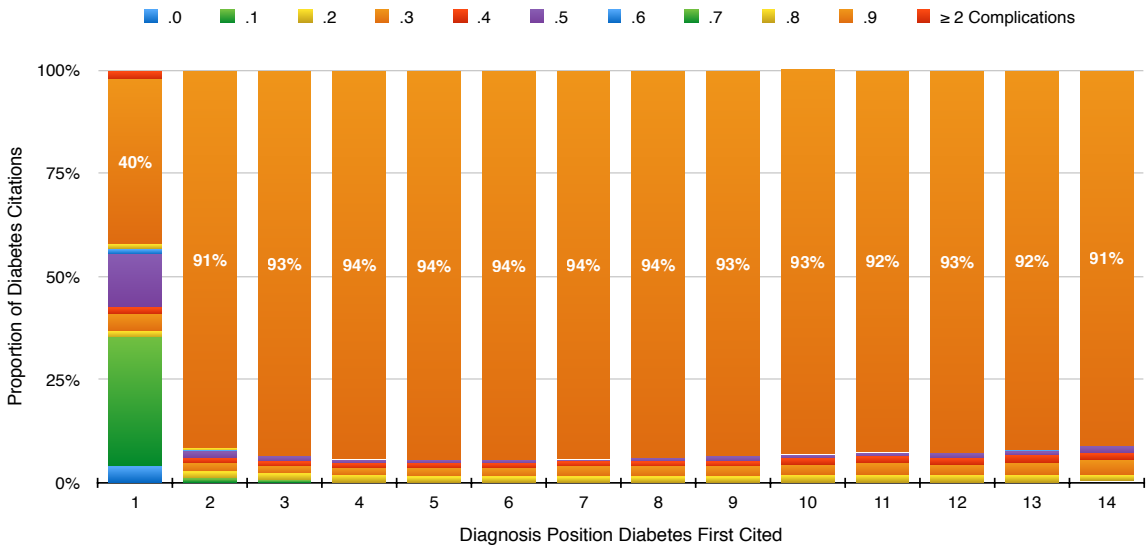


Figure 9. Diabetes complications by position in which diabetes was first cited in HES emergency admissions, 2004/05 - 2010/11.

Percentages shown are the proportion of diabetes citations with a suffix of .9 for a given diagnosis position; .0 = coma; .1 = ketoacidosis; .2 = renal; .3 = ophthalmic; .4 = neurological; .5 = peripheral circulatory; .6 = other specified complications; .7 = multiple complications; .8 = unspecified complications; .9 = no complications

The most common suffix across all diabetes types was .9, with 71.97% (201,705) of T1DM, 92.75% (1,660,081) of T2DM and 86.10% (56,847) of other and unspecified diabetes being cited in this manner. T1DM showed the greatest differentiation with respect to recorded complications, with 13.14% (36,829) cited as complicated by ketoacidosis, 3.95% (11,074) cited ophthalmic complications and 3.15% (8,830) cited renal complications (Figure 10)

The most common first diagnosis, including ICD-10 codes denoting symptoms (Rxx.x), across all emergency admissions citing diabetes was ‘chest pain, unspecified’ (R07.4), accounting for 98,167 (4.60%) emergency admissions. Three of the top 30 primary diagnoses were coded as diabetes – E10.1, E11.9 and E10.9, ranked 9th (34,096, 1.60%), 11th (32,111, 1.50%) and 23rd (18,975, 0.89%) respectively.

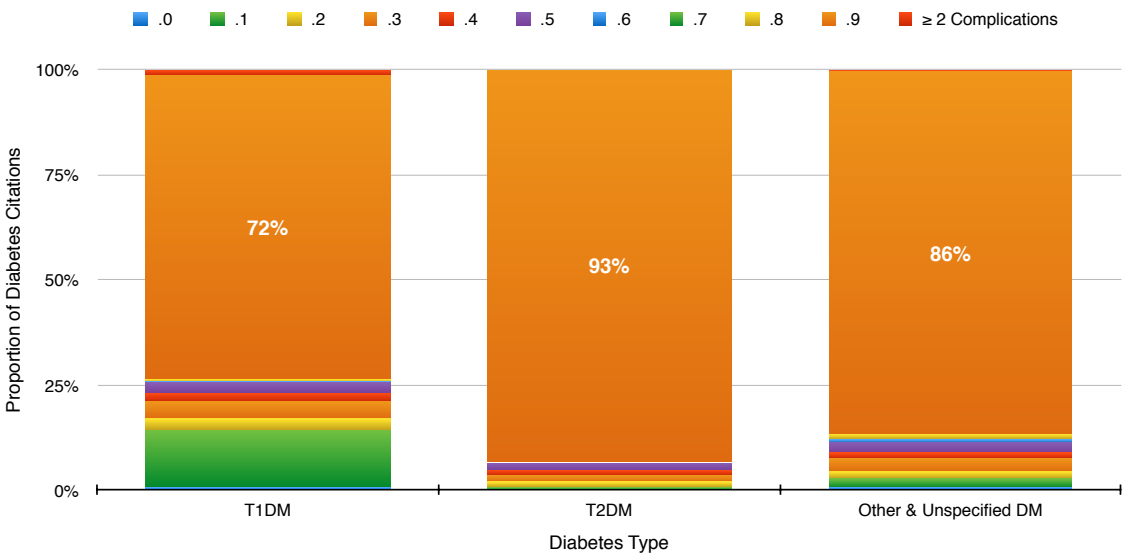


Figure 10. Diabetes complications by diabetes type in HES emergency admissions, 2005/06 - 2010/11.

Percentages shown are the proportion of diabetes citations with a suffix of .9 for a given diagnosis position; .0 = coma; .1 = ketoacidosis; .2 = renal; .3 = ophthalmic; .4 = neurological; .5 = peripheral circulatory; .6 = other specified complications; .7 = multiple complications; .8 = unspecified complications; .9 = no complications

Once first diagnoses citing ICD-10 symptom codes were discounted and superseded by the first non-symptom diagnosis in relevant admissions, the most common first diagnosis was 'non-insulin-dependent diabetes mellitus without complications' (E11.9), accounting for 114,232 (5.35%) emergency admissions (Table 15).

Of note, 'hypoglycaemia, unspecified' (E16.2) placed highly in the lists including and excluding symptom codes, ranked 5th (39,275, 1.84%) and 7th (41,082, 1.92%) respectively.

Rank	Including Symptom Codes (Rxx.x)				Excluding Symptom Codes (Rxx.x)			
	ICD-10 Code		n	%	ICD-10 Code		n	%
1	R07.4	Chest pain, unspecified	98,167	4.60%	E11.9	Non-insulin-dependent diabetes mellitus	114,232	5.35%
2	N39.0	Urinary tract infection, site not specified	67,958	3.18%	N39.0	Urinary tract infection, site not specified	73,100	3.42%
3	R55.X	Syncope and collapse	46,728	2.19%	I20.9	Angina pectoris, unspecified	47,485	2.22%
4	J22.X	Unspecified acute lower respiratory infection	40,320	1.89%	I10.X	Essential (primary) hypertension	42,596	1.99%
5	E16.2	Hypoglycaemia, unspecified	39,275	1.84%	J22.X	Unspecified acute lower respiratory infection	41,818	1.96%
6	I20.0	Unstable angina	37,030	1.73%	I48.X	Atrial fibrillation and flutter	41,209	1.93%
7	I50.0	Congestive heart failure	35,438	1.66%	E16.2	Hypoglycaemia, unspecified	41,082	1.92%
8	R07.3	Other chest pain	34,734	1.63%	I50.0	Congestive heart failure	38,116	1.78%
9	E10.1	Insulin-dependent diabetes mellitus	34,096	1.60%	I20.0	Unstable angina	37,694	1.76%
10	K52.9	Non-infective gastroenteritis and colitis, unspecified	33,583	1.57%	K52.9	Non-infective gastroenteritis and colitis, unspecified	37,587	1.76%

Table 15. Top 10 first diagnoses, including and excluding ICD-10 symptom codes, across all emergency admissions citing diabetes mellitus in HES 2005/06 - 2010/11.

ICD-10 = International Classification of Diseases, 10th Revision

Discussion

From the data presented above, it is evident that sole reliance on the first diagnosis field to identify potentially diabetes-related emergency admissions is far from optimal; only 6.26% of HES emergency admissions citing diabetes and, therefore, have the potential to be related to diabetes, in the period 1st April 2005 - 31st March 2011 would have been identified by such an approach. Failing to identify a considerable proportion of admissions that may be related to diabetes is likely to introduce bias and reduce statistical power.

The only diagnostic position that demonstrated a meaningful differentiation of suffixes denoting complications of diabetes was the first, where coma and peripheral circulatory complications featured prominently. It is conceivable that patients who present with complications that may be considered pathognomonic of diabetes to clinicians are more likely to have their current condition directly ascribed to diabetes. Conversely, emergency admissions that arise from conditions for which diabetes confers an excess risk but are relatively common in the general population are likely to take precedence over diabetes insofar as assigning the first diagnosis (which could well be considered as the proximal cause) for an admission.

There are also indications that the suffix .9, denoting diabetes without complications, is grossly overused in HES; .9 was the most common suffix across all diagnosis positions, including the first, and was consistently used in over 90% of all diabetes citations in diagnosis positions 2 to 14. This raises two issues; first, it is evident that the suffix .9 is being utilised as the 'default' code for diabetes and may more accurately reflect that diabetes has been recorded without mention of complications rather than there being a *de facto* absence of them; secondly, this finding implies that utilisation of suffixes in HES data to identify specific complications of diabetes would be subject to poor sensitivity.

The proportion of admissions citing diabetes multiple times was relatively small (44,290, 2.07%). The majority of instances of multiple diabetes citations did so using concordant diabetes types (41,975, 94.77%), but this finding may indicate a lack of clarity insofar as the procedure for defining diabetes types or diabetes complications is concerned.

The accuracy of diabetes diagnoses in HES may also be related to a particular shortcoming of the ICD-10 coding schema; the present version of ICD-10 has no suffix for denoting diabetes complicated by cardiovascular disease, for which diabetes confers a considerable excess risk. The addition of such a suffix may aid the accuracy of diabetes complication coding and may, in some cases, promote

diabetes to a higher diagnosis position, thereby potentially aiding identification of emergency admissions that are diabetes-related. The frequency of primary diagnoses citing cardiovascular disorders in the context of the presence of diabetes in emergency admissions (Table 15) highlights the need for consideration of this issue.

It should be noted that, whilst identifying emergency admissions attributable to diabetes from the first diagnosis field alone is subject to poor sensitivity, the other extreme – classing an emergency admission as attributable to diabetes if diabetes is cited anywhere – is also far from ideal and subject to poor specificity. A 'middle-ground' approach, whereby an emergency admission is classed as resulting from diabetes if a known complication of diabetes is cited as the first diagnosis in the context of diabetes with any suffix being cited in any other diagnostic position, may be a potential solution to this problem. Of course, this is a moot point for studies that are analysing outcomes from a known cohort of people with diabetes.[178,179]

One important aspect of clinical coding is that Coders, whilst trained in the extraction and classification of data from medical notes, are not clinically trained; as such, the quality of coding that they can output is intrinsically linked to the clarity and completeness of the information recorded in patient notes. Accordingly, if a clinician has not specified the inter-relationship between the condition that has precipitated an emergency admission and chronic disease, this information is unlikely to be reflected in the diagnosis codes – both in terms of their presence and order – assigned to a particular episode of care.

Whilst the use of datasets such as HES for research enables large-scale ecological studies linking primary care with outcomes, it should be borne in mind that the primary use for HES data is for quantifying hospital activity, where the presence of diagnosis codes is more important than their explicit order. Regardless, accurate identification of secondary and tertiary care utilisation resulting from chronic diseases such as diabetes will be of increasing importance. Accurately monitoring the rate of emergency admissions ascribable to diabetes will allow for assessment of healthcare quality, secondary and tertiary prevention activities, aid allocation of resources and strengthen the robustness of studies examining predictors of unscheduled care usage.

Practice QOF Performance and Emergency Admissions

Background

One of the primary goals of QOF, through remuneration of general practices for specified activities, is to improve the quality of delivered healthcare. By extension, improved outcomes – such as a reduced burden of potentially avoidable unscheduled care – should result from improvements in primary care activity.

QOF is a voluntary incentivisation scheme that rewards general practices for certain activities; practices are remunerated for their performance against a number of indicators, with tiers of payment for a given indicator being awarded at specific achievement levels. In order to prevent atypical patients, or those with terminal diagnoses in whom aggressive treatment would not be considered appropriate, impacting negatively on practice income, general practices can cite patients as an 'exception' to a specific indicator under a specific set of circumstances[135], thereby removing them from the eligible population for the purposes of calculating practice achievement.

QOF, in and of itself, does not currently contain any 'hard' clinical outcomes in its assessment of the quality of delivered care, relying instead on intermediate outcomes that may reflect engagement with care (both on the part of the patient and the primary care team), recording of data to support efficient delivery of care and attainment of physiological goals, such as specific blood pressure and serum cholesterol targets, that imply effective treatment.

The evidence that exists to support QOF driving improvements in population health – as opposed to the mere act of attaining targets – is somewhat limited and inconsistent in its findings. Studies have indicated an association between decreased emergency hospital admission rates for conditions incentivised in QOF,[180] others have observed that relatively few clinically-based indicators are associated with reduced admissions;[145] however, access to primary care services is an important, and somewhat more consistent, determinant of unscheduled care utilisation.[144,·145,·161,·162]

It should be noted, however, that other studies observed that primary care quality, as measured by QOF, showed no evidence of an association with decreased admission rates[143] or, where such an association was present, the estimated difference in admission rates was of questionable clinical significance.[143·] The public health impact of the quality measures in QOF has also been called into question[149,·153,·160,·168], as has the lack of equity across ethnic groups and in deprived communities.[142, · 155-157, · 181] The ability of practices to declare patients as an 'exception' with respect to specific targets, combined with the fact that maximum payment for a given indicator is awarded at achievement levels often considerably less than 100%, may further disenfranchise minorities and other patient groups who are subject to poor access to, or lack of appropriateness of, services in a bid to protect practice income.[136,·139,·150]

In order to further explore the impact of the various potential determinants of unscheduled hospital care utilisation described above, this analysis will explore a number of relationships between reported QOF performance, practice and population characteristics and emergency admissions from the registered population with diabetes in England over a period of six years.

Methodology

Data Sources

Multiple data sources were utilised for this analysis; Hospital Episode Statistics data for England (HES), practice QOF returns, practice population age and sex structure, practice population ethnicity estimates, practice workforce data, English Index of Multiple Deprivation (IMD) data, rural-urban area classification data and age-sex specific estimates of diabetes prevalence. All data were linked via the unique practice identifier as reported in QOF.

Quality and Outcomes Framework Data

All general practices in England are required to submit their QOF data to the Health & Social Care Information Centre (HSCIC) at the end of each financial year (1st April - 31st March inclusive) for the purposes of determining QOF payments to practices and calculation of aspiration payments, a monthly payment related to expected levels of achievement in the coming financial year.[134,182,183]

QOF results for each practice for each financial year are published by the H&SCIC as publicly-available data[184], providing data on points awarded, underlying achievement and exceptions declared for all indicators.

Data for practice-level achievement and exception reporting in England was obtained from the H&SCIC[184] for QOF years 2005/06 – 2010/11 inclusive. The presence of individual indicators in QOF varied by year and, in order to maximise comparability between years and the degree of variation between performance of individual general practices, diabetes indicators were thematically grouped into process measures, intermediate cardiovascular outcomes (blood pressure and total cholesterol targets) and stringent, intermediate and moderate glycaemic control (see Table 16). These indicator groupings were utilised for both underlying achievement and exception rates.

The rationale for combining the indicators for attainment of blood pressure and total cholesterol targets, aside from the advantages of maximising inter-practice variability in performance, was to arrive at a single predictor that summarised activities taken to minimise cardiovascular risk other than glycaemic control.

Patient experience indicators PE07 (proportion of patients able to obtain a consultation within 2 working days) and PE08 (proportion of patients able to obtain a consultation more than two days ahead), available from QOF years 2008/09 to 2010/11 inclusive, were considered as separate indicators.

Indicator		2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
Process Measures							
DM02	**BMI record**	✓	✓	✓	✓	✓	✓
DM03	**Smoking record**	✓	✗	✗	✗	✗	✗
DM04	**Smoking cessation**	✓	✗	✗	✗	✗	✗
DM08	**Retinal screening record**	✓	✗	✗	✗	✗	✗
DM09	**Peripheral pulses record**	✓	✓	✓	✓	✓	✓
DM10	**Neuropathy record**	✓	✓	✓	✓	✓	✓
DM11	**BP record**	✓	✓	✓	✓	✓	✓
DM13	**Microalbuminuria record**	✓	✓	✓	✓	✗	✗
DM14	**Serum creatinine record**	✓	✗	✗	✗	✗	✗
DM15	**ACEi / A2A treatment for proteinuria**	✓	✓	✓	✓	✓	✓
DM16	**Total cholesterol record**	✓	✗	✗	✗	✗	✗
DM18	**Influenza immunisation**	✓	✓	✓	✓	✓	✓
DM21	**Retinal screening record**	✗	✓	✓	✓	✓	✓
DM22	**Serum creatinine / eGFR record**	✗	✓	✓	✓	✓	✓
Cardiovascular Intermediate Outcomes							
DM12	**BP ≤ 145/85 mmHg**	✓	✓	✓	✓	✓	✓
DM17	**Total cholesterol ≤ 5.0 mmol/L**	✓	✓	✓	✓	✓	✓
Stringent Glycaemic Control							
DM06	**HbA1c ≤ 7.4%**	✓	✗	✗	✗	✗	✗
DM20	**HbA1c ≤ 7.5%**	✗	✓	✓	✓	✗	✗
DM23	**HbA1c ≤ 7.0%**	✗	✗	✗	✗	✓	✓
Intermediate Glycaemic Control							
DM24	**HbA1c ≤ 8.0%**	✗	✗	✗	✗	✓	✓
Moderate Glycaemic Control							
DM07	**HbA1c ≤ 10.0%**	✓	✓	✓	✓	✗	✗
DM25	**HbA1c ≤ 9.0%**	✗	✗	✗	✗	✓	✓

Table 16. Thematic groupings of diabetes-specific QOF indicators and their availability by QOF year, 2005/06 - 2010/11.

Assessment of practice level performance was based on the underlying achievement for each group of diabetes indicators and separately for each patient experience indicator (PE07 and PE08). Underlying achievement was calculated as follows:

$$\text{Underlying Achievement} = \frac{\sum \text{Patients Achieving Target}_i}{\sum \text{Indicator Denominator}_i}$$

The number of patients achieving a given target equates to the total number of patients meeting or exceeding a given target; the target denominator is the number of patients who are eligible for consideration for a given target, less those that have been declared as an exception.

Indicator-level exception rates are only publicly available for the QOF year 2007/08 onwards and do not apply to the patient experience indicators chosen for this analysis (PE07 and PE08). Exception 'rates' are defined as the proportion of potentially eligible patients who have been declared as exceptions out of the entire population who would be potentially eligible for the indicator in question.[185]

When considering groups of indicators, as with the calculations for underlying achievement, indicator numerators and denominators were summed in order to arrive at an overall exception rate, thus:

$$\text{Exception Rate} = \frac{\sum \text{Number of Exceptions}_i}{\sum \left(\text{Number of Exceptions}_i + \text{Indicator Denominator}_i\right)}$$

The distributions of practice underlying achievement and exception rates for each group of diabetes indicators and for indicators PE07 and PE08 for each QOF year were split into fifths according to quintiles of the relevant distribution, with the first fifth denoting those practices with the lowest relative levels of underlying achievement or exception proportion.

For this analysis, the list sizes of registered patients for each general practice were categorised into three groups – ≤ 4,000 patients, 4,000 – 7,999 patients and ≥ 8,000 patients – as detailed in the GP Workload Survey.[186] List size was also utilised, in conjunction with reported numbers of people with diabetes, to calculate each practice's prevalence of diabetes mellitus. Practices were excluded if they had a list size less than 1,000 patients or declared that they had no patients with diabetes on their diabetes register.

Hospital Episode Statistics Data

The nature of HES data has been previously described in this chapter (see page 52). The criteria for the selection of eligible episodes for this analyses were as follows (HES field names given in italics):

- Admission date in the range 1st April 2005 – 31st March 2011 inclusive (*admidate*)
- Restriction to the first episode in a given spell (*epiorder* = 1)
- Patient aged ≥ 17 years but ≤ 120 years (*startage*)
- Citation of diabetes (ICD-10 classifications E10, E11, E13, E14) in any diagnostic position (*diag_01* to *diag_20*)
- Patients were admitted as an emergency (*admimeth* = 21, 22, 23, 34 or 28)

These criteria will identify diabetes-citing emergency admissions, hereafter referred to as emergency admissions. The first episode of a spell was considered representative of the state of a given patient at the time of admission.

Admissions were broadly categorised by diabetes type according to ICD-10 classification; E10 (insulin-dependent diabetes mellitus) was considered analogous to Type 1 diabetes mellitus (T1DM), E11 (non-insulin-dependent diabetes mellitus) was considered analogous to Type 2 diabetes mellitus (T2DM) and E13 (other specified diabetes mellitus) and E14 (unspecified diabetes mellitus) were grouped together as 'other or unspecified diabetes mellitus'.

Admissions that cited the same classification of diabetes multiple times were classified accordingly; those that cited different classifications of diabetes were classified as 'other or unspecified diabetes mellitus'.

In addition to diabetes type, each admission was classified by patient gender, broad age band (15 – 44y, 45 – 64y, 65 – 74y and ≥ 75y) and the QOF year in which the admission occurred (based on admission date), with QOF years running from 1st April – 31st March inclusive.

All admissions within HES denote the practice, using the standard unique general practice identifier, that has responsibility for the delivery of primary care services to a given patient (*gpprac*). As HES data describes episodes by patient, aggregates of admissions (total and age-sex specific) were generated for each practice for each QOF year.

Practice Population Structure, Ethnicity and GP Workforce

Data on practice population structure covering the period 2000 – 2010 was obtained from the NHS Information Centre (now superseded by the H&SCIC)[187]; this data describes, by QOF year, the proportion of the total registered population of a practice that falls into a specific gender and age band (0 – 4 years, 5 – 14 years, 15 – 44 years, 45 – 64 years, 65 – 74 years, 75 – 84 years and ≥ 85 years).

The original data on population structure for each practice was presented as numerical totals for each age-sex stratum; for the purposes of analysis, these totals were converted into proportions of the total registered population for each QOF year.

The ethnic composition of practice populations were estimated from pooled HES hospital attendance data for the period 2004 – 2010 inclusive. This approach has been demonstrated to be more closely aligned to the ethnic structure of practice populations, based on self-reporting of ethnicity by patients, than the assignation of ethnic structure of practice populations via postcode attribution from the national census, a method used for the construction of the Attribution Data Set.[188]

For this analysis, patient ethnicity was grouped as white, non-white and not recorded and, as values were pooled estimates from multiple years of data, these ethnicity proportions were static for each practice across QOF years. Further subdivision of ethnicity was considered, but in light of the considerable number of existing variables, many of which were categorical and further described socio-economic deprivation, to be included in the models, a parsimonious approach with respect to ethnicity data was decided upon.

Data pertaining to the size of general practitioner workforce, based on pooled estimates from the period 2002 – 2012 inclusive, for each general practice was obtained from H&SCIC.[189] Total GP full-time equivalents (FTEs) were determined as the sum of FTEs for GP providers, other GPs, GP Registrars and GP retainers. For the purposes of analysis, GP workforce was expressed as the total FTEs per 1,000 registered patients; as workforce data was determined from pooled data, FTEs per 1,000 patients were static across all QOF years in the analysis dataset.

Estimates of The Population Structure of People With Diabetes

At present, there are no datasets publicly available that describe the age-sex structure of the population of people with diabetes at the level of general practices. Estimates of age-sex specific prevalence of diabetes mellitus for England as a whole (Table 17), based on patient reports of doctor-diagnosed diabetes, have been reported as part of the Health Survey for England (HSfE).[30,190]

These estimates were applied to the relevant age-sex bands of each practice population, using the arithmetic mean of multiple HSfE age groups to match the age-bands given for practice population age data where appropriate.

		2003	2006	2009	2010
Males	**16 – 24y**	0.4%	0.8%	0.5%	0.5%
	25 – 34y	0.3%	1.2%	1.0%	1.3%
	35 – 44y	2.8%	2.4%	1.9%	2.5%
	45 – 54y	3.6%	6.0%	8.1%	7.0%
	55 – 64y	8.1%	8.5%	10.5%	11.1%
	65 – 74y	11.9%	15.7%	15.7%	15.2%
	≥ 75y	10.0%	13.5%	19.5%	15.9%
Females	**16 – 24y**	0.9%	0.9%	0.4%	0.4%
	25 – 34y	0.9%	1.2%	0.8%	1.7%
	35 – 44y	1.5%	1.2%	3.2%	2.5%
	45 – 54y	2.6%	3.6%	3.5%	4.1%
	55 – 64y	4.7%	6.0%	6.3%	8.0%
	65 – 74y	8.4%	10.4%	902%	12.2%
	≥ 75y	8.9%	10.6%	12.7%	13.2%

Table 17. Age-sex specific estimates of diabetes prevalence in England from HSfE 2003 - 2010.

The number of individuals in the various age-sex-specific bands for a practice was determined from the reported proportion of individuals within that band (see page 70) by the total registered population for that year. These estimates of numbers of individuals in a age-sex-specific band were then multiplied by the estimated prevalence of diabetes for that age-sex band; the estimated numbers of people with diabetes were then converted into proportions and the final age-sex specific estimates of numbers of individuals with diabetes were derived by multiplying these estimated proportions by the total diabetes register size for that practice.

$$n_{all}\left(\text{age-sex}\right)_i = p_{all}\left(\text{age-sex}\right)_i \times n_{all}\left(\text{registered}\right)$$

$$\rightarrow n_{dm}\left(\text{age-sex}\right)_i = n_{all}\left(\text{age-sex}\right)_i \times p_{hsfe}\left(\text{age-sex}\right)_i$$

$$\rightarrow p_{dm}\left(\text{age-sex}\right)_i = \frac{n_{dm}\left(\text{age-sex}\right)_i}{\sum n_{dm}\left(\text{age-sex}\right)_i}$$

$$\rightarrow N_{dm}\left(\text{age-sex}\right)_i = p_{dm}\left(\text{age-sex}\right)_i \times n_{dm}\left(\text{registered}\right)$$

Where n_{all} = estimates of whole practice numbers, p_{all} = proportion of practice population, n_{dm} = interim estimated numbers of individuals in an age-sex stratum, p_{hsfe} = HSfE-reported diabetes prevalence for an age-sex stratum, p_{dm} = estimated proportion of a practice's population with diabetes that falls into an age-sex stratum, N_{dm} = final estimated numbers of individuals with diabetes in an age-sex stratum.

It should be noted that the minimum ages of the various data sources to arrive at the final estimate of numbers of people with diabetes in the youngest strata of age did not quite match; 17 years for practice diabetes registers, 16 years for HSfE age-sex prevalence estimates and 15 years for the proportions of practice populations. As more granular detail, such as single-age specific prevalences and proportions, was not available, the bottom limit of age for the relevant groups in each data source had to be assumed to be equivalent.

Index of Multiple Deprivation and Rurality Classification

The English Index of Multiple Deprivation (IMD) is a measure that describes the relative deprivation of one area in comparison to another. IMD scores and ranks are available up to the resolution of Lower Super Output Areas (LSOAs) which comprise of between 1,000 to 3,000 residents and 400 to 1,200 residences; from 2001 – 2010, there were 32,482 LSOAs in England.[191]

IMD scores are a composite measure that summarises the level of deprivation across seven separate domains (income, employment, health and disability, education, skills and training, barriers to housing and services, crime and living environment). As such, a given IMD score can be arrived at through a number of different ways and are non-linear in their measurement of deprivation – for example, an area with an IMD score of 100 is not necessarily twice as deprived as an area with an IMD score of 50.

To avoid any potential issues with directly comparing IMD scores, LSOA IMD ranks were utilised in this analysis. The scores for all 32,482 LSOAs were obtained for the IMD assessments of 2004[192], 2007[193] and 2010[194] and ranked in descending order for each IMD assessment; LSOAs were then allocated to tenths of the distribution of IMD scores, based on their IMD rank, with the first tenth (containing the highest IMD scores) representing the most deprived LSOAs in England.

Categorisation of IMD ranks was considered preferable to utilisation of this information as a continuous variable on the grounds of clarity with respect to reporting of results; it is likely that the effect sizes associated with a unitary increase in rank would be minimal and, accordingly, potentially difficult to interpret. Furthermore, one cannot discount the possibility of deprivation measurement error between LSOAs, meaning that a single rank difference could potentially result from bias as opposed to a true difference; use of IMD deprivation scores as a continuous variable would also be problematic, as a particular IMD score could be arrived at through a number of different ways depending on a LSOA's IMD domain scores.

The LSOA for each general practice was determined from the practice's postcode via the GeoConvert tool provided by the UK Data Service.[195] Practice LSOAs were then cross-referenced with LSOA-level IMD scores and ranks to determine which tenth of the distribution of deprivation in England that a given practice fell into. IMD 2004 scores and ranks were utilised for the QOF year of 2005/06, IMD 2007 for QOF years 2007/08 to 2009/10 inclusive and IMD 2010 for the QOF year 2010/11.

The Office for National Statistics (ONS) rural/urban area classifications for LSOAs[196] were also utilised for this analysis as a proxy for concentration of and potential access to primary care services. Area classifications were aggregated to rural and urban as per ONS guidance.[197] Practices were matched to their LSOA via postcode conversion in the same manner as detailed above.

Standardised Emergency Admission Ratios

In order to take account of potential differentials in the age-sex structure of the populations of people with diabetes between practices, standardised emergency admission ratios (SEARs) were calculated for each practice by means of indirect standardisation.

The reference population utilised was the entire registered diabetic population for a given QOF year. The size of each age-sex group was defined as the sum of that age-sex group across all practices. The total number of admissions arising from each age-sex stratum were also determined and the admission rate for that age-sex stratum was calculated accordingly.

To determine the expected number of emergency admissions for a given practice, the number of people with diabetes in each age-sex stratum was multiplied by the overall admission rate for that age-sex stratum; the expected numbers of admissions for all age-sex strata were summed to give the expected number of admissions for each practice. SEARs were calculated for each practice by dividing the observed number of admissions by the expected number of admissions and multiplying the result by 100.

$$O = \sum a_i$$
$$E = \sum (n_i r_i)$$
$$\text{SEAR} = \left(\frac{O}{E} \right) \times 100$$

Statistical Analysis

The primary outcome measure for this analysis was practice SEAR. Models were constructed using negative binomial regression on the grounds of the variance of admission counts greatly exceeding the mean (see Table 18).

QOF Year	Mean	Variance
2005/06	33.28	761.08
2006/07	35.74	892.88
2007/08	35.79	913.83
2008/09	40.26	1,144.68
2009/10	42.93	1,292.58
2010/11	45.44	1,494.32

Table 18. Mean and variance of admission counts per English general practice, QOF years 2005/06 - 2010/11.

QOF = Quality and Outcomes Framework

For all models, the dependent variable was the observed number of emergency admissions, with the log-transformed expected number of admissions included as the offset term.

$$\ln(\text{SEAR}) = \ln\left(\frac{O}{E}\right)$$

$$\ln\left(\frac{O}{E}\right) = \beta_1 x_1 + \cdots + \beta_n x_n + c$$

$$\rightarrow \ln(O) - \ln(E) = \beta_1 x_1 + \cdots + \beta_n x_n + c$$

$$\rightarrow \ln(O) = \beta_1 x_1 + \cdots + \beta_n x_n + c + \ln(E)$$

Where SEAR = standardised emergency admission ratio; O = observed admissions; E = expected admissions.

Practices with no registered diabetics or a list size less than 1,000 patients were excluded from analysis, as were non-English general practices; all regression analyses clustered practices by Primary Care Trust (PCT) in order to take account of local similarities in commissioning of services, healthcare infrastructure and unmeasured population and environmental characteristics.

Initially, analyses of the following predictors were performed to assess associations with SEARs:

- Practice list size category (≤ 4,000, 4,000 – 7,999, ≥ 8,000)
- GP FTEs per 1,000 patients
- Practice diabetes prevalence
- National tenth of IMD rank (2004, 2007 or 2010 as appropriate)
- Rural/urban area classification
- Fifth of achievement for each diabetes QOF indicator group (all years)
- Fifth of exception reporting for each diabetes QOF indicator group (2007/08 onwards)
- Fifth of achievement for PE07 (2008/09 onwards)

- Fifth of achievement for PE08 (2008/09 onwards)

Following univariate modelling, multiple variable models were separately constructed for both underlying achievement and exception rate for each indicator or indicator group; these models were additionally adjusted for practice list size category, GP FTEs per 1,000 patients, practice diabetes prevalence, national tenth of IMD rank and rural/urban area classification. Final models, containing all predictors were then constructed in order to examine the robustness of associations that may have been observed in previous models once adjusted for levels of performance in other indicators and indicator groups.

For ease of interpretation, coefficients from negative binomial models have been reported as incidence rate ratios (IRRs), with an IRR greater than 1 denoting an association with increased emergency admission rates and an IRR less than 1 denoting an association with decreased admission rates.

Statistical significance was assumed at $\alpha = 0.05$; the datasets utilised in this analysis were linked using the practice identifier as the key field and aggregate data for analysis generated with FileMaker Pro Advanced version 13 (Apple Incorporated, CA, USA) for Mac OS X; analyses were performed in STATA IC version 12.1 (StataCorp, TX, USA) for Mac OS X.

Results

The characteristics of the practices eligible for inclusion in this analysis are shown in Table 19. A total of 2,074,628 emergency admissions were observed during QOF years 2005/06 – 2010/11, with a peak of 2,409,268 registered people with diabetes in 2010/11. Crude emergency admission rates from the registered population with diabetes increased from 157.77 per 1,000 in 2005/06 to 167.60 per 1,000 in 2010/11 (Figure 11).

		2005/06		2006/07		2007/08		2008/09		2009/10		2010/11	
		n / Mean	% / SD	n / Mean	% / SD	n / Mean	% / SD	n / Mean	% / SD	n / Mean	% / SD	n / Mean	% / SD
Practices		8,237		8,186		8,091		7,664		7,931		7,834	
Admissions		35.44	27.32	38.39	29.48	38.86	29.74	45.23	33.29	47.65	34.98	51.08	37.51
Age (years)	**0 - 4**	5.49%	1.59%	5.56%	1.61%	5.66%	1.62%	5.80%	1.64%	5.86%	1.69%	5.91%	1.68%
	5 - 14	12.18%	2.56%	11.93%	2.51%	11.67%	2.47%	11.51%	2.40%	11.37%	2.42%	11.27%	2.42%
	15 - 44	43.17%	8.10%	43.13%	8.17%	42.94%	8.27%	42.55%	8.27%	42.28%	8.38%	41.83%	8.52%
	45 - 64	24.06%	4.57%	24.36%	4.61%	24.65%	4.63%	24.90%	4.61%	25.10%	4.62%	25.36%	4.62%
	65 - 74	7.94%	2.46%	7.85%	2.47%	7.85%	2.50%	7.97%	2.56%	8.11%	2.71%	8.25%	2.83%
	≥ 75	7.16%	3.05%	7.18%	3.07%	7.22%	3.08%	7.25%	3.08%	7.27%	3.12%	7.37%	3.26%
Sex	**% Male**	50.41%	2.77%	50.41%	2.68%	50.38%	2.69%	50.26%	2.59%	50.32%	2.62%	50.35%	2.74%
Ethnicity	**White**	71.45%	19.45%	71.50%	19.40%	71.63%	19.30%	71.94%	19.12%	71.80%	19.22%	71.86%	19.16%
	Non-White	9.22%	14.97%	9.22%	14.95%	9.14%	14.84%	8.94%	14.69%	9.04%	14.80%	9.00%	14.76%
	Unknown	9.00%	14.76%	19.33%	10.40%	19.28%	10.34%	19.23%	10.31%	19.12%	10.28%	19.14%	10.27%
List Size Category	**< 4,000**	2,815	34.18%	2,722	33.25%	2,591	32.02%	2,223	29.01%	2,420	30.51%	2,323	29.65%
	4,000 – 7,999	2,945	35.75%	2,935	35.85%	2,851	35.24%	2,851	37.20%	2,847	35.90%	2,829	36.11%
	≥ 8,000	2,477	30.07%	2,529	30.89%	2,590	32.01%	2,590	33.79%	2,664	33.59%	2,682	34.24%
GP FTEs per 1,000 patients		0.671	0.298	0.663	0.288	0.657	0.285	0.651	0.275	0.644	0.274	0.639	0.260
Diabetes Prevalence		3.65%	1.05%	3.73%	1.07%	3.96%	1.10%	4.18%	1.14%	4.40%	1.28%	4.60%	1.25%
IMD Tenth (1 = Most Deprived)	**1**	1,340	16.27%	1,329	16.24%	1,332	16.46%	1,236	16.13%	1,293	16.30%	1,256	16.03%
	2	1,110	13.48%	1,105	13.50%	1,040	12.85%	968	12.63%	1,013	12.77%	1,011	12.91%
	3	967	11.74%	960	11.73%	927	11.46%	875	11.42%	909	11.46%	889	11.35%
	4	832	10.10%	828	10.11%	876	10.83%	816	10.65%	851	10.73%	888	11.34%
	5	852	10.34%	845	10.32%	782	9.67%	738	9.63%	762	9.61%	760	9.70%
	6	724	8.79%	722	8.82%	745	9.21%	725	9.46%	740	9.33%	716	9.14%
	7	704	8.55%	702	8.58%	691	8.54%	658	8.59%	680	8.57%	669	8.54%
	8	585	7.10%	579	7.07%	597	7.38%	574	7.49%	590	7.44%	585	7.47%
	9	590	7.16%	589	7.20%	575	7.11%	555	7.24%	571	7.20%	559	7.14%
	10	509	6.18%	506	6.18%	512	6.33%	489	6.38%	504	6.35%	484	6.18%
	Missing Data	24	0.29%	21	0.26%	14	0.17%	30	0.39%	18	0.23%	17	0.22%
QOF Process UA		91.61%	6.93%	91.92%	6.20%	92.42%	5.26%	92.68%	4.52%	93.34%	4.18%	93.71%	3.72%
QOF CVS UA		76.86%	8.10%	81.01%	7.25%	81.33%	6.25%	81.35%	5.91%	81.85%	5.79%	82.01%	5.61%
QOF Strict Glycaemic Control UA		61.71%	10.69%	67.67%	10.68%	66.62%	9.40%	66.22%	8.65%	53.79%	9.66%	54.18%	8.98%
QOF Intermediate Glycaemic Control UA		N/A		N/A		N/A		N/A		77.11%	7.60%	77.70%	7.04%
QOF Moderate Glycaemic Control UA		91.04%	6.07%	92.31%	5.25%	92.01%	4.77%	91.96%	4.35%	87.65%	6.13%	88.07%	5.51%
QOF PE07 UA		N/A		N/A		N/A		84.23%	13.95%	82.22%	13.64%	82.21%	13.47%
QOF PE08 UA		N/A		N/A		N/A		76.91%	17.52%	74.89%	16.89%	75.35%	16.61%
QOF Process ER		N/A		N/A		5.86%	3.33%	5.96%	3.58%	5.67%	3.03%	5.81%	3.34%
QOF CVS ER		N/A		N/A		7.83%	4.13%	7.40%	3.72%	7.69%	3.91%	7.58%	4.12%
QOF Strict Glycaemic Control ER		N/A		N/A		10.33%	7.02%	9.43%	6.22%	12.96%	8.60%	13.31%	8.88%
QOF Intermediate Glycaemic Control ER		N/A		N/A		N/A		N/A		9.42%	6.43%	9.57%	6.55%
QOF Moderate Glycaemic Control ER		N/A		N/A		5.58%	4.07%	5.15%	3.47%	7.31%	5.02%	7.34%	5.15%

Table 19. Descriptive statistics of general practices included in practice-level analysis.
GP = General practitioner; FTE = Full-time equivalent; IMD = Index of Multiple Deprivation; UA = underlying achievement; ER = exception rate; N/A denotes variable not available in given QOF year

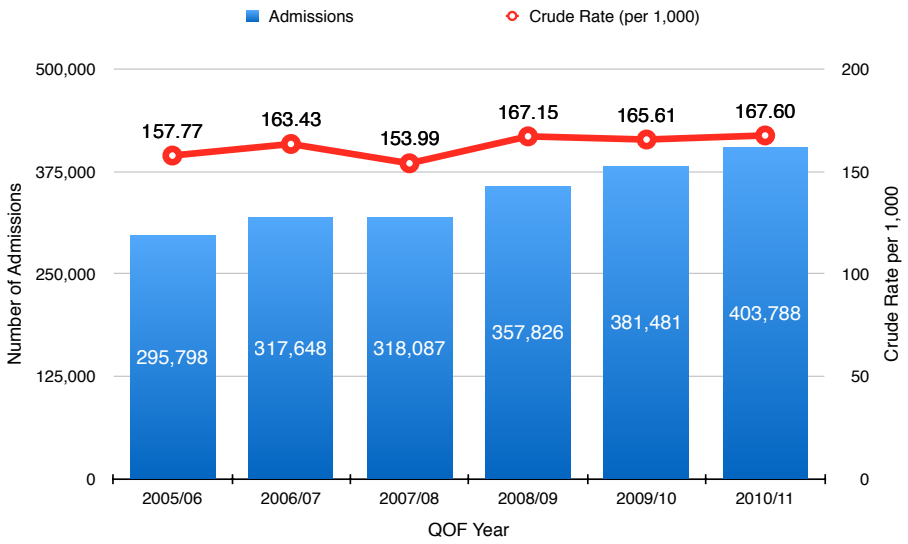


Figure 11. Emergency admissions and crude admission rate per 1,000 registered people with diabetes in England, 2005/06 to 2010/11.

Numbers on bars represent the count of emergency admissions for each QOF year; numbers above data points denote the crude emergency admission rate for that QOF year.

The estimated structure of the registered population with diabetes differed considerably to that of the general registered population; the estimated population with diabetes was older (Figure 12) and had an excess of males (Figure 13) in comparison to the general registered population.

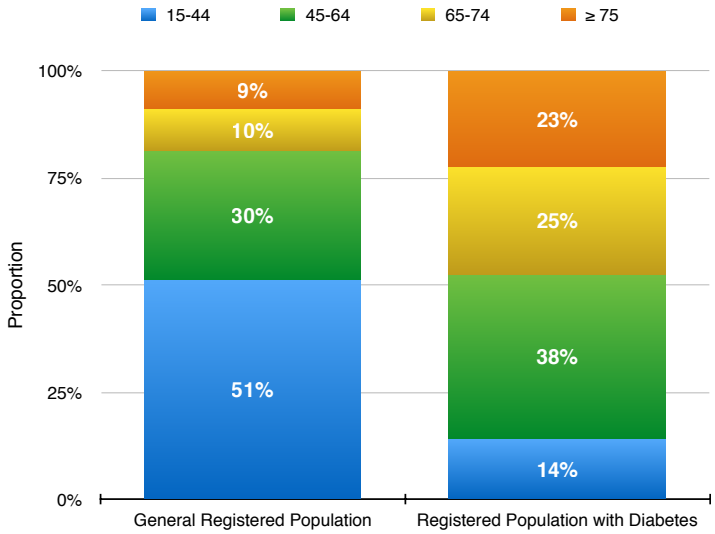


Figure 12. Proportion of patients by age-band in the general registered population and the estimated registered population with diabetes, QOF 2005/06 - 2010/11.

Proportions given exclude patients aged ≤ 14 years; the lower limit for age in HSfE age-specific prevalences was 16, whereas the equivalent age-band for the registered population was 15.

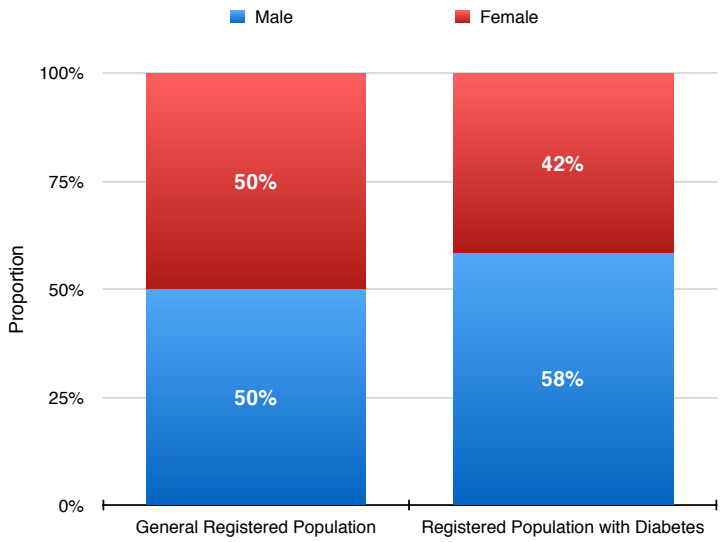


Figure 13. Proportion of patients by gender in the general registered population and the estimated registered population with diabetes, QOF 2005/06 - 2010/11.

Overall, crude emergency admission rates generally rose with increasing age (Table 14) and females experienced a higher crude emergency admission rate than males (Table 15). Standardised emergency admission ratios (SEARs) showed a wide distribution across all years; distribution characteristics, box and scatter plots of SEAR (excluding outliers) are shown in Table 20, Figure 16 and Table 17 respectively.

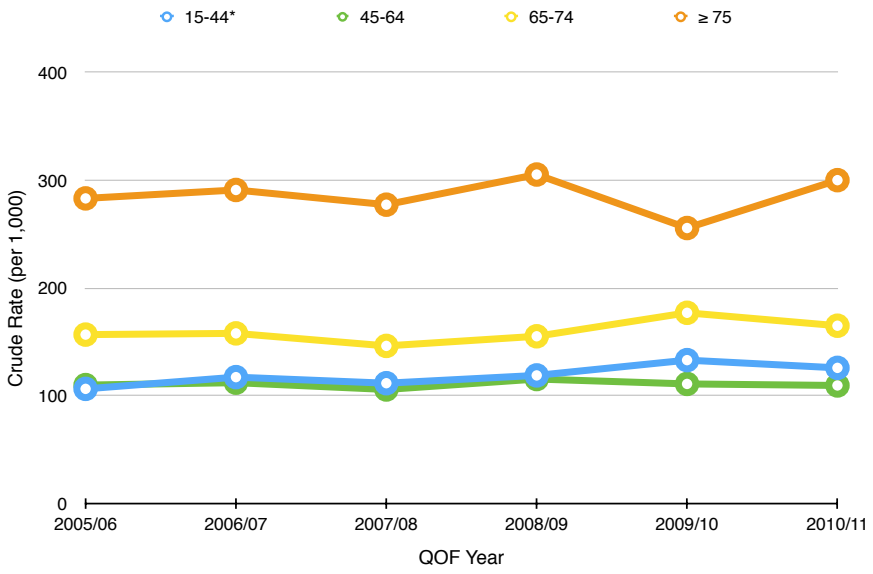


Figure 14. Crude emergency admission ratios by age-band, QOF 2005/06 - 2010/11.

* = the lower age limit of HSfE prevalence estimates was 16 and the lower age limit of eligible emergency admissions was 17.

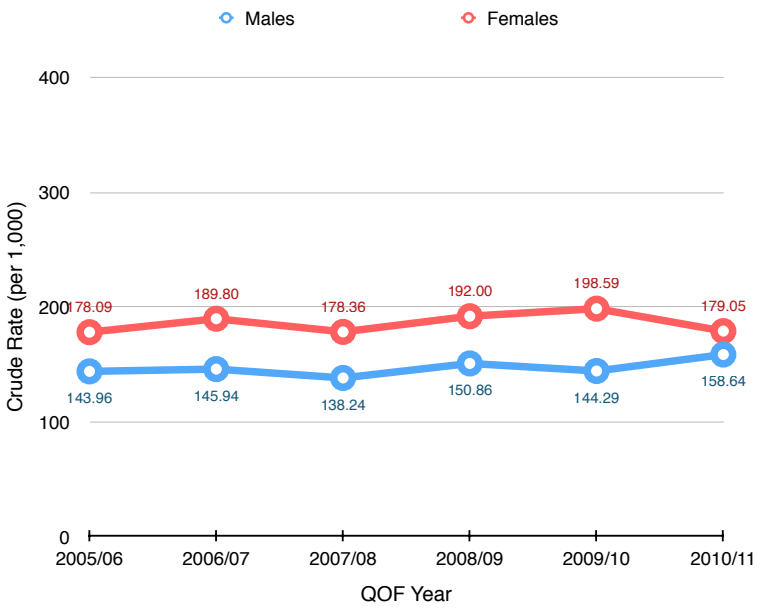


Figure 15. Crude emergency admission rates by gender, QOF 2005/06 - 2010/11.

Quoted numbers indicate crude admission rate (per 1,000) for each gender during the given QOF year.

QOF Year	Mean	Median	IQR (p25– p75)	Total Practices	Total Outliers
2005/06	102.19	94.22	62.55 (66.00–128.54)	8,237	268
2006/07	104.65	94.23	60.50 (67.48–127.98)	8,186	302
2007/08	102.69	93.20	58.33 (67.72–126.05)	8,091	309
2008/09	100.27	91.27	54.68 (68.03–122.71)	7,664	248
2009/10	103.17	93.52	54.17 (71.01–125.19)	7,931	243
2010/11	103.20	93.19	52.89 (71.27–124.16)	7,834	262

Table 20. Characteristics of distribution of standardised emergency admission ratios (SEARs) for English general practices, QOF 2005/06 - 2010/11.

IQR = interquartile range; p25 = 25th centile; p75 = 75th centile. Low outliers were defined as observations where the SEAR was less than p25 – (1.5 × IQR); high outliers were defined as observations where the SEAR was less than p75 + (1.5 × IQR).

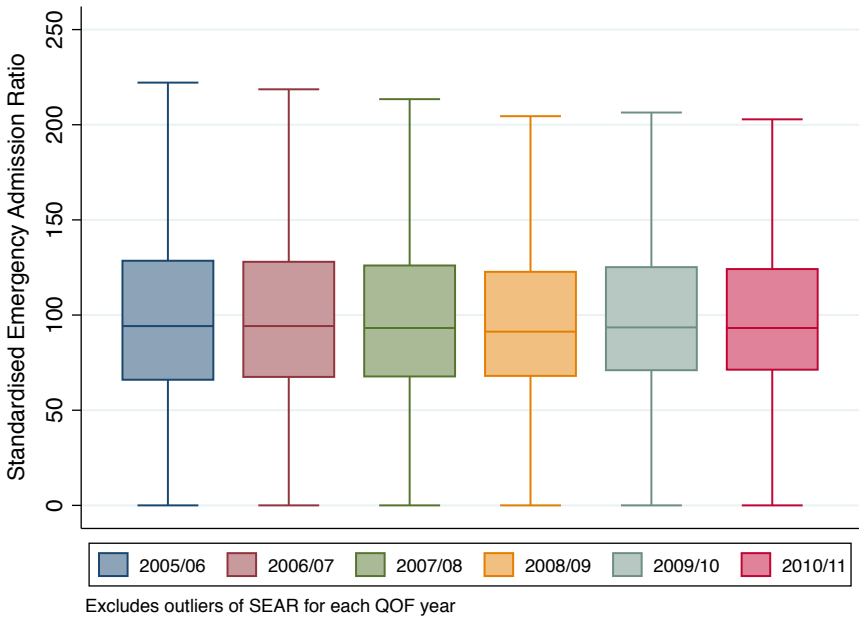


Figure 16. Box plots of standardised emergency admission ratios (SEARs) for English general practices, QOF 2005/06 - 2010/11.

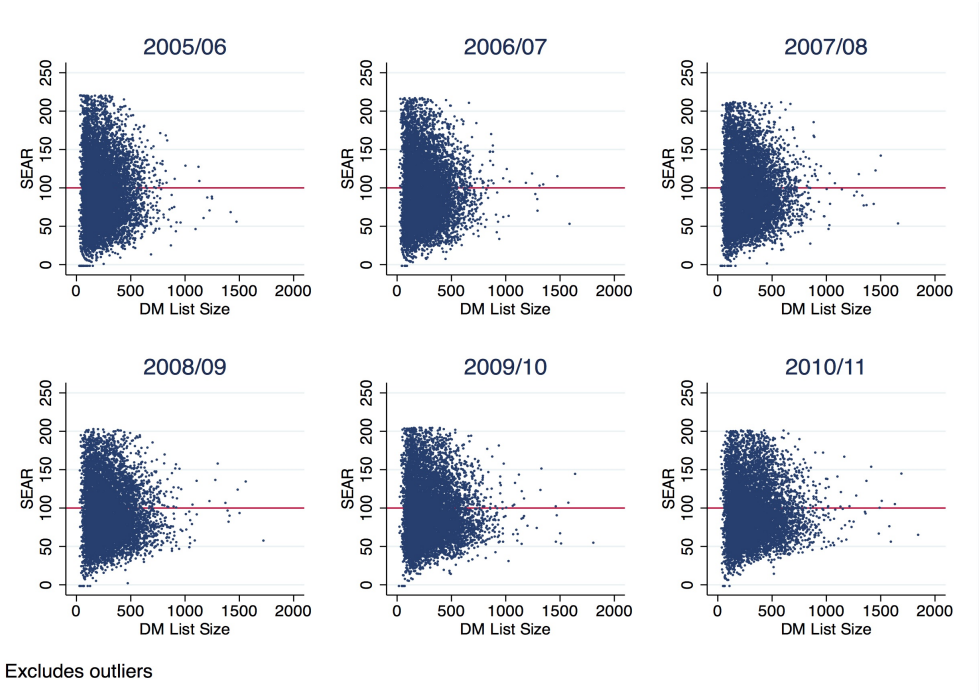


Figure 17. Scatter plot of practice SEARs versus practice diabetes register size for English practices, QOF 2005/06 - 2010/11.

Blue markers denote individual practices; red line denotes a SEAR of 100

IRRs resulting from univariate regression for all candidate predictors are shown in Table 21, Table 22 and Table 23. All candidate predictors, bar proportions of practice registered population in age-bands and practice performance in the cardiovascular QOF indicator group, showed significant associations with SEAR across all QOF years in univariate analysis.

Practices with a higher proportion of males and non-white patients generally experienced higher admission rates in univariate analyses; larger practice list sizes, higher practice diabetes prevalences, practices located in more affluent areas and practices located in urban areas generally experienced lower admission rates in univariate analyses (Table 21).

With regards to practice QOF performance, the most consistent associations with a decreased admission rate in univariate analyses were with underlying achievement for the process group of diabetes QOF indicators, the intermediate and moderate glycaemic control groups of diabetes QOF indicators and patient access indicators (Table 22). Practices in the highest fifth of exception rates for the majority of QOF indicator groups experienced higher admission rates in univariate analyses (Table 23).

		2005/06		2006/07		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
Age (years)	0 - 4	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	5 - 14	1.039	**< 0.001**	1.013	0.129	1.010	0.251	1.007	0.991	0.985	**0.044**	0.958	**< 0.001**
	15 - 44	1.023	**< 0.001**	1.006	0.337	1.009	0.146	1.007	0.996	0.994	0.234	0.975	**< 0.001**
	45 - 64	1.004	0.469	0.988	**0.030**	0.995	0.353	0.994	0.984	0.986	**0.004**	0.972	**< 0.001**
	65 - 74	1.029	**< 0.001**	1.016	**0.021**	0.998	0.758	0.996	0.983	0.975	**< 0.001**	0.954	**< 0.001**
	≥ 75	1.011	0.084	0.991	0.155	1.001	0.898	0.996	0.985	0.987	**0.026**	0.965	**< 0.001**
Proportion male		1.014	**< 0.001**	1.023	**< 0.001**	1.023	**< 0.001**	1.024	**< 0.001**	1.022	**< 0.001**	1.022	**< 0.001**
Ethnicity	White	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	Non-White	1.001	0.078	1.002	**< 0.001**	1.001	**< 0.001**	1.002	**< 0.001**	1.001	**< 0.001**	1.002	**< 0.001**
	Unknown	0.998	**< 0.001**	0.997	**< 0.001**	0.999	0.165	1.031	**< 0.001**	0.998	**< 0.001**	1.000	0.751
List Size	< 4,000	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	4,000 – 7,999	0.962	**0.003**	0.951	**< 0.001**	0.956	**< 0.001**	0.954	**< 0.001**	0.954	**< 0.001**	0.963	**0.001**
	≥ 8,000	0.917	**< 0.001**	0.889	**< 0.001**	0.913	**< 0.001**	0.917	**< 0.001**	0.917	**< 0.001**	0.930	**< 0.001**
GP FTEs per 1,000 patients		0.929	**< 0.001**	0.906	**< 0.001**	0.935	**< 0.001**	0.927	**< 0.001**	0.940	**0.001**	0.935	**< 0.001**
Diabetes Prevalence		0.983	**0.001**	0.964	**< 0.001**	0.983	**< 0.001**	0.993	**< 0.001**	0.979	**< 0.001**	0.981	**< 0.001**
IMD Tenth (1 = Most Deprived)	1	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	2	0.824	**< 0.001**	0.820	**< 0.001**	0.842	**< 0.001**	0.841	**< 0.001**	0.856	**< 0.001**	0.893	**< 0.001**
	3	0.790	**< 0.001**	0.810	**< 0.001**	0.812	**< 0.001**	0.825	**< 0.001**	0.828	**< 0.001**	0.842	**< 0.001**
	4	0.727	**< 0.001**	0.737	**< 0.001**	0.769	**< 0.001**	0.775	**< 0.001**	0.774	**< 0.001**	0.804	**< 0.001**
	5	0.714	**< 0.001**	0.699	**< 0.001**	0.746	**< 0.001**	0.737	**< 0.001**	0.745	**< 0.001**	0.762	**< 0.001**
	6	0.700	**< 0.001**	0.698	**< 0.001**	0.705	**< 0.001**	0.729	**< 0.001**	0.729	**< 0.001**	0.729	**< 0.001**
	7	0.687	**< 0.001**	0.677	**< 0.001**	0.693	**< 0.001**	0.705	**< 0.001**	0.710	**< 0.001**	0.732	**< 0.001**
	8	0.661	**< 0.001**	0.659	**< 0.001**	0.687	**< 0.001**	0.690	**< 0.001**	0.687	**< 0.001**	0.696	**< 0.001**
	9	0.644	**< 0.001**	0.636	**< 0.001**	0.668	**< 0.001**	0.692	**< 0.001**	0.697	**< 0.001**	0.683	**< 0.001**
	10	0.655	**< 0.001**	0.627	**< 0.001**	0.646	**< 0.001**	0.663	**< 0.001**	0.694	**< 0.001**	0.678	**< 0.001**
Area Classification	Rural	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	Urban	0.817	**< 0.001**	0.810	**< 0.001**	0.780	**< 0.001**	0.787	**< 0.001**	0.776	**< 0.001**	0.780	**< 0.001**

Table 21. Results of univariate negative binomial regression for variables describing practice characteristics, QOF 2005/06 - 2010/11.

IRR = Incidence rate ratio; GP = General practitioner; FTE = Full-time equivalent; IMD = Index of Multiple Deprivation.

Regression coefficients converted to IRRs; practice population age structure and ethnicity described as the proportion of the registered population falling within a given category; IRRs for practice population age-bands, proportion male, ethnicities and diabetes prevalence denote the magnitude of estimated effect of a 1% increase.

		2005/06		2006/07		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
Process UA Fifth	**1**	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	2	0.949	**0.001**	0.911	**< 0.001**	0.936	**< 0.001**	0.940	**< 0.001**	0.908	**< 0.001**	0.936	**< 0.001**
	3	0.945	**0.001**	0.903	**< 0.001**	0.926	**< 0.001**	0.912	**< 0.001**	0.908	**< 0.001**	0.921	**< 0.001**
	4	0.930	**< 0.001**	0.907	**< 0.001**	0.898	**< 0.001**	0.907	**< 0.001**	0.888	**< 0.001**	0.936	**< 0.001**
	5	0.947	**0.001**	0.927	**< 0.001**	0.926	**< 0.001**	0.902	**< 0.001**	0.911	**< 0.001**	0.926	**< 0.001**
CVS UA Fifth	**1**	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	2	0.987	0.435	0.971	0.073	0.968	**0.041**	0.987	0.410	0.997	0.841	0.993	0.643
	3	0.994	0.715	0.987	0.429	1.000	0.990	1.012	0.426	0.989	0.445	0.987	0.375
	4	0.994	0.727	0.996	0.784	0.990	0.541	0.998	0.891	0.994	0.690	1.006	0.694
	5	1.001	0.951	0.998	0.902	0.991	0.591	1.020	0.193	1.034	**0.023**	1.019	0.198
Strict Glycaemic Control UA Fifth	**1**	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	2	0.971	**0.071**	0.955	**0.005**	1.005	0.768	0.980	0.195	0.933	**< 0.001**	0.947	**< 0.001**
	3	0.966	**0.036**	0.968	**0.048**	0.989	0.475	0.944	**< 0.001**	0.923	**< 0.001**	0.942	**< 0.001**
	4	0.975	0.118	0.996	0.787	0.991	0.581	0.953	**0.002**	0.952	**0.001**	0.973	0.058
	5	0.975	0.119	0.988	0.472	1.037	**0.023**	0.969	**0.042**	1.010	0.501	1.019	0.190
Intermediate Glycaemic Control UA Fifth	**1**									*Reference*		*Reference*	
	2									0.924	**< 0.001**	0.915	**< 0.001**
	3	N/A		N/A		N/A		N/A		0.892	**< 0.001**	0.919	**< 0.001**
	4									0.899	**< 0.001**	0.893	**< 0.001**
	5									0.925	**< 0.001**	0.939	**< 0.001**
Moderate Glycaemic Control UA Fifth	**1**	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	2	0.970	0.059	0.959	**0.011**	0.950	**0.001**	0.960	**0.008**	0.940	**< 0.001**	0.909	**< 0.001**
	3	0.962	**0.017**	0.888	**< 0.001**	0.922	**< 0.001**	0.913	**< 0.001**	0.887	**< 0.001**	0.888	**< 0.001**
	4	0.903	**< 0.001**	0.911	**< 0.001**	0.894	**< 0.001**	0.902	**< 0.001**	0.897	**< 0.001**	0.894	**< 0.001**
	5	0.905	**< 0.001**	0.906	**< 0.001**	0.924	**< 0.001**	0.879	**< 0.001**	0.881	**< 0.001**	0.911	**< 0.001**
PE07 UA Fifth	**1**							*Reference*		*Reference*		*Reference*	
	2							0.955	**0.002**	0.934	**< 0.001**	0.948	**< 0.001**
	3	N/A		N/A		N/A		0.911	**< 0.001**	0.915	**< 0.001**	0.934	**< 0.001**
	4							0.881	**< 0.001**	0.897	**< 0.001**	0.893	**< 0.001**
	5							0.877	**< 0.001**	0.875	**< 0.001**	0.856	**< 0.001**
PE08 UA Fifth	**1**							*Reference*		*Reference*		*Reference*	
	2							0.946	**< 0.001**	1.002	0.893	0.986	0.329
	3	N/A		N/A		N/A		0.924	**< 0.001**	0.973	0.054	0.962	**0.007**
	4							0.886	**< 0.001**	0.925	**< 0.001**	0.930	**< 0.001**
	5							0.872	**< 0.001**	0.920	**< 0.001**	0.888	**< 0.001**

Table 22. Results of univariate negative binomial regression for variables describing underlying QOF performance, QOF 2005/06 - 2010/11.

CVS = cardiovascular system (includes targets pertaining to blood pressure and total cholesterol); UA = underlying achievement.

Regression coefficients converted to IRRs; practices assigned to fifth of underlying achievement (UA) for each indicator / indicator group; the lowest fifth (1) denotes those practices with the worst performances in that indicator / indicator group; N/A denotes that the indicator / indicator group was not present for that QOF year.

		2005/06		2006/07		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
Process ER Fifth	**1**	N/A		N/A		*Reference*		*Reference*		*Reference*		*Reference*	
	2					0.990	0.506	0.996	0.807	1.003	0.861	1.012	0.411
	3					0.994	0.680	1.037	**0.019**	1.026	0.081	1.036	**0.016**
	4					1.044	**0.006**	1.055	**< 0.001**	1.047	**0.002**	1.049	**0.001**
	5					1.110	**< 0.001**	1.116	**< 0.001**	1.129	**< 0.001**	1.127	**< 0.001**
CVS ER Fifth	**1**	N/A		N/A		*Reference*		*Reference*		*Reference*		*Reference*	
	2					0.961	**0.013**	0.994	0.701	0.977	0.112	0.999	0.936
	3					0.964	**0.021**	0.987	0.381	1.001	0.935	0.997	0.842
	4					0.968	**0.039**	0.984	0.293	0.985	0.292	1.021	0.149
	5					1.022	0.165	1.036	**0.024**	1.055	**< 0.001**	1.074	**< 0.001**
Strict Glycaemic Control ER Fifth	**1**	N/A		N/A		*Reference*		*Reference*		*Reference*		*Reference*	
	2					0.992	0.622	1.017	0.271	1.008	0.596	1.029	0.052
	3					1.007	0.644	1.034	**0.027**	1.020	0.177	1.052	**< 0.001**
	4					1.042	**0.009**	1.054	**0.001**	1.062	**< 0.001**	1.063	**< 0.001**
	5					1.089	**< 0.001**	1.122	**< 0.001**	1.122	**< 0.001**	1.142	**< 0.001**
Intermediate Glycaemic Control ER Fifth	**1**	N/A		N/A		N/A		N/A		*Reference*		*Reference*	
	2									1.020	0.172	1.025	0.091
	3									1.030	**0.041**	1.052	**0.001**
	4									1.067	**< 0.001**	1.057	**< 0.001**
	5									1.142	**< 0.001**	1.167	**< 0.001**
Moderate Glycaemic Control ER Fifth	**1**	N/A		N/A		*Reference*		*Reference*		*Reference*		*Reference*	
	2					0.974	0.090	1.003	0.844	0.994	0.683	1.031	**0.035**
	3					0.976	0.127	1.009	0.550	1.033	**0.026**	1.055	**< 0.001**
	4					1.008	0.634	1.043	**0.005**	1.059	**< 0.001**	1.071	**< 0.001**
	5					1.100	**< 0.001**	1.126	**< 0.001**	1.148	**< 0.001**	1.166	**< 0.001**

Table 23. Results of univariate negative binomial regression for variables describing QOF exception rates, QOF 2005/06 - 2010/11.

CVS = cardiovascular system (includes targets pertaining to blood pressure and total cholesterol); ER = exception rate.

Regression coefficients converted to IRRs; practices assigned to fifth of exception rate (ER) for each indicator / indicator group; the lowest fifth (1) denotes those practices with the least exception reports in that indicator / indicator group; N/A denotes that the indicator / indicator group was not present for that QOF year.

Multiple variable models, adjusted for practice list size category, GP FTEs per 1,000 patients, practice diabetes prevalence, tenth of IMD rank and rural/urban area classification, that were separately constructed for the underlying achievement or exception rate for each indicator or indicator group for each QOF year, demonstrated some attenuation of the estimated effects from the univariate models for the majority of performance and exception measures. Results for the multiple variable models are shown in Tables 24 – 35.

The most consistent association of performance with emergency admission rates were observed for the process group of indicators, where the best performing practices experienced emergency admission rates 2.8% – 7.5% lower than the worst performing practices (Table 24), and for indicators PE07 (Table 34) and PE08 (Table 35), where the best performing practices were subject to admission rates 5.5% – 9.7% lower and 6.3% – 10.3% lower respectively.

Exception reporting for a number of indicator groups were consistently associated with an increase in emergency admissions across observed QOF years. Practices with the highest levels of exception reporting for the process group of indicators (Table 25), strict glycaemic control indicators (Table 29), intermediate glycaemic control indicators (Table 31) and moderate glycaemic control indicators (Table 33) experienced emergency admission rates that were higher by 5.7% – 7.8%, 5.5% – 7.9%, 6.6% – 9.3% and 5.4 – 8.7% respectively in comparison to those practices with the lowest levels of exception reporting.

Of particular interest, there appeared to be no association between achievement in the cardiovascular indicator group and emergency admission rates (Table 26); exception reporting for this indicator group generally showed no association with emergency admission rates, with the exception of QOF year 2010/11, where practices with the highest levels of exception reporting experienced emergency admission rates 5.6% higher than those with the lowest levels of exception reporting (Table 27).

Of the variables describing practice characteristics, the most consistent associations with emergency admission rates across all models were observed for practice LSOA deprivation, where those located in the most affluent areas experienced emergency admission rates 26.3% – 38.3% lower than those in the most deprived areas, and practice location, where practices in urban areas were subject to emergency admission rates 7.9% – 12.0% lower than those located in rural areas.

		2005/06		2006/07		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
Age (years)	0 - 4	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	5 - 14	1.015	0.139	1.010	0.368	1.012	0.249	1.017	0.125	1.002	0.828	0.986	0.158
	15 - 44	1.006	0.473	0.997	0.742	1.006	0.409	1.010	0.162	1.002	0.727	0.990	0.177
	45 - 64	1.000	0.953	0.994	0.390	1.004	0.608	1.003	0.641	0.997	0.651	0.989	0.103
	65 - 74	1.016	0.144	1.019	0.136	1.007	0.518	1.011	0.258	0.996	0.673	0.982	0.080
	≥ 75	0.991	0.391	0.985	0.143	0.993	0.526	0.996	0.682	0.991	0.339	0.977	**0.015**
Sex	% Male	1.003	0.496	1.009	0.045	1.005	0.432	1.003	0.632	1.006	0.187	1.004	0.470
Ethnicity	White	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	Non-White	0.997	**0.006**	0.999	0.360	0.997	0.060	0.998	0.081	0.996	**0.001**	0.997	**0.010**
	Unknown	0.999	0.418	0.998	0.276	0.999	0.715	0.996	0.109	0.998	0.264	0.999	0.607
List Size	< 4,000	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	4,000 – 7,999	0.991	0.517	0.990	0.477	0.983	0.280	0.972	0.077	0.984	0.265	0.985	0.369
	≥ 8,000	0.966	0.056	0.955	**0.018**	0.959	**0.046**	0.952	**0.010**	0.959	**0.017**	0.968	0.092
GP FTEs per 1,000 patients		0.958	0.084	0.945	0.055	0.981	0.524	0.972	0.433	1.002	0.957	0.988	0.760
Diabetes Prevalence		0.957	**0.001**	0.917	**< 0.001**	0.960	**0.003**	0.974	**0.036**	0.976	**0.013**	0.971	**0.015**
IMD Tenth (1 = Most Deprived)	1	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	2	0.832	**< 0.001**	0.834	**< 0.001**	0.850	**< 0.001**	0.860	**< 0.001**	0.864	**< 0.001**	0.887	**< 0.001**
	3	0.797	**< 0.001**	0.817	**< 0.001**	0.819	**< 0.001**	0.844	**< 0.001**	0.835	**< 0.001**	0.850	**< 0.001**
	4	0.743	**< 0.001**	0.757	**< 0.001**	0.781	**< 0.001**	0.809	**< 0.001**	0.800	**< 0.001**	0.821	**< 0.001**
	5	0.732	**< 0.001**	0.720	**< 0.001**	0.764	**< 0.001**	0.778	**< 0.001**	0.778	**< 0.001**	0.791	**< 0.001**
	6	0.717	**< 0.001**	0.714	**< 0.001**	0.726	**< 0.001**	0.772	**< 0.001**	0.767	**< 0.001**	0.762	**< 0.001**
	7	0.700	**< 0.001**	0.691	**< 0.001**	0.723	**< 0.001**	0.759	**< 0.001**	0.756	**< 0.001**	0.773	**< 0.001**
	8	0.679	**< 0.001**	0.673	**< 0.001**	0.707	**< 0.001**	0.739	**< 0.001**	0.734	**< 0.001**	0.731	**< 0.001**
	9	0.656	**< 0.001**	0.641	**< 0.001**	0.692	**< 0.001**	0.741	**< 0.001**	0.744	**< 0.001**	0.719	**< 0.001**
	10	0.660	**< 0.001**	0.618	**< 0.001**	0.657	**< 0.001**	0.704	**< 0.001**	0.729	**< 0.001**	0.704	**< 0.001**
Area Classification	Rural	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	Urban	0.920	**0.004**	0.914	**0.005**	0.881	**< 0.001**	0.896	**< 0.001**	0.889	**< 0.001**	0.914	**0.001**
Process UA Fifth	1	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	2	0.976	0.217	0.938	**< 0.001**	0.965	**0.020**	0.966	**0.022**	0.939	**< 0.001**	0.964	**0.009**
	3	0.991	0.661	0.956	**0.017**	0.978	0.209	0.952	**0.010**	0.956	**0.007**	0.968	**0.040**
	4	0.983	0.436	0.947	**0.010**	0.952	**0.002**	0.941	**0.002**	0.929	**< 0.001**	0.966	**0.043**
	5	0.980	0.361	0.950	**0.009**	0.959	**0.039**	0.925	**< 0.001**	0.932	**< 0.001**	0.953	**0.010**

Table 24. Results of multi-variable negative binomial regression for underlying achievement of QOF process indicator group, QOF 2005/06 - 2010/11.

IRR = Incidence rate ratio; GP = General practitioner; FTE = Full-time equivalent; IMD = Index of Multiple Deprivation; UA = underlying achievement.

Regression coefficients converted to IRRs; practice population age structure and ethnicity described as the proportion of the registered population falling within a given category; IRRs for practice population age-bands, proportion male, ethnicities and diabetes prevalence denote the magnitude of estimated effect of a 1% increase.

		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p
Age (years)	0 - 4	*Reference*		*Reference*		*Reference*		*Reference*	
	5 - 14	1.013	0.236	1.018	0.106	1.005	0.645	0.988	0.247
	15 - 44	1.006	0.393	1.011	0.144	1.004	0.538	0.993	0.304
	45 - 64	1.004	0.586	1.004	0.600	0.999	0.861	0.991	0.187
	65 - 74	1.009	0.434	1.013	0.198	0.998	0.853	0.985	0.133
	≥ 75	0.993	0.533	0.996	0.719	0.992	0.434	0.979	**0.024**
Sex	% Male	1.005	0.382	1.003	0.579	1.007	0.178	1.004	0.475
Ethnicity	White	*Reference*		*Reference*		*Reference*		*Reference*	
	Non-White	0.997	0.069	0.998	0.118	0.997	**0.002**	0.997	**0.017**
	Unknown	0.999	0.714	0.996	0.108	0.998	0.283	0.999	0.654
List Size	< 4,000	*Reference*		*Reference*		*Reference*		*Reference*	
	4,000 – 7,999	0.983	0.285	0.975	0.102	0.984	0.257	0.985	0.355
	≥ 8,000	0.958	**0.036**	0.953	**0.011**	0.955	**0.007**	0.964	0.051
GP FTEs per 1,000 patients		0.978	0.473	0.967	0.369	0.996	0.907	0.983	0.645
Diabetes Prevalence		0.962	**0.006**	0.976	0.054	0.978	**0.021**	0.973	**0.023**
IMD Tenth (1 = Most Deprived)	1	*Reference*		*Reference*		*Reference*		*Reference*	
	2	0.851	**< 0.001**	0.861	**< 0.001**	0.864	**< 0.001**	0.891	**< 0.001**
	3	0.819	**< 0.001**	0.847	**< 0.001**	0.839	**< 0.001**	0.853	**< 0.001**
	4	0.781	**< 0.001**	0.811	**< 0.001**	0.802	**< 0.001**	0.825	**< 0.001**
	5	0.765	**< 0.001**	0.780	**< 0.001**	0.780	**< 0.001**	0.793	**< 0.001**
	6	0.726	**< 0.001**	0.772	**< 0.001**	0.767	**< 0.001**	0.764	**< 0.001**
	7	0.723	**< 0.001**	0.760	**< 0.001**	0.757	**< 0.001**	0.775	**< 0.001**
	8	0.708	**< 0.001**	0.739	**< 0.001**	0.735	**< 0.001**	0.734	**< 0.001**
	9	0.693	**< 0.001**	0.743	**< 0.001**	0.746	**< 0.001**	0.722	**< 0.001**
	10	0.656	**< 0.001**	0.703	**< 0.001**	0.727	**< 0.001**	0.706	**< 0.001**
Area Classification	Rural	*Reference*		*Reference*		*Reference*		*Reference*	
	Urban	0.882	**< 0.001**	0.896	**< 0.001**	0.888	**< 0.001**	0.913	**0.001**
Process ER Fifth	1	*Reference*		*Reference*		*Reference*		*Reference*	
	2	0.997	0.837	0.994	0.650	1.007	0.651	1.015	0.371
	3	1.000	0.996	1.034	0.066	1.015	0.334	1.031	0.059
	4	1.025	0.227	1.052	**0.006**	1.030	0.081	1.047	**0.010**
	5	1.057	**0.010**	1.067	**0.001**	1.078	**< 0.001**	1.076	**< 0.001**

Table 25. Results of multi-variable negative binomial regression for exception rates for QOF process indicator group, QOF 2007/08 - 2010/11.

IRR = Incidence rate ratio; GP = General practitioner; FTE = Full-time equivalent; IMD = Index of Multiple Deprivation; ER = exception rate.

Regression coefficients converted to IRRs; practice population age structure and ethnicity described as the proportion of the registered population falling within a given category; IRRs for practice population age-bands, proportion male, ethnicities and diabetes prevalence denote the magnitude of estimated effect of a 1% increase.

		2005/06		2006/07		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
Age (years)	0 - 4	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	5 - 14	1.016	0.132	1.009	0.405	1.012	0.267	1.016	0.138	1.003	0.809	0.986	0.162
	15 - 44	1.006	0.460	0.997	0.690	1.005	0.438	1.010	0.191	1.003	0.715	0.991	0.182
	45 - 64	1.000	0.968	0.993	0.350	1.003	0.663	1.003	0.717	0.997	0.653	0.989	0.104
	65 - 74	1.016	0.141	1.019	0.150	1.007	0.549	1.010	0.288	0.995	0.659	0.982	0.076
	≥ 75	0.991	0.407	0.984	0.143	0.993	0.523	0.996	0.678	0.991	0.374	0.977	**0.016**
Sex	% Male	1.003	0.458	1.010	**0.033**	1.005	0.396	1.003	0.571	1.007	0.154	1.004	0.463
Ethnicity	White	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	Non-White	0.997	**0.007**	0.999	0.391	0.997	0.060	0.998	0.091	0.996	**0.001**	0.997	**0.013**
	Unknown	0.999	0.418	0.998	0.277	0.999	0.712	0.996	0.113	0.998	0.281	0.999	0.635
List Size	< 4,000	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	4,000 – 7,999	0.990	0.486	0.989	0.441	0.983	0.279	0.975	0.111	0.985	0.310	0.987	0.437
	≥ 8,000	0.965	**0.045**	0.953	**0.013**	0.960	**0.048**	0.957	**0.023**	0.961	**0.021**	0.970	0.111
GP FTEs per 1,000 patients		0.956	0.069	0.942	**0.042**	0.978	0.466	0.968	0.380	0.998	0.951	0.985	0.694
Diabetes Prevalence		0.957	**0.001**	0.917	**< 0.001**	0.960	**0.003**	0.974	**0.035**	0.976	**0.013**	0.971	**0.014**
IMD Tenth (1 = Most Deprived)	1	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	2	0.833	**< 0.001**	0.834	**< 0.001**	0.850	**< 0.001**	0.860	**< 0.001**	0.864	**< 0.001**	0.888	**< 0.001**
	3	0.797	**< 0.001**	0.818	**< 0.001**	0.819	**< 0.001**	0.845	**< 0.001**	0.837	**< 0.001**	0.852	**< 0.001**
	4	0.743	**< 0.001**	0.757	**< 0.001**	0.780	**< 0.001**	0.809	**< 0.001**	0.801	**< 0.001**	0.822	**< 0.001**
	5	0.731	**< 0.001**	0.719	**< 0.001**	0.763	**< 0.001**	0.778	**< 0.001**	0.778	**< 0.001**	0.791	**< 0.001**
	6	0.717	**< 0.001**	0.713	**< 0.001**	0.724	**< 0.001**	0.768	**< 0.001**	0.765	**< 0.001**	0.761	**< 0.001**
	7	0.699	**< 0.001**	0.689	**< 0.001**	0.721	**< 0.001**	0.757	**< 0.001**	0.755	**< 0.001**	0.772	**< 0.001**
	8	0.679	**< 0.001**	0.672	**< 0.001**	0.706	**< 0.001**	0.736	**< 0.001**	0.732	**< 0.001**	0.731	**< 0.001**
	9	0.656	**< 0.001**	0.640	**< 0.001**	0.690	**< 0.001**	0.740	**< 0.001**	0.744	**< 0.001**	0.719	**< 0.001**
	10	0.659	**< 0.001**	0.617	**< 0.001**	0.655	**< 0.001**	0.702	**< 0.001**	0.728	**< 0.001**	0.703	**< 0.001**
Area Classification	Rural	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	Urban	0.919	**0.004**	0.913	**0.004**	0.881	**< 0.001**	0.895	**< 0.001**	0.886	**< 0.001**	0.913	**0.001**
CVS UA Fifth	1	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	2	1.003	0.873	0.986	0.451	0.984	0.339	0.991	0.515	1.005	0.716	1.003	0.824
	3	1.017	0.401	0.993	0.693	0.997	0.866	1.008	0.632	0.993	0.643	0.993	0.614
	4	1.004	0.820	0.995	0.781	0.989	0.528	0.992	0.634	0.996	0.823	1.004	0.815
	5	1.008	0.727	0.986	0.515	0.989	0.605	1.002	0.906	1.017	0.396	1.009	0.651

Table 26. Results of multi-variable negative binomial regression for underlying achievement of QOF cardiovascular indicator group, QOF 2005/06 - 2010/11.

IRR = Incidence rate ratio; GP = General practitioner; FTE = Full-time equivalent; IMD = Index of Multiple Deprivation; CVS = cardiovascular system (includes targets pertaining to blood pressure and total cholesterol); UA = underlying achievement.

Regression coefficients converted to IRRs; practice population age structure and ethnicity described as the proportion of the registered population falling within a given category; IRRs for practice population age-bands, proportion male, ethnicities and diabetes prevalence denote the magnitude of estimated effect of a 1% increase.

		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p
Age (years)	0 - 4	*Reference*		*Reference*		*Reference*		*Reference*	
	5 - 14	1.011	0.299	1.017	0.130	1.004	0.720	0.987	0.217
	15 - 44	1.005	0.488	1.010	0.178	1.004	0.621	0.992	0.253
	45 - 64	1.003	0.711	1.003	0.697	0.998	0.756	0.990	0.152
	65 - 74	1.006	0.581	1.011	0.259	0.997	0.745	0.984	0.106
	≥ 75	0.993	0.498	0.995	0.668	0.992	0.399	0.978	**0.019**
Sex	% Male	1.005	0.389	1.003	0.575	1.007	0.188	1.004	0.462
Ethnicity	White	*Reference*		*Reference*		*Reference*		*Reference*	
	Non-White	0.997	0.056	0.998	0.093	0.996	**0.002**	0.997	**0.013**
	Unknown	0.999	0.722	0.996	0.112	0.998	0.277	0.999	0.621
List Size	< 4,000	*Reference*		*Reference*		*Reference*		*Reference*	
	4,000 – 7,999	0.985	0.349	0.975	0.105	0.985	0.295	0.985	0.329
	≥ 8,000	0.963	0.068	0.956	**0.018**	0.958	**0.012**	0.965	**0.050**
GP FTEs per 1,000 patients		0.978	0.472	0.967	0.369	0.996	0.907	0.982	0.628
Diabetes Prevalence		0.961	**0.004**	0.975	**0.045**	0.977	**0.018**	0.974	**0.024**
IMD Tenth (1 = Most Deprived)	1	*Reference*		*Reference*		*Reference*		*Reference*	
	2	0.850	**< 0.001**	0.860	**< 0.001**	0.863	**< 0.001**	0.890	**< 0.001**
	3	0.818	**< 0.001**	0.845	**< 0.001**	0.837	**< 0.001**	0.852	**< 0.001**
	4	0.779	**< 0.001**	0.809	**< 0.001**	0.799	**< 0.001**	0.823	**< 0.001**
	5	0.762	**< 0.001**	0.778	**< 0.001**	0.778	**< 0.001**	0.792	**< 0.001**
	6	0.724	**< 0.001**	0.770	**< 0.001**	0.764	**< 0.001**	0.763	**< 0.001**
	7	0.721	**< 0.001**	0.757	**< 0.001**	0.755	**< 0.001**	0.773	**< 0.001**
	8	0.706	**< 0.001**	0.736	**< 0.001**	0.731	**< 0.001**	0.732	**< 0.001**
	9	0.691	**< 0.001**	0.740	**< 0.001**	0.743	**< 0.001**	0.720	**< 0.001**
	10	0.655	**< 0.001**	0.701	**< 0.001**	0.726	**< 0.001**	0.704	**< 0.001**
Area Classification	Rural	*Reference*		*Reference*		*Reference*		*Reference*	
	Urban	0.881	**< 0.001**	0.894	**< 0.001**	0.887	**< 0.001**	0.913	**0.001**
CVS ER Fifth	1	*Reference*		*Reference*		*Reference*		*Reference*	
	2	0.969	**0.045**	1.009	0.543	0.986	0.359	1.018	0.238
	3	0.978	0.217	1.008	0.627	1.014	0.314	1.015	0.355
	4	0.968	0.079	1.003	0.861	0.989	0.532	1.040	**0.022**
	5	0.996	0.870	1.023	0.269	1.028	0.173	1.056	**0.010**

Table 27. Results of multi-variable negative binomial regression for exception reporting for QOF cardiovascular indicator group, QOF 2007/08 - 2010/11.

IRR = Incidence rate ratio; GP = General practitioner; FTE = Full-time equivalent; IMD = Index of Multiple Deprivation; CVS = cardiovascular system (includes targets pertaining to blood pressure and total cholesterol); ER = exception rate.

Regression coefficients converted to IRRs; practice population age structure and ethnicity described as the proportion of the registered population falling within a given category; IRRs for practice population age-bands, proportion male, ethnicities and diabetes prevalence denote the magnitude of estimated effect of a 1% increase.

		2005/06		2006/07		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
Age (years)	0 - 4	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	5 - 14	1.016	0.137	1.010	0.361	1.012	0.238	1.016	0.145	1.003	0.772	0.986	0.161
	15 - 44	1.006	0.465	0.997	0.701	1.005	0.460	1.010	0.192	1.003	0.677	0.990	0.163
	45 - 64	1.000	0.957	0.993	0.355	1.003	0.698	1.003	0.723	0.997	0.693	0.988	0.096
	65 - 74	1.016	0.142	1.019	0.144	1.007	0.542	1.010	0.291	0.996	0.669	0.982	0.073
	≥ 75	0.991	0.397	0.985	0.145	0.993	0.507	0.995	0.676	0.992	0.410	0.977	**0.014**
Sex	% Male	1.003	0.475	1.011	**0.023**	1.006	0.317	1.003	0.566	1.007	0.148	1.005	0.410
Ethnicity	White	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	Non-White	0.997	**0.007**	0.999	0.491	0.998	0.106	0.998	0.086	0.996	**0.002**	0.997	**0.016**
	Unknown	0.999	0.409	0.998	0.290	0.999	0.773	0.996	0.114	0.998	0.290	0.999	0.651
List Size	< 4,000	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	4,000 – 7,999	0.990	0.480	0.990	0.468	0.984	0.304	0.975	0.110	0.988	0.390	0.992	0.595
	≥ 8,000	0.964	**0.042**	0.956	**0.016**	0.963	0.062	0.958	**0.022**	0.965	**0.031**	0.976	0.176
GP FTEs per 1,000 patients		0.957	0.073	0.940	**0.037**	0.976	0.430	0.968	0.384	0.998	0.965	0.988	0.745
Diabetes Prevalence		0.958	**0.001**	0.916	**< 0.001**	0.957	**0.001**	0.974	**0.035**	0.976	**0.011**	0.969	**0.007**
IMD Tenth (1 = Most Deprived)	1	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	2	0.833	**< 0.001**	0.835	**< 0.001**	0.852	**< 0.001**	0.861	**< 0.001**	0.865	**< 0.001**	0.889	**< 0.001**
	3	0.797	**< 0.001**	0.819	**< 0.001**	0.820	**< 0.001**	0.845	**< 0.001**	0.838	**< 0.001**	0.854	**< 0.001**
	4	0.742	**< 0.001**	0.759	**< 0.001**	0.781	**< 0.001**	0.810	**< 0.001**	0.802	**< 0.001**	0.823	**< 0.001**
	5	0.731	**< 0.001**	0.720	**< 0.001**	0.763	**< 0.001**	0.778	**< 0.001**	0.779	**< 0.001**	0.790	**< 0.001**
	6	0.717	**< 0.001**	0.712	**< 0.001**	0.723	**< 0.001**	0.768	**< 0.001**	0.766	**< 0.001**	0.762	**< 0.001**
	7	0.700	**< 0.001**	0.689	**< 0.001**	0.720	**< 0.001**	0.758	**< 0.001**	0.757	**< 0.001**	0.774	**< 0.001**
	8	0.679	**< 0.001**	0.671	**< 0.001**	0.704	**< 0.001**	0.736	**< 0.001**	0.733	**< 0.001**	0.730	**< 0.001**
	9	0.656	**< 0.001**	0.640	**< 0.001**	0.689	**< 0.001**	0.740	**< 0.001**	0.744	**< 0.001**	0.718	**< 0.001**
	10	0.660	**< 0.001**	0.617	**< 0.001**	0.652	**< 0.001**	0.702	**< 0.001**	0.729	**< 0.001**	0.702	**< 0.001**
Area Classification	Rural	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	Urban	0.919	**0.003**	0.914	**0.004**	0.884	**< 0.001**	0.894	**< 0.001**	0.888	**< 0.001**	0.914	**0.001**
Strict Glycaemic Control UA Fifth	1	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	2	1.002	0.925	0.990	0.640	1.035	0.135	1.000	0.987	0.969	0.079	0.980	0.157
	3	1.002	0.929	1.015	0.546	1.029	0.271	0.976	0.218	0.958	0.053	0.980	0.186
	4	1.002	0.950	1.037	0.249	1.037	0.267	0.995	0.827	0.983	0.524	1.010	0.626
	5	0.994	0.840	1.034	0.348	1.092	**0.017**	1.000	0.995	1.015	0.666	1.034	0.248

Table 28. Results of multi-variable negative binomial regression for underlying achievement of QOF strict glycaemic control indicator group, QOF 2005/06 - 2010/11.

IRR = Incidence rate ratio; GP = General practitioner; FTE = Full-time equivalent; IMD = Index of Multiple Deprivation; UA = underlying achievement.

Regression coefficients converted to IRRs; practice population age structure and ethnicity described as the proportion of the registered population falling within a given category; IRRs for practice population age-bands, proportion male, ethnicities and diabetes prevalence denote the magnitude of estimated effect of a 1% increase.

		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p
Age (years)	0 - 4	*Reference*		*Reference*		*Reference*		*Reference*	
	5 - 14	1.011	0.275	1.017	0.115	1.004	0.711	0.987	0.202
	15 - 44	1.005	0.452	1.010	0.167	1.004	0.601	0.992	0.247
	45 - 64	1.003	0.654	1.004	0.634	0.998	0.810	0.990	0.156
	65 - 74	1.007	0.536	1.012	0.242	0.997	0.752	0.983	0.103
	≥ 75	0.993	0.515	0.996	0.699	0.992	0.413	0.978	**0.019**
Sex	% Male	1.005	0.381	1.003	0.574	1.007	0.180	1.004	0.513
Ethnicity	White	*Reference*		*Reference*		*Reference*		*Reference*	
	Non-White	0.997	0.055	0.998	0.081	0.996	**0.001**	0.997	**0.008**
	Unknown	0.999	0.715	0.996	0.111	0.998	0.272	0.999	0.640
List Size	< 4,000	*Reference*		*Reference*		*Reference*		*Reference*	
	4,000 – 7,999	0.985	0.337	0.976	0.121	0.986	0.304	0.986	0.373
	≥ 8,000	0.961	0.054	0.957	**0.019**	0.958	**0.012**	0.967	0.063
GP FTEs per 1,000 patients		0.977	0.464	0.967	0.363	0.993	0.842	0.980	0.597
Diabetes Prevalence		0.962	**0.005**	0.976	0.057	0.979	**0.025**	0.974	**0.028**
IMD Tenth (1 = Most Deprived)	1	*Reference*		*Reference*		*Reference*		*Reference*	
	2	0.849	**< 0.001**	0.860	**< 0.001**	0.862	**< 0.001**	0.890	**< 0.001**
	3	0.818	**< 0.001**	0.846	**< 0.001**	0.838	**< 0.001**	0.852	**< 0.001**
	4	0.779	**< 0.001**	0.810	**< 0.001**	0.801	**< 0.001**	0.823	**< 0.001**
	5	0.762	**< 0.001**	0.779	**< 0.001**	0.779	**< 0.001**	0.792	**< 0.001**
	6	0.725	**< 0.001**	0.772	**< 0.001**	0.764	**< 0.001**	0.763	**< 0.001**
	7	0.722	**< 0.001**	0.760	**< 0.001**	0.756	**< 0.001**	0.773	**< 0.001**
	8	0.706	**< 0.001**	0.737	**< 0.001**	0.734	**< 0.001**	0.734	**< 0.001**
	9	0.691	**< 0.001**	0.742	**< 0.001**	0.746	**< 0.001**	0.722	**< 0.001**
	10	0.655	**< 0.001**	0.702	**< 0.001**	0.728	**< 0.001**	0.706	**< 0.001**
Area Classification	Rural	*Reference*		*Reference*		*Reference*		*Reference*	
	Urban	0.880	**< 0.001**	0.895	**< 0.001**	0.886	**< 0.001**	0.912	**0.001**
Strict Glycaemic Control ER Fifth	1	*Reference*		*Reference*		*Reference*		*Reference*	
	2	0.991	0.528	1.012	0.418	0.987	0.315	1.010	0.552
	3	0.983	0.347	1.020	0.225	0.998	0.915	1.023	0.129
	4	1.001	0.955	1.023	0.171	1.024	0.185	1.024	0.202
	5	1.025	0.326	1.055	**0.012**	1.059	**0.015**	1.079	**0.002**

Table 29. Results of multi-variable negative binomial regression for exception reporting for QOF strict glycaemic control indicator group, QOF 2007/08 - 2010/11.

IRR = Incidence rate ratio; GP = General practitioner; FTE = Full-time equivalent; IMD = Index of Multiple Deprivation; ER = exception rate.

Regression coefficients converted to IRRs; practice population age structure and ethnicity described as the proportion of the registered population falling within a given category; IRRs for practice population age-bands, proportion male, ethnicities and diabetes prevalence denote the magnitude of estimated effect of a 1% increase.

		2009/10		2010/11	
		IRR	p	IRR	p
Age (years)	0 - 4	*Reference*		*Reference*	
	5 - 14	1.002	0.861	0.985	0.137
	15 - 44	1.002	0.750	0.990	0.150
	45 - 64	0.996	0.618	0.988	0.087
	65 - 74	0.995	0.635	0.981	0.061
	≥ 75	0.991	0.360	0.976	**0.012**
Sex	% Male	1.007	0.169	1.004	0.471
Ethnicity	White	*Reference*		*Reference*	
	Non-White	0.996	**0.001**	0.997	**0.010**
	Unknown	0.998	0.269	0.999	0.622
List Size	< 4,000	*Reference*		*Reference*	
	4,000 – 7,999	0.987	0.377	0.990	0.554
	≥ 8,000	0.964	**0.034**	0.974	0.161
GP FTEs per 1,000 patients		0.999	0.976	0.987	0.735
Diabetes Prevalence		0.976	**0.015**	0.972	**0.014**
IMD Tenth (1 = Most Deprived)	1	*Reference*		*Reference*	
	2	0.865	**< 0.001**	0.888	**< 0.001**
	3	0.838	**< 0.001**	0.852	**< 0.001**
	4	0.801	**< 0.001**	0.823	**< 0.001**
	5	0.779	**< 0.001**	0.790	**< 0.001**
	6	0.767	**< 0.001**	0.761	**< 0.001**
	7	0.757	**< 0.001**	0.772	**< 0.001**
	8	0.733	**< 0.001**	0.731	**< 0.001**
	9	0.744	**< 0.001**	0.719	**< 0.001**
	10	0.729	**< 0.001**	0.702	**< 0.001**
Area Classification	Rural	*Reference*		*Reference*	
	Urban	0.888	**< 0.001**	0.914	**0.001**
Intermediate Glycaemic Control UA Fifth	1	*Reference*		*Reference*	
	2	0.966	**0.027**	0.958	0.003
	3	0.955	**0.010**	0.991	0.594
	4	0.971	0.126	0.970	0.098
	5	0.992	0.720	1.014	0.538

Table 30. Results of multi-variable negative binomial regression for underlying achievement of QOF intermediate glycaemic control indicator group, QOF 2009/10 - 2010/11.

IRR = Incidence rate ratio; GP = General practitioner; FTE = Full-time equivalent; IMD = Index of Multiple Deprivation; UA = underlying achievement.

Regression coefficients converted to IRRs; practice population age structure and ethnicity described as the proportion of the registered population falling within a given category; IRRs for practice population age-bands, proportion male, ethnicities and diabetes prevalence denote the magnitude of estimated effect of a 1% increase.

		2009/10		2010/11	
		IRR	p	IRR	p
Age (years)	0 - 4	*Reference*		*Reference*	
	5 - 14	1.004	0.689	0.987	0.200
	15 - 44	1.004	0.587	0.992	0.242
	45 - 64	0.999	0.838	0.990	0.159
	65 - 74	0.997	0.778	0.984	0.109
	≥ 75	0.992	0.427	0.978	**0.019**
Sex	% Male	1.007	0.173	1.004	0.512
Ethnicity	White	*Reference*		*Reference*	
	Non-White	0.996	**0.001**	0.997	**0.009**
	Unknown	0.998	0.268	0.999	0.636
List Size	< 4,000	*Reference*		*Reference*	
	4,000 – 7,999	0.986	0.316	0.986	0.385
	≥ 8,000	0.958	**0.013**	0.966	0.062
GP FTEs per 1,000 patients		0.994	0.865	0.981	0.617
Diabetes Prevalence		0.978	**0.023**	0.974	**0.030**
IMD Tenth (1 = Most Deprived)	1	*Reference*		*Reference*	
	2	0.862	**< 0.001**	0.890	**< 0.001**
	3	0.837	**< 0.001**	0.852	**< 0.001**
	4	0.800	**< 0.001**	0.823	**< 0.001**
	5	0.779	**< 0.001**	0.794	**< 0.001**
	6	0.765	**< 0.001**	0.764	**< 0.001**
	7	0.757	**< 0.001**	0.775	**< 0.001**
	8	0.734	**< 0.001**	0.737	**< 0.001**
	9	0.745	**< 0.001**	0.724	**< 0.001**
	10	0.728	**< 0.001**	0.707	**< 0.001**
Area Classification	Rural	*Reference*		*Reference*	
	Urban	0.887	**< 0.001**	0.912	**0.001**
Intermediate Glycaemic Control ER Fifth	1	*Reference*		*Reference*	
	2	1.001	0.965	1.012	0.408
	3	1.008	0.602	1.038	**0.014**
	4	1.032	0.086	1.027	0.149
	5	1.066	**0.006**	1.093	**< 0.001**

Table 31. Results of multi-variable negative binomial regression for exception reporting for QOF intermediate glycaemic control indicator group, QOF 2009/10 - 2010/11.

IRR = Incidence rate ratio; GP = General practitioner; FTE = Full-time equivalent; IMD = Index of Multiple Deprivation; ER = exception rate.

Regression coefficients converted to IRRs; practice population age structure and ethnicity described as the proportion of the registered population falling within a given category; IRRs for practice population age-bands, proportion male, ethnicities and diabetes prevalence denote the magnitude of estimated effect of a 1% increase.

		2005/06		2006/07		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
Age (years)	0 - 4	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	5 - 14	1.016	0.133	1.009	0.435	1.011	0.299	1.016	0.146	1.002	0.858	0.985	0.153
	15 - 44	1.006	0.453	0.996	0.673	1.005	0.495	1.010	0.190	1.002	0.731	0.990	0.167
	45 - 64	1.000	0.996	0.993	0.346	1.002	0.717	1.003	0.703	0.997	0.643	0.988	0.096
	65 - 74	1.017	0.136	1.019	0.153	1.005	0.617	1.011	0.262	0.996	0.674	0.981	0.063
	≥ 75	0.991	0.417	0.984	0.142	0.993	0.501	0.995	0.672	0.991	0.361	0.977	**0.014**
Sex	% Male	1.003	0.526	1.010	**0.039**	1.005	0.382	1.003	0.621	1.007	0.186	1.004	0.450
Ethnicity	White	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	Non-White	0.997	**0.006**	0.999	0.359	0.997	0.060	0.998	0.081	0.996	**0.001**	0.997	**0.009**
	Unknown	0.999	0.394	0.998	0.266	0.999	0.722	0.996	0.108	0.998	0.261	0.999	0.620
List Size	< 4,000	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	4,000 – 7,999	0.990	0.496	0.990	0.493	0.985	0.348	0.975	0.114	0.985	0.307	0.991	0.592
	≥ 8,000	0.964	**0.041**	0.955	**0.017**	0.965	0.082	0.958	**0.025**	0.961	**0.022**	0.977	0.205
GP FTEs per 1,000 patients		0.959	0.091	0.942	**0.044**	0.977	0.452	0.971	0.427	1.000	0.992	0.986	0.713
Diabetes Prevalence		0.957	**0.001**	0.917	**< 0.001**	0.960	**0.003**	0.974	**0.036**	0.976	**0.013**	0.972	**0.017**
IMD Tenth (1 = Most Deprived)	1	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	2	0.832	**< 0.001**	0.833	**< 0.001**	0.851	**< 0.001**	0.859	**< 0.001**	0.864	**< 0.001**	0.889	**< 0.001**
	3	0.797	**< 0.001**	0.818	**< 0.001**	0.818	**< 0.001**	0.845	**< 0.001**	0.838	**< 0.001**	0.853	**< 0.001**
	4	0.742	**< 0.001**	0.759	**< 0.001**	0.780	**< 0.001**	0.809	**< 0.001**	0.800	**< 0.001**	0.822	**< 0.001**
	5	0.732	**< 0.001**	0.719	**< 0.001**	0.762	**< 0.001**	0.779	**< 0.001**	0.778	**< 0.001**	0.791	**< 0.001**
	6	0.718	**< 0.001**	0.713	**< 0.001**	0.723	**< 0.001**	0.770	**< 0.001**	0.766	**< 0.001**	0.761	**< 0.001**
	7	0.702	**< 0.001**	0.691	**< 0.001**	0.720	**< 0.001**	0.758	**< 0.001**	0.756	**< 0.001**	0.772	**< 0.001**
	8	0.680	**< 0.001**	0.673	**< 0.001**	0.705	**< 0.001**	0.738	**< 0.001**	0.734	**< 0.001**	0.731	**< 0.001**
	9	0.658	**< 0.001**	0.641	**< 0.001**	0.690	**< 0.001**	0.742	**< 0.001**	0.745	**< 0.001**	0.720	**< 0.001**
	10	0.661	**< 0.001**	0.619	**< 0.001**	0.653	**< 0.001**	0.704	**< 0.001**	0.730	**< 0.001**	0.703	**< 0.001**
Area Classification	Rural	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	Urban	0.921	**0.005**	0.913	**0.004**	0.880	**< 0.001**	0.896	**< 0.001**	0.888	**< 0.001**	0.912	**0.001**
Moderate Glycaemic Control UA Fifth	1	*Reference*		*Reference*		*Reference*		*Reference*		*Reference*		*Reference*	
	2	1.003	0.889	1.001	0.953	0.986	0.443	0.991	0.505	0.988	0.487	0.955	0.004
	3	1.006	0.794	0.949	**0.012**	0.992	0.707	0.971	0.109	0.962	**0.029**	0.970	0.107
	4	0.971	0.193	0.990	0.667	0.974	0.313	0.976	0.179	0.980	0.318	0.982	0.366
	5	0.980	0.448	0.980	0.442	1.024	0.366	0.969	0.150	0.977	0.250	1.008	0.687

Table 32. Results of multi-variable negative binomial regression for underlying achievement of QOF moderate glycaemic control indicator group, QOF 2005/06 - 2010/11.

IRR = Incidence rate ratio; GP = General practitioner; FTE = Full-time equivalent; IMD = Index of Multiple Deprivation; UA = underlying achievement.

Regression coefficients converted to IRRs; practice population age structure and ethnicity described as the proportion of the registered population falling within a given category; IRRs for practice population age-bands, proportion male, ethnicities and diabetes prevalence denote the magnitude of estimated effect of a 1% increase.

		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p
Age (years)	0 - 4	*Reference*		*Reference*		*Reference*		*Reference*	
	5 - 14	1.011	0.285	1.017	0.115	1.005	0.658	0.987	0.210
	15 - 44	1.005	0.475	1.010	0.167	1.004	0.549	0.992	0.258
	45 - 64	1.003	0.677	1.004	0.630	0.999	0.876	0.990	0.172
	65 - 74	1.007	0.543	1.012	0.223	0.998	0.833	0.984	0.119
	≥ 75	0.993	0.503	0.996	0.686	0.993	0.453	0.978	**0.021**
Sex	% Male	1.006	0.366	1.003	0.587	1.007	0.172	1.004	0.510
Ethnicity	White	*Reference*		*Reference*		*Reference*		*Reference*	
	Non-White	0.997	0.055	0.998	0.089	0.996	**0.001**	0.997	**0.011**
	Unknown	0.999	0.718	0.996	0.108	0.998	0.268	0.999	0.632
List Size	< 4,000	*Reference*		*Reference*		*Reference*		*Reference*	
	4,000 – 7,999	0.987	0.400	0.977	0.137	0.986	0.326	0.984	0.327
	≥ 8,000	0.964	0.077	0.957	**0.021**	0.958	**0.013**	0.965	**0.050**
GP FTEs per 1,000 patients		0.978	0.466	0.968	0.387	0.994	0.881	0.981	0.621
Diabetes Prevalence		0.962	**0.005**	0.976	0.052	0.978	**0.021**	0.973	**0.024**
IMD Tenth (1 = Most Deprived)	1	*Reference*		*Reference*		*Reference*		*Reference*	
	2	0.849	**< 0.001**	0.859	**< 0.001**	0.863	**< 0.001**	0.890	**< 0.001**
	3	0.818	**< 0.001**	0.846	**< 0.001**	0.838	**< 0.001**	0.852	**< 0.001**
	4	0.780	**< 0.001**	0.809	**< 0.001**	0.800	**< 0.001**	0.823	**< 0.001**
	5	0.763	**< 0.001**	0.780	**< 0.001**	0.780	**< 0.001**	0.793	**< 0.001**
	6	0.726	**< 0.001**	0.771	**< 0.001**	0.766	**< 0.001**	0.764	**< 0.001**
	7	0.722	**< 0.001**	0.760	**< 0.001**	0.757	**< 0.001**	0.774	**< 0.001**
	8	0.707	**< 0.001**	0.738	**< 0.001**	0.734	**< 0.001**	0.735	**< 0.001**
	9	0.692	**< 0.001**	0.741	**< 0.001**	0.746	**< 0.001**	0.723	**< 0.001**
	10	0.656	**< 0.001**	0.702	**< 0.001**	0.728	**< 0.001**	0.706	**< 0.001**
Area Classification	Rural	*Reference*		*Reference*		*Reference*		*Reference*	
	Urban	0.880	**< 0.001**	0.895	**< 0.001**	0.887	**< 0.001**	0.913	**0.001**
Moderate Glycaemic Control ER Fifth	1	*Reference*		*Reference*		*Reference*		*Reference*	
	2	0.971	0.080	0.997	0.829	0.989	0.412	1.023	0.116
	3	0.975	0.121	1.003	0.865	1.017	0.236	1.046	**0.002**
	4	0.975	0.222	1.016	0.332	1.027	0.169	1.043	**0.045**
	5	1.021	0.400	1.054	**0.017**	1.064	**0.004**	1.087	**< 0.001**

Table 33. Results of multi-variable negative binomial regression for exception reporting for QOF moderate glycaemic control indicator group, QOF 2007/08 - 2010/11.

IRR = Incidence rate ratio; GP = General practitioner; FTE = Full-time equivalent; IMD = Index of Multiple Deprivation; ER = exception rate.

Regression coefficients converted to IRRs; practice population age structure and ethnicity described as the proportion of the registered population falling within a given category; IRRs for practice population age-bands, proportion male, ethnicities and diabetes prevalence denote the magnitude of estimated effect of a 1% increase.

		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p
Age (years)	0 - 4	*Reference*		*Reference*		*Reference*	
	5 - 14	1.019	0.081	1.005	0.610	0.989	0.302
	15 - 44	1.011	0.127	1.004	0.532	0.993	0.319
	45 - 64	1.005	0.539	0.999	0.864	0.991	0.208
	65 - 74	1.012	0.241	0.997	0.784	0.984	0.114
	≥ 75	0.998	0.862	0.994	0.524	0.981	**0.045**
Sex	% Male	1.004	0.468	1.008	0.118	1.006	0.336
Ethnicity	White	*Reference*		*Reference*		*Reference*	
	Non-White	0.997	0.064	0.996	**0.001**	0.997	**0.007**
	Unknown	0.996	0.112	0.998	0.272	0.999	0.614
List Size	< 4,000	*Reference*		*Reference*		*Reference*	
	4,000 – 7,999	0.969	0.054	0.978	0.120	0.977	0.164
	≥ 8,000	0.950	**0.009**	0.948	**0.003**	0.952	**0.014**
GP FTEs per 1,000 patients		0.974	0.482	1.004	0.912	0.995	0.896
Diabetes Prevalence		0.973	**0.026**	0.974	**0.007**	0.969	**0.007**
IMD Tenth (1 = Most Deprived)	1	*Reference*		*Reference*		*Reference*	
	2	0.861	**< 0.001**	0.865	**< 0.001**	0.889	**< 0.001**
	3	0.845	**< 0.001**	0.838	**< 0.001**	0.854	**< 0.001**
	4	0.812	**< 0.001**	0.803	**< 0.001**	0.825	**< 0.001**
	5	0.781	**< 0.001**	0.782	**< 0.001**	0.793	**< 0.001**
	6	0.772	**< 0.001**	0.769	**< 0.001**	0.765	**< 0.001**
	7	0.761	**< 0.001**	0.757	**< 0.001**	0.776	**< 0.001**
	8	0.739	**< 0.001**	0.736	**< 0.001**	0.734	**< 0.001**
	9	0.744	**< 0.001**	0.748	**< 0.001**	0.722	**< 0.001**
	10	0.707	**< 0.001**	0.732	**< 0.001**	0.708	**< 0.001**
Area Classification	Rural	*Reference*		*Reference*		*Reference*	
	Urban	0.898	**< 0.001**	0.890	**< 0.001**	0.918	**0.001**
PE07 UA Fifth	1	*Reference*		*Reference*		*Reference*	
	2	0.981	0.244	0.958	**0.008**	0.962	0.060
	3	0.957	**0.019**	0.963	0.079	0.964	0.084
	4	0.941	**0.002**	0.946	**0.007**	0.937	**0.006**
	5	0.945	**0.008**	0.928	**0.001**	0.903	**< 0.001**

Table 34. Results of multi-variable negative binomial regression for underlying achievement of QOF indicator PE07, QOF 2008/09 - 2010/11.

IRR = Incidence rate ratio; GP = General practitioner; FTE = Full-time equivalent; IMD = Index of Multiple Deprivation; UA = underlying achievement.

Regression coefficients converted to IRRs; practice population age structure and ethnicity described as the proportion of the registered population falling within a given category; IRRs for practice population age-bands, proportion male, ethnicities and diabetes prevalence denote the magnitude of estimated effect of a 1% increase.

		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p
Age (years)	0 - 4	*Reference*		*Reference*		*Reference*	
	5 - 14	1.018	0.090	1.004	0.697	0.987	0.192
	15 - 44	1.012	0.100	1.004	0.530	0.992	0.262
	45 - 64	1.005	0.476	0.999	0.847	0.991	0.177
	65 - 74	1.012	0.211	0.997	0.756	0.983	0.093
	≥ 75	0.998	0.878	0.993	0.506	0.980	**0.028**
Sex	% Male	1.004	0.462	1.008	0.115	1.005	0.363
Ethnicity	White	*Reference*		*Reference*		*Reference*	
	Non-White	0.998	0.077	0.996	**0.001**	0.997	**0.010**
	Unknown	0.996	0.099	0.998	0.253	0.999	0.593
List Size	< 4,000	*Reference*		*Reference*		*Reference*	
	4,000 – 7,999	0.959	**0.013**	0.972	0.056	0.971	0.088
	≥ 8,000	0.932	**< 0.001**	0.938	**0.001**	0.943	**0.003**
GP FTEs per 1,000 patients		0.974	0.465	1.004	0.921	0.993	0.843
Diabetes Prevalence		0.969	**0.010**	0.973	**0.006**	0.966	**0.005**
IMD Decile (1 = Most Deprived)	1	*Reference*		*Reference*		*Reference*	
	2	0.864	**< 0.001**	0.866	**< 0.001**	0.889	**< 0.001**
	3	0.848	**< 0.001**	0.839	**< 0.001**	0.854	**< 0.001**
	4	0.813	**< 0.001**	0.803	**< 0.001**	0.825	**< 0.001**
	5	0.781	**< 0.001**	0.781	**< 0.001**	0.794	**< 0.001**
	6	0.774	**< 0.001**	0.769	**< 0.001**	0.765	**< 0.001**
	7	0.762	**< 0.001**	0.759	**< 0.001**	0.777	**< 0.001**
	8	0.742	**< 0.001**	0.738	**< 0.001**	0.735	**< 0.001**
	9	0.748	**< 0.001**	0.750	**< 0.001**	0.723	**< 0.001**
	10	0.712	**< 0.001**	0.737	**< 0.001**	0.710	**< 0.001**
Area Classification	Rural	*Reference*		*Reference*		*Reference*	
	Urban	0.901	**< 0.001**	0.891	**< 0.001**	0.919	**0.002**
PE08 UA Fifth	1	*Reference*		*Reference*		*Reference*	
	2	0.948	**0.002**	0.995	0.770	0.981	0.322
	3	0.937	**0.001**	0.971	0.112	0.954	**0.021**
	4	0.905	**< 0.001**	0.937	**0.001**	0.938	**0.005**
	5	0.897	**< 0.001**	0.937	**0.005**	0.909	**< 0.001**

Table 35. Results of multi-variable negative binomial regression for underlying achievement of QOF indicator PE08, QOF 2008/09 - 2010/11.

IRR = Incidence rate ratio; GP = General practitioner; FTE = Full-time equivalent; IMD = Index of Multiple Deprivation; UA = underlying achievement.

Regression coefficients converted to IRRs; practice population age structure and ethnicity described as the proportion of the registered population falling within a given category; IRRs for practice population age-bands, proportion male, ethnicities and diabetes prevalence denote the magnitude of estimated effect of a 1% increase.

For the model containing all predictors – that is, all variables describing practice population characteristics, practice characteristics, deprivation, rurality, fifths of underlying achievement for all selected QOF indicators and indicator groups and fifths of exception rates, where available, for all QOF indicators and indicator groups – significant associations with emergency admission rates remained for a number of predictors (Table 36).

Increasing practice diabetes prevalence was associated with decreased emergency admissions across all QOF years, with a 1% increase in prevalence conferring a relative reduction in emergency admissions between 2.8% – 8.5%.

Deprivation, as with previous models, was associated with significant changes in emergency admission rates across all QOF years, with practices in the most affluent areas experiencing emergency admission rates that were 25.2% – 38.0% lower than those located in the most deprived areas; all levels of decreasing deprivation were associated with significantly lower emergency admission rates in comparison to practices located in the most deprived areas across all QOF years. Likewise, practices located in urban areas were associated with lower emergency admission rates in comparison to those located in rural areas across all QOF years, with relative reductions in the range 7.7% – 11.2%.

Insofar as QOF performance is concerned, the most consistent associations with changes in emergency admission rates in the full model were observed for underlying achievement for the process group of indicators and indicator PE08 (ability to book an appointment more than two days in advance), with relative emergency admission rate reductions ranging between 4.7% – 9.1% and 6.0% – 8.8% respectively for the best-performing fifth of practices in comparison to the worst performing fifth.

For indicator and indicator group exception rates, relatively consistent associations with changes in emergency admission rates were observed for the process and for the intermediate cardiovascular outcome groups of indicators. In QOF years 2007/08 to 2009/10, practices in the highest fifth of exception reporting for the process group of indicators were associated with relative increases in emergency admission rates of between 8.9% – 12.7% in comparison to practices in the lowest fifth of exception reporting for the process group of indicators.

Practices that were in the highest fifth of exception reporting for the cardiovascular intermediate outcome group of indicators were associated with emergency admission rates that were 7.1% – 11.0% lower than practices with the lowest levels of exception reporting; of interest, practices in the highest fifth of performance for this indicator group tended to have elevated emergency admission rates, with a significant relative increase of 4.9% in 2008/09 and 2009/10 in comparison to the worst-performing fifth of practices.

Some other significant associations were also observed, albeit not with the degree of consistency observed for the predictors already discussed. Practices with list sizes of 8,000 or more patients were associated with relative reductions in emergency admission rates ranging between 4.1% – 6.9% for 2006/07 and 2008/09 – 2010/11 in comparison to practices with list sizes less than 4,000 patients. Sporadic associations between the proportion of practice populations recorded as non-white and reduced emergency admission rates were observed in 2005/06 and 2009/10 – 2010/11, although the clinical significance of such a finding may be marginal, as each 1% increase of the non-white population was only associated with a 0.3% – 0.4% relative decrease in emergency admission rates.

		2005/06		2006/07		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
Age (years)	0 - 4	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	5 - 14	1.017	0.131	1.014	0.186	1.013	0.211	1.022	0.037	1.007	0.489	0.990	0.354
	15 - 44	1.007	0.432	1.000	0.956	1.006	0.401	1.014	0.051	1.006	0.391	0.994	0.405
	45 - 64	1.001	0.928	0.996	0.545	1.004	0.583	1.008	0.250	1.002	0.766	0.993	0.334
	65 - 74	1.017	0.155	1.023	0.073	1.009	0.407	1.015	0.128	1.000	0.995	0.987	0.193
	≥ 75	0.992	0.473	0.987	0.191	0.993	0.520	1.001	0.917	0.996	0.675	0.982	0.051
Sex	% Male	1.002	0.630	1.009	0.054	1.006	0.371	1.004	0.485	1.007	0.145	1.005	0.342
Ethnicity	White	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Non-White	0.997	**0.011**	0.999	0.539	0.998	0.112	0.998	0.087	0.996	**0.002**	0.997	**0.008**
	Unknown	0.999	0.484	0.998	0.281	0.999	0.811	0.996	0.108	0.998	0.302	0.999	0.636
List Size	< 4,000	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	4,000 – 7,999	0.991	0.491	0.992	0.575	0.989	0.497	0.964	**0.023**	0.980	0.156	0.974	0.103
	≥ 8,000	0.966	0.065	0.959	**0.024**	0.968	0.120	0.931	**< 0.001**	0.948	**0.004**	0.943	**0.002**
GP FTEs per 1,000 patients		0.959	0.124	0.945	**0.049**	0.987	0.655	0.981	0.576	1.013	0.712	1.004	0.914
Diabetes Prevalence		0.956	**0.001**	0.915	**< 0.001**	0.958	**0.001**	0.969	**0.010**	0.972	**0.003**	0.967	**0.003**
IMD Tenth (1 = Most Deprived)	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.832	**< 0.001**	0.835	**< 0.001**	0.853	**< 0.001**	0.867	**< 0.001**	0.868	**< 0.001**	0.892	**< 0.001**
	3	0.797	**< 0.001**	0.818	**< 0.001**	0.821	**< 0.001**	0.850	**< 0.001**	0.845	**< 0.001**	0.856	**< 0.001**
	4	0.743	**< 0.001**	0.761	**< 0.001**	0.782	**< 0.001**	0.821	**< 0.001**	0.812	**< 0.001**	0.832	**< 0.001**
	5	0.734	**< 0.001**	0.722	**< 0.001**	0.767	**< 0.001**	0.788	**< 0.001**	0.791	**< 0.001**	0.801	**< 0.001**
	6	0.719	**< 0.001**	0.714	**< 0.001**	0.731	**< 0.001**	0.785	**< 0.001**	0.782	**< 0.001**	0.774	**< 0.001**
	7	0.702	**< 0.001**	0.693	**< 0.001**	0.725	**< 0.001**	0.773	**< 0.001**	0.772	**< 0.001**	0.787	**< 0.001**
	8	0.680	**< 0.001**	0.674	**< 0.001**	0.712	**< 0.001**	0.754	**< 0.001**	0.751	**< 0.001**	0.746	**< 0.001**
	9	0.658	**< 0.001**	0.642	**< 0.001**	0.697	**< 0.001**	0.759	**< 0.001**	0.764	**< 0.001**	0.733	**< 0.001**
	10	0.662	**< 0.001**	0.620	**< 0.001**	0.659	**< 0.001**	0.723	**< 0.001**	0.748	**< 0.001**	0.717	**< 0.001**
Area Classification	Rural	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Urban	0.923	**0.008**	0.920	**0.005**	0.888	**< 0.001**	0.903	**< 0.001**	0.897	**< 0.001**	0.919	**0.002**
Process UA Fifth	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.975	0.219	0.938	**< 0.001**	0.961	**0.016**	0.961	**0.012**	0.939	**< 0.001**	0.961	**0.007**
	3	0.990	0.632	0.955	**0.027**	0.974	0.165	0.947	**0.012**	0.949	**0.004**	0.960	**0.014**
	4	0.983	0.520	0.949	**0.023**	0.947	**0.005**	0.931	**0.002**	0.919	**< 0.001**	0.954	**0.014**
	5	0.982	0.497	0.953	**0.034**	0.945	**0.014**	0.909	**< 0.001**	0.917	**< 0.001**	0.930	**0.001**
CVS UA Fifth	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.011	0.532	1.000	0.990	0.986	0.377	1.006	0.640	1.017	0.256	1.018	0.176
	3	1.028	0.176	1.006	0.737	0.995	0.777	1.031	0.065	1.015	0.351	1.008	0.600
	4	1.020	0.372	1.008	0.657	0.982	0.318	1.025	0.183	1.024	0.146	1.023	0.195
	5	1.028	0.295	0.996	0.867	0.976	0.262	1.049	**0.040**	1.049	**0.034**	1.028	0.231
Strict Glycaemic Control UA Fifth	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.004	0.820	1.008	0.711	1.051	**0.040**	1.005	0.780	0.992	0.750	0.994	0.699
	3	1.010	0.723	1.049	0.098	1.056	0.064	0.986	0.555	0.987	0.662	1.001	0.978
	4	1.015	0.671	1.084	**0.037**	1.073	0.056	1.010	0.727	1.018	0.652	1.042	0.147
	5	1.015	0.737	1.092	0.056	1.130	**0.007**	1.016	0.710	1.056	0.275	1.068	0.072

(continued...)

		2005/06		2006/07		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
Strict Glycaemic Control UA Fifth	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.004	0.820	1.008	0.711	1.051	**0.040**	1.005	0.780	0.992	0.750	0.994	0.699
	3	1.010	0.723	1.049	0.098	1.056	0.064	0.986	0.555	0.987	0.662	1.001	0.978
	4	1.015	0.671	1.084	**0.037**	1.073	0.056	1.010	0.727	1.018	0.652	1.042	0.147
	5	1.015	0.737	1.092	0.056	1.130	**0.007**	1.016	0.710	1.056	0.275	1.068	0.072
Intermediate Glycaemic Control UA Fifth	**1**	N/A		N/A		N/A		N/A		*Reference Group*		*Reference Group*	
	2									0.970	0.135	0.965	0.064
	3									0.964	0.115	0.977	0.360
	4									0.971	0.346	0.933	**0.016**
	5									0.970	0.352	0.939	0.063
Moderate Glycaemic Control UA Fifth	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.998	0.932	1.001	0.942	0.983	0.400	1.004	0.787	1.010	0.631	0.974	0.171
	3	0.996	0.890	0.934	**0.004**	0.982	0.455	0.985	0.498	0.984	0.516	0.989	0.655
	4	0.958	0.167	0.962	0.160	0.952	0.101	0.992	0.730	0.990	0.733	1.002	0.950
	5	0.964	0.296	0.939	0.063	0.985	0.625	0.983	0.569	0.966	0.295	1.018	0.581
PE07 UA Fifth	**1**	N/A		N/A		N/A		*Reference Group*		*Reference Group*		*Reference Group*	
	2							1.004	0.827	0.973	0.079	0.974	0.209
	3							0.985	0.399	0.982	0.405	0.981	0.370
	4							0.973	0.173	0.970	0.145	0.960	0.096
	5							0.985	0.531	0.956	0.065	0.932	**0.011**
PE08 UA Fifth	**1**	N/A		N/A		N/A		*Reference Group*		*Reference Group*		*Reference Group*	
	2							0.949	**0.002**	0.998	0.885	0.983	0.376
	3							0.939	**0.001**	0.979	0.229	0.962	0.051
	4							0.913	**< 0.001**	0.949	**0.008**	0.952	**0.028**
	5							0.912	**< 0.001**	0.961	0.077	0.940	**0.015**
Process ER Fifth	**1**	N/A		N/A		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2					1.021	0.178	1.004	0.768	1.018	0.259	1.008	0.646
	3					1.041	0.053	1.058	**0.006**	1.030	0.115	1.020	0.309
	4					1.087	**0.003**	1.086	**0.001**	1.047	**0.039**	1.034	0.190
	5					1.127	**< 0.001**	1.105	**0.001**	1.089	**0.004**	1.047	0.103

(continued...)

		2005/06		2006/07		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
CVS ER Fifth	1	N/A		N/A		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2					0.957	**0.011**	0.995	0.732	0.973	0.134	1.002	0.903
	3					0.951	**0.034**	0.976	0.223	0.981	0.280	0.986	0.508
	4					0.910	**0.001**	0.946	**0.023**	0.934	**0.005**	0.991	0.739
	5					0.890	**0.001**	0.929	**0.013**	0.925	**0.007**	0.975	0.414
Strict Glycaemic Control ER Fifth	1	N/A		N/A		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2					1.025	0.130	1.017	0.315	0.983	0.421	0.986	0.542
	3					1.030	0.228	1.026	0.272	0.994	0.853	0.976	0.380
	4					1.046	0.150	1.024	0.394	1.019	0.602	0.971	0.450
	5					1.049	0.229	1.044	0.184	1.048	0.273	0.991	0.860
Intermediate Glycaemic Control ER Fifth	1	N/A		N/A		N/A		N/A		*Reference Group*		*Reference Group*	
	2									1.016	0.506	0.995	0.840
	3									1.004	0.910	1.024	0.486
	4									1.009	0.808	1.026	0.538
	5									1.014	0.758	1.089	0.096
Moderate Glycaemic Control ER Fifth	1	N/A		N/A		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2					0.964	**0.030**	0.979	0.156	0.984	0.439	1.027	0.171
	3					0.955	**0.031**	0.968	0.121	1.013	0.596	1.038	0.170
	4					0.944	**0.039**	0.971	0.273	1.010	0.765	1.019	0.578
	5					0.979	0.541	0.997	0.939	1.026	0.467	1.008	0.864

Table 36. Results of multi-variable negative binomial regression for all selected predictors, QOF 2008/09 - 2010/11.

IRR = Incidence rate ratio; GP = General practitioner; FTE = Full-time equivalent; IMD = Index of Multiple Deprivation; CVS = cardiovascular system (includes targets pertaining to blood pressure and total cholesterol); UA = underlying achievement; ER = exception rate.

Regression coefficients converted to IRRs; practice population age structure and ethnicity described as the proportion of the registered population falling within a given category; IRRs for practice population age-bands, proportion male, ethnicities and diabetes prevalence denote the magnitude of estimated effect of a 1% increase; N/A denotes that the indicator / indicator group was not present for that QOF year.

Whilst direct calculation of the degree of variability in emergency admissions attributable to the full model was precluded through use of clustering by PCT, pseudo-R2 values were calculated for an unclustered variant of the full model for each QOF year (Table 37). For the unclustered models, the degree of variation between practices attributable to models was relatively low, with pseudo-R^2 values ranging between 0.0175 – 0.0231.

	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
Pseudo-R^2	0.0175	0.0210	0.0196	0.0203	0.0223	0.0231

Table 37. Pseudo-R^2 values, by QOF year, for unclustered versions of the full emergency admissions model.

Discussion

Principal Findings

Over the period 2005/06 to 2010/11, the prevalence of diabetes rose from 3.55% to 4.45% in the English registered population, representing an increase in the number of people with diabetes by over 565,000.

Over the same period, emergency admissions in people with diabetes increased from a crude rate of 157.77 per 1,000 registered people with diabetes to a crude rate of 167.60 per 1,000; the mean emergency admissions per practice increased from 35.44 to 51.08. Such observations could be due to a true increase in risk of disease requiring emergency admission (likely due to an ageing population of people with diabetes) or improvements in clinical coding, whereby a person who has diabetes is more likely to be reported as such.

Crude emergency admission rates for people younger than 65 years remained relatively static over the observation period, whereas those for people aged 65 or older increased. This may well reflect the impact of multi-morbidity in older members of the population, but further investigation of how appropriate existing quality targets for older people with diabetes are with respect to minimising the risk of emergency hospital admissions.

Crude emergency admission rates increased with age, likely representing the elevated risk of co-morbidity in older individuals. The greatest changes in admission rates over the observation period were observed in the youngest (15 – 44 years) and oldest (≥ 75 years) age groups, where crude emergency admission rates rose from 106.35 to 125.84 per 1,000 people with diabetes and 283.18 to 300.11 per 1,000 people with diabetes respectively. Females were consistently subject to a higher emergency admission rates than males; this could be due to differences in health-seeking behaviour or the under-diagnosis and under-treatment of cardiovascular disease in women.[198,199]

In order to control for the effects of practice population age and gender on emergency admission rates, SEARs for each practice were generated. There was considerable variability in SEARs across practices, which would imply that there are variations in underlying determinants of emergency admission rates of people with diabetes.

Although quantification of residual confounding in the full negative binomial models is precluded by use of clustering, adjusted R^2 values for unclustered models indicate that there is considerable residual confounding, meaning that additional factors, some of which may not be adequately captured by the available data, also have a role to play when considering determinants of emergency admissions in people with diabetes. That aside, all of the negative binomial models demonstrated significant effects of the selected predictors on practice emergency admissions, likely as a result of the large sample size used for model construction.

It should be noted that the population structure of people with diabetes, and hence the derived SEARs, are based on estimates from HSfE rather than known counts. This would mean that there is likely to be a degree of error in the SEARs; however, all practices would be subject to such errors, meaning that any resulting bias would be likely to be non-differential in nature.

A number of associations between predictors and emergency admission rates were relatively robust and persisted across increasingly verbose models, most notably practice deprivation, practice rurality, diabetes prevalence and underlying achievement for the process group of QOF indicators and underlying achievement for indicator PE08 (ability to book an appointment two or more days in advance). The majority of indicators and indicator groups based upon intermediate clinical targets (cardiovascular intermediate outcomes and glycaemic control indicator groups) failed to show any consistent associations with emergency admission rates.

The findings from the full model with regards to practice deprivation – that the most affluent practices are subject to relative reductions in emergency admission rates estimated to be in the range of 25.2% – 38.0% in comparison to the most deprived – and practice rurality – where urban practices were estimated to have emergency admission rates 7.7% – 11.2% lower than their rural counterparts – is in keeping with a number of existing studies.[13,159,160,172,200] Such differences are likely to represent differences in risk factor distribution, health-seeking behaviours, de-prioritisation of one's own health and accessibility of services.

Increasing practice diabetes prevalence was associated with decreased emergency admission rates across all QOF years for the full model, with relative reductions in emergency admissions ranging between 2.8% – 8.5% with every 1% increase in practice diabetes prevalence. This may indicate that more frequent exposure of the primary care workforce to people with diabetes increases familiarity with the ongoing management of diabetes, promoting delivery of care that is timely, comprehensive and efficacious. Practice list size had no discernible association with emergency admission rates.

In the full model, achievement for diabetes-specific process indicators was significantly associated with decreased emergency admission rates for five of the six years observed (2006/07 – 2010/11 inclusive), with the best performing fifth of practices estimated to have emergency admission rates 4.7% – 9.1% lower than those observed for the worst performing practices. This finding may reflect that practices who are able to attain high levels of achievement for this group of indicators have a higher level of engagement with their patients who have diabetes; success in the process group of indicators is dependent on regular patient review, which would promote discussion of secondary and tertiary prevention measures that may, in turn, reduce the risk of emergency admission at the patient level.

The ability of individuals to book appointments more than two days in advance, as measured by indicator PE08, was associated with a decreased emergency admission rate for two of the three years this indicator was available in the full model (2008/09 and 2010/11, 6.0% – 8.8% reduction for the best performing fifth of practices in comparison to the worst). Ease of booking appointments less than two days in advance (indicator PE07) only demonstrated an association with reduced

admission rates for QOF year 2010/11 in the full model, with an estimate of the magnitude less than the maximum observed for PE08, with the best performing fifth of practices experiencing emergency admission rates 6.8% lower than the worst performing fifth. In particular, the findings for PE08 highlight the central role that proactive, planned care has in the maximisation of health outcomes in the population with diabetes, as opposed to reactive care for acute illnesses and complications. The removal of all indicators pertaining to patient experience and access from QOF in recent years[130] is, therefore, of considerable concern, as improved accessibility and appointment availability are strongly associated with a decreased rate of emergency admissions from the population with diabetes.

The general lack of associations between underlying achievement for the indicators and indicator groups based on intermediate targets and emergency admissions in the full model may be attributable to a number of factors. Firstly, engagement with care – to a certain degree – on behalf of the patient is necessary to obtain a measurement of blood pressure, total cholesterol or HbA1c; the adjusted incidence rate ratios for emergency admissions for these indicators and indicator groups may well have been non-significant as achievement for the process group of indicators had already been accounted for.

However, few of these indicators and indicator groups exhibited significant associations in models in which the effects of performance for these indicators and indicator groups was unadjusted for practice performance in other indicators. This raises the question of whether the blood pressure, total cholesterol and HbA1c QOF targets are suitably stringent to exert a meaningful effect on emergency admissions.[201]

Another potential explanation for the lack of consistent associations between achievement in indicators and indicator groups based upon intermediate targets is heterogeneity of patients and the degree to which their blood pressure, total cholesterol and HbA1c is lowered. There is a need for personalisation of treatment targets for people with diabetes[124,·202] that concentrate on the attributes and risks to individual patients as opposed to incentivisation of physician behaviour, introducing the possibility that the gains realised with respect to improved outcomes for some patients is masked by the lack of benefit in those for whom these targets are not

suitable. It is also likely that individuals who have achieved the targets stipulated exhibit a range of values for blood pressure, total cholesterol and HbA1c. A number of recent studies have described a U-shaped relationship between these variables and outcomes such as mortality and unscheduled admissions, with values above and below a certain range conferring elevated levels of risk[100,101,203,204]; patients who are in receipt of intensive treatment may have exceeded treatment targets and have values that lie below the optimal range and, therefore, exhibit increased risks of emergency admissions that may eclipse the benefits realised for individuals who have met intermediate targets but still have values within the optimal range.

The potentially deleterious effects of overtly aggressive treatment of hypertension and hypercholesterolaemia discussed above may also partially explain the seemingly counterintuitive associations between increased emergency admission rates for practices in the best performing fifth of the cardiovascular intermediate outcome indicator group in 2008/09 – 2009/10 and for the decreased emergency admission rates associated with practices in the highest fifth of exception reporting in 2007/08 – 2009/10.

Aside from the associations between levels of exception reporting for the cardiovascular intermediate outcome indicator group and emergency admissions, the only other significant associations observed for exception reporting was for the process indicator group. For QOF years 2007/08 – 2009/10, practices in the highest fifth of exception reporting were subject to emergency admission rates estimated to be 8.9% – 12.7% higher than those with the lowest levels of exception reporting.

This finding could result from practices with the highest levels of exception reporting having a larger proportion of individuals with co-existing terminal disease for whom it may not be appropriate to continue regular diabetes reviews, a considerable number of individuals who cannot access services due to problems with mobility, individuals who are disinclined to access services on the grounds of perceived societal barriers, patients already on maximal therapy or that these practices serve a population which does not engage well with the services offered by primary care.

Whilst QOF business rules allow for declaration of patients as exceptions for many of the above reasons, there is considerable variation in exception reporting rates between practices that could be argued to be above and beyond that which would be expected from varying practice populations (Figure 18). Such an observation could result from 'gaming' of the exception reporting system[139], thereby disenfranchising patients for whom services are inaccessible or inappropriate. Exploration of this potential issue is beyond the scope of this analysis; however, the role of exception reporting with respect to ascertainment of quality of primary care is worthy of further investigation with respect to people with diabetes.

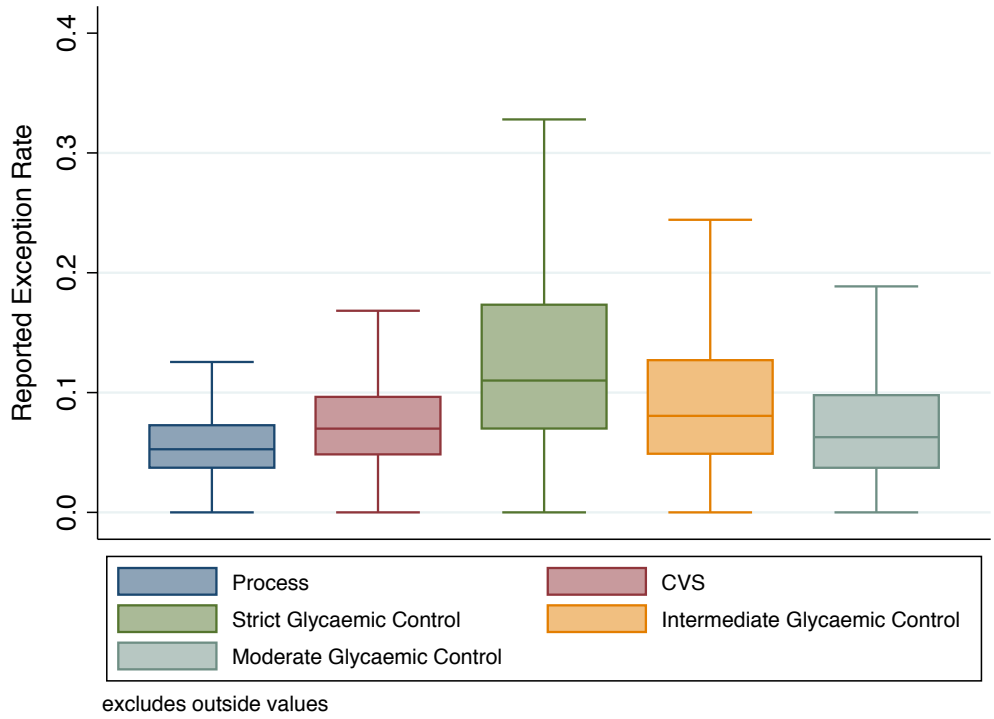


Figure 18. Box plots of exception rates for diabetes-specific QOF indicator groups for English practices, QOF 2010/11.

For the process group of indicators, and for indicator PE08, the estimated improvements in emergency admission rates for those practices attaining the highest levels of performance are both statistically and clinically significant in the full model. For the purposes of illustration, the potential reductions in the number of emergency admissions in QOF year 2010/11 should the lowest performing fifth attain the performance of the highest fifth for the process indicator group and for PE08 are shown in Table 38.

	Estimated IRR for Best Performing Fifth	Number of Emergency Admissions From Worst Performing Fifth	Total Diabetes Register Size of Worst Performing Fifth	Crude Admission Rate per 1,000 for Worst Performing Fifth	Potential Reduction in Admissions
Process	0.930	78,634	453,979	173.21	5,474.41
PE08	0.940	104,033	600,455	173.26	6,250.12

Table 38. Potential reductions in emergency admissions from the worst performing fifth of practices should they attain the levels of performance observed in the best performing fifth of practices, QOF 2010/11.

Strengths and Limitations

Despite the large sample size of practices, analysis over multiple QOF years and adjustment for multiple measures of primary care quality, these analyses are subject to a number of potential limitations. For such analyses, ecological bias is highly likely; metrics of care quality, such as those reported in QOF, are an aggregate of the care actually delivered to individual patients. That is to say that we cannot state with certainty that a given patient did or did not attain a given quality target – furthermore, as emergency admission data was aggregated to the level of practices, no direct correlations can be made between the quality of care actually received and the outcome of interest at the patient level.

Whist the decision to combine indicators into thematic groups was taken to maximise differences in performance between practices, this approach may have masked associations with individual indicators and does imply that all component indicators in a group have a similar impact with respect to modulation of emergency admission rates.

Ecological bias is also likely to be present in estimates of deprivation and rurality. Practices were assigned deprivation and rurality scores on the basis of the postcode, and hence LSOA, in which they were located. Such measures of accessibility and deprivation may not necessarily apply to the registered population of a practice; a practice located in an affluent area may serve a large lumber of individuals from an adjoining area that is subject to high levels of deprivation, for example.

The decision to group the data pertaining to the ethnic composition of practice populations into 'white' and 'non-white' may have masked important effects on outcomes between the ethnic subgroups within these categories. In their current state, these analyses make the assumption that the risk profile – be it cultural, societal or genetic – of the subgroups that comprise a particular ethnic category is identical; this was an approach that was taken on the grounds of parsimony that, in hindsight, was not appropriate and worthy of further investigation.

As previously discussed (see pages 51-63), the accuracy of clinical coding of hospital admissions with respect to determining whether or not diabetes is the direct cause is questionable. Therefore, this analysis took the approach of capturing all emergency admissions from HES that cited diabetes in any diagnostic position.

This approach assumes that a patient has received a diagnosis of diabetes prior to the emergency admission in question; if a large number of individuals were only diagnosed with diabetes at the time of admission to hospital, estimates of admission rates could be falsely inflated.

Furthermore, this approach means that it is impossible to delineate between emergency admissions directly due to diabetes as opposed to admissions that have arisen from the registered diabetic population, meaning that assessment of variations in admission rates is not limited to conditions that are explicitly linked to diabetes mellitus. However, as diabetes, and the adequacy of its management, is associated with an increased risk of a number of acute illnesses, this approach may be more reasonable than only considering admissions where diabetes has been cited as the first diagnosis and may give a more accurate indication of the total burden of emergency hospital admissions arising from the population with diabetes.

Following on from the use of emergency admissions that cite diabetes in any diagnosis position, there is also an assumption that all causes of emergency admissions are equally modifiable by the selected markers of primary care quality. This issue is likely to be more pertinent for certain groupings of indicators (specifically glycaemic control and intermediate cardiovascular outcomes), but may be of lesser importance when considering more general markers of quality such as achievement in the process indicator group and patient access.

It is also likely that there is considerable residual confounding in this analysis, stemming, to some degree, from the use of aggregate data, the limitations of available datasets and the impact of ecological bias. Although practice emergency admission rates have been adjusted for age and sex, the actual case-mix and prevalence of additional risk factors of emergency hospital admission could not be ascertained.

Use of patient-level data to further explore the relationship between the quality of care received, individual risk factors, co-morbidities and clinical outcomes would allow for a more granular analysis that may be less subject to bias and confounding.

Closing Summary

These analyses have indicated that the rates of emergency hospital admissions from the population with diabetes vary considerably and that emergency admission rates may, to an extent, be modifiable by some aspects of primary care quality, in particular process measures of care and patient access. Deprivation has been shown to have strong, consistent associations with emergency admission rates, with associated effect sizes commonly outstripping those observed for the highest levels of QOF attainment, emphasising the importance of factors that lie outside of the sphere of influence of medicine may have on influencing outcomes of care.

Patient-Level Analyses

Background

Practice-level data, such as that used in the previous chapter, is of considerable use when profiling the performance of individual practices and geographic regions within England; however, use of such data is subject to ecological bias. That being said, for certain applications and research questions, use of aggregate data is both sound and appropriate.

In terms of QOF, reports of practice-level performance only provide information on the practice as a whole as opposed to supplying data on what care a given patient actually received. This issue also extends to use of additional aggregate data sources which may describe other characteristics, such as age and ethnicity, of a population; it is impossible to deduce the characteristics of an individual from the characteristics of the group to which they belong.

Use of patient-level data for exploring relationships between quality of care received and clinical outcomes obviates these concerns; furthermore, longitudinal patient-level data permits temporal sequencing of events, allowing assessment of whether a change in clinical state (or risk profile) subsequently led to an event of interest.

Another advantage of using patient-level data, as opposed to QOF data, to assess the impact quality of care on outcomes is that the issue of exception reporting becomes moot. Patient-level data allows for determination of the level of care received and their attainment of intermediate treatment targets, regardless of exception status – ensuring that the entire population of interest is sampled and their outcomes tracked rather than a subgroup of individuals who have been deemed to be compliant with and amenable to management provided in primary care.

In England, patient-level data is a available as a commercial product via the Clinical Practice Research Datalink (CPRD) from the Medicines & Healthcare Products Regulatory Agency (MHRA) and the National Institute for Health Research (NIHR). The CPRD dataset contains data on all primary care patient events, directly extracted from electronic patient record systems, from a nationally representative sample of English general practices. CPRD datasets are subject to quality checks at the level of the patient and the source general practice as a whole prior to delivery to customers.

The following analyses utilise a bespoke dataset purchased from CPRD that was originally requested for the examination of clinical outcomes in people with diabetes. Primary care data was linked to HES, ONS mortality and IMD data by CPRD prior to delivery.

Methodology

Data Sources

The dataset utilised for this analysis was a custom extract from the CPRD dataset, linked to HES data. The CPRD dataset contains longitudinal data on patients registered to a representative sample of English General Practices. HES data pertaining to hospital admissions, diagnoses and procedures was linked to the main CPRD dataset on a patient-by-patient basis, allowing for analysis of associations between primary care and in-patient activities at the level of individual patients. All CPRD data linkage, cleaning and preparation was performed by the MHRA prior to delivery of the final research dataset.

All patients were anonymised by the MHRA; accordingly, information on place of residence was only available at the resolution of region of England and only the year of birth (as opposed to the full date of birth) was available for each patient. Furthermore, the identity of individual general practices was also pseudonymised, precluding linkage of additional datasets describing further practice attributes.

Deprivation data, expressed as the Index of Multiple Deprivation (IMD) 2007 quintile for the LSOA in which the postcode of a given patient's last known address is located, was also linked to the dataset by the MHRA; more granular deprivation data (e.g. LSOA deprivation rank) was not available in the CPRD-HES dataset utilised for these analyses.

Patient events, such as consultations, investigation results, diagnoses in addition to patient characteristics such as occupation and social circumstances are recorded in primary care patient notes using Read codes, a hierarchical clinical coding system that have been in use in the NHS since 1985.

The CPRD-HES dataset provided by the MHRA contained a randomly selected sample of 125,000 people, aged 17 years or older with a recorded diagnosis of diabetes; supplied data covered the period 2003 – 2010. These 125,000 individuals with diabetes were matched to 125,000 patients without diabetes (defined as no mention of diabetes or receipt of hypoglycaemic agents).

The patients included in the dataset as supplied were randomly selected from the pool of individuals with records deemed to be of an acceptable standard from practices participating in the HES and ONS linkage scheme, with a valid postcode and with at least one episode of care – defined as a record of BP, cholesterol or HbA1c – between 2003 and 2009.

The Read codes used by MHRA to define the presence of diabetes are given in Table 39. Whilst the list of codes is likely to capture the majority of people with diabetes, certain codes – such as "Type I diabetes mellitus with diabetic cataract" or "Type 1 diabetes mellitus with neuropathic arthropathy" or "Unstable type 1 diabetes mellitus" and "Insulin dose changed" – that are strongly suggestive of diabetes are not included in this list. In addition to these codes, individuals with a record of at least one prescription for a hypoglycaemic agent between 2003 and 2009 were also considered as having a diagnosis of diabetes. A total of 155,372 individuals were identified, from which the sample of 125,000 patients with diabetes were drawn (see Figure 19 for selection flowchart).

Read Code	Description
66A..00	Diabetic monitoring
66A1.00	Initial diabetic assessment
66A2.00	Follow-up diabetic assessment
66A3.00	Diabetic on diet only
66A4.00	Diabetic on oral treatment
66A5.00	Diabetic on insulin
66A8.00	Has seen dietician - diabetes
66A9.00	Understands diet - diabetes
66Aa.00	Diabetic diet - poor compliance
66AA.11	Injection sites - diabetic
66Ab.00	Diabetic foot examination
66Ac.00	Diabetic peripheral neuropathy screening
66AD.00	Fundoscopy - diabetic check
66Af.00	Patient diabetes education review
66AG.00	Diabetic drug side effects
66AH.00	Diabetic treatment changed
66AI.00	Diabetic - good control
66Ai.00	Diabetic 6 month review
66AJ.00	Diabetic - poor control
66AJ.11	Unstable diabetes
66AJz00	Diabetic - poor control NOS
66AK.00	Diabetic - cooperative patient
66Ak.00	Diabetic monitoring - lower risk albumin excretion
66AL.00	Diabetic-uncooperative patient
66Al.00	Diabetic monitoring - higher risk albumin excretion
66AM.00	Diabetic - follow-up default
66An.00	Diabetes type 1 review
66AN.00	Date diabetic treatment start
66Ao.00	Diabetes type 2 review
66AO.00	Date diabetic treatment stopp.
66AP.00	Diabetes: practice programme
66Aq.00	Diabetic foot screen
66AQ.00	Diabetes: shared care programme
66AR.00	Diabetes management plan given
66AS.00	Diabetic annual review
66AT.00	Annual diabetic blood test
66AU.00	Diabetes care by hospital only
66AV.00	Diabetic on insulin and oral treatment
66AW.00	Diabetic foot risk assessment
66AY.00	Diabetic diet - good compliance
66AZ.00	Diabetic monitoring NOS
C10..00	Diabetes mellitus
C100.00	Diabetes mellitus with no mention of complication
C100000	Diabetes mellitus, juvenile type, no mention of complication
C100011	Insulin dependent diabetes mellitus
C100100	Diabetes mellitus, adult onset, no mention of complication
C100111	Maturity onset diabetes
C100112	Non-insulin dependent diabetes mellitus
C100z00	Diabetes mellitus NOS with no mention of complication
C101.00	Diabetes mellitus with ketoacidosis
C101000	Diabetes mellitus, juvenile type, with ketoacidosis
C101z00	Diabetes mellitus NOS with ketoacidosis
C102.00	Diabetes mellitus with hyperosmolar coma
C103.00	Diabetes mellitus with ketoacidotic coma
C104.00	Diabetes mellitus with renal manifestation
C104.11	Diabetic nephropathy
C104z00	Diabetes mellitus with nephropathy NOS
C105.00	Diabetes mellitus with ophthalmic manifestation
C105100	Diabetes mellitus, adult onset, + ophthalmic manifestation
C105z00	Diabetes mellitus NOS with ophthalmic manifestation
C106.00	Diabetes mellitus with neurological manifestation
C106.12	Diabetes mellitus with neuropathy
C106.13	Diabetes mellitus with polyneuropathy
C106100	Diabetes mellitus, adult onset, + neurological manifestation
C106z00	Diabetes mellitus NOS with neurological manifestation
C107.00	Diabetes mellitus with peripheral circulatory disorder
C107.11	Diabetes mellitus with gangrene
C107.12	Diabetes with gangrene
C107z00	Diabetes mellitus NOS with peripheral circulatory disorder
C108.00	Insulin dependent diabetes mellitus
C108.11	IDDM-Insulin dependent diabetes mellitus
C108.12	Type 1 diabetes mellitus
C108.13	Type I diabetes mellitus
C108400	Unstable insulin dependent diabetes mellitus
C108500	Insulin dependent diabetes mellitus with ulcer
C108700	Insulin dependent diabetes mellitus with retinopathy
C108800	Insulin dependent diabetes mellitus - poor control
C108900	Insulin dependent diabetes maturity onset
C109.00	Non-insulin dependent diabetes mellitus
C109.11	NIDDM - Non-insulin dependent diabetes mellitus
C109.12	Type 2 diabetes mellitus
C109.13	Type II diabetes mellitus
C109400	Non-insulin dependent diabetes mellitus with ulcer
C109600	Non-insulin-dependent diabetes mellitus with retinopathy
C109700	Non-insulin dependent diabetes mellitus - poor control
C109900	Non-insulin-dependent diabetes mellitus without complication
C109C00	Non-insulin dependent diabetes mellitus with nephropathy
C109J00	Insulin treated Type 2 diabetes mellitus
C10A100	Malnutrition-related diabetes mellitus with ketoacidosis
C10B.00	Diabetes mellitus induced by steroids
C10B000	Steroid induced diabetes mellitus without complication
C10C.11	Maturity onset diabetes in youth
C10D.00	Diabetes mellitus autosomal dominant type 2
C10E.00	Type 1 diabetes mellitus
C10E.11	Type I diabetes mellitus
C10E.12	Insulin dependent diabetes mellitus
C10E700	Type 1 diabetes mellitus with retinopathy
C10E800	Type 1 diabetes mellitus - poor control
C10ED00	Type 1 diabetes mellitus with nephropathy
C10EE00	Type 1 diabetes mellitus with hypoglycaemic coma
C10EK00	Type 1 diabetes mellitus with persistent proteinuria
C10EL00	Type 1 diabetes mellitus with persistent microalbuminuria
C10EM00	Type 1 diabetes mellitus with ketoacidosis
C10EN00	Type 1 diabetes mellitus with ketoacidotic coma
C10EQ00	Type 1 diabetes mellitus with gastroparesis
C10F.00	Type 2 diabetes mellitus
C10F.11	Type II diabetes mellitus
C10F000	Type 2 diabetes mellitus with renal complications
C10F100	Type 2 diabetes mellitus with ophthalmic complications
C10F200	Type 2 diabetes mellitus with neurological complications
C10F400	Type 2 diabetes mellitus with ulcer
C10F600	Type 2 diabetes mellitus with retinopathy
C10F700	Type 2 diabetes mellitus - poor control
C10F711	Type II diabetes mellitus - poor control
C10F900	Type 2 diabetes mellitus without complication
C10F911	Type II diabetes mellitus without complication
C10FB00	Type 2 diabetes mellitus with polyneuropathy
C10FC00	Type 2 diabetes mellitus with nephropathy
C10FE00	Type 2 diabetes mellitus with diabetic cataract
C10FH00	Type 2 diabetes mellitus with neuropathic arthropathy
C10FJ00	Insulin treated Type 2 diabetes mellitus
C10FJ11	Insulin treated Type II diabetes mellitus
C10FK00	Hyperosmolar non-ketotic state in type 2 diabetes mellitus
C10FL00	Type 2 diabetes mellitus with persistent proteinuria
C10FL11	Type II diabetes mellitus with persistent proteinuria
C10FM00	Type 2 diabetes mellitus with persistent microalbuminuria
C10FN00	Type 2 diabetes mellitus with ketoacidosis
C10FQ00	Type 2 diabetes mellitus with exudative maculopathy
C10z.00	Diabetes mellitus with unspecified complication

Table 39. Read codes used by the MHRA to identify patients with diabetes in the CPRD-HES dataset.

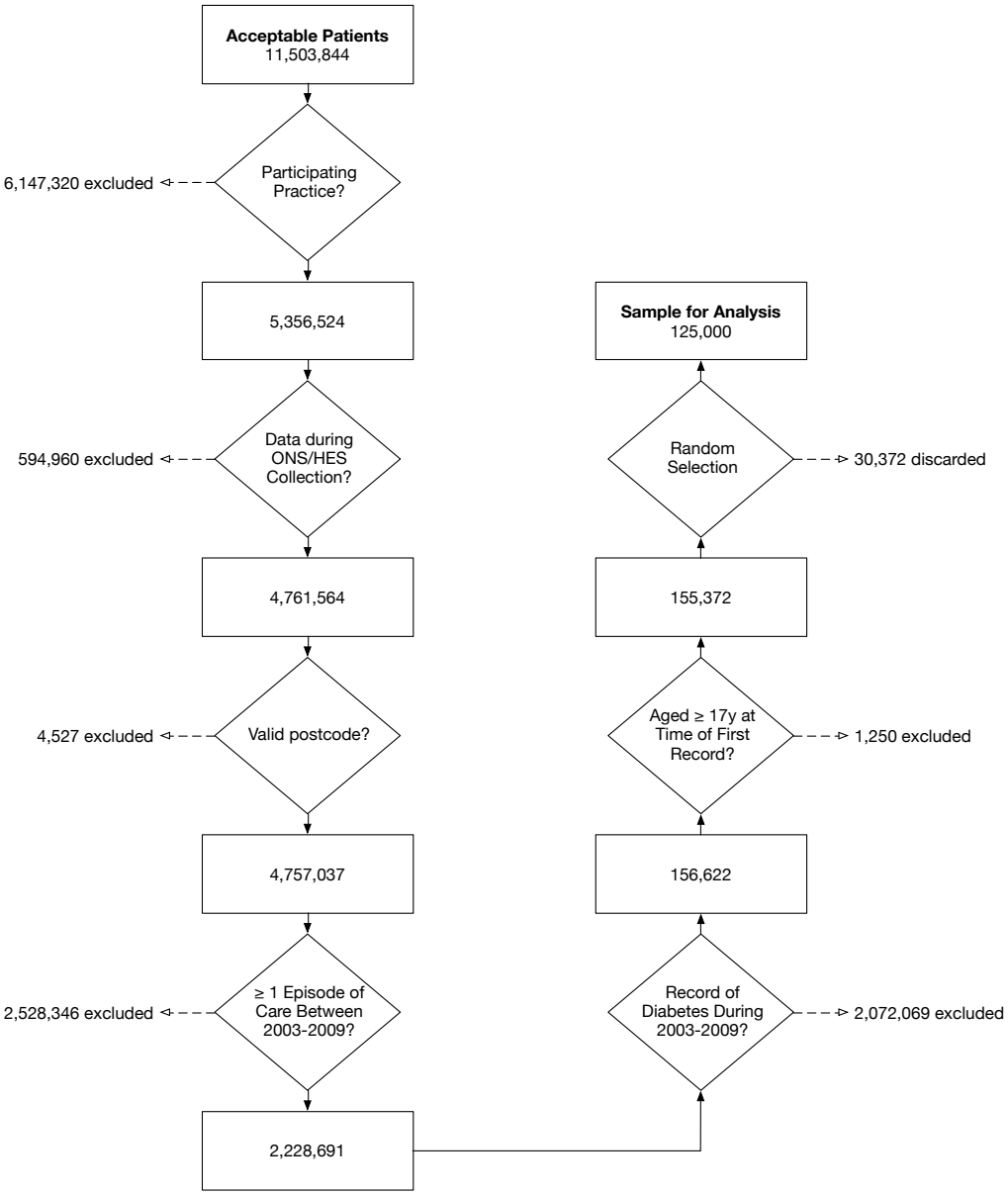


Figure 19. Flowchart of selection process undertaken by the MHRA to identify eligible patients with diabetes from the CPRD dataset.

Preparation of Data

As supplied, the CPRD-HES data consisted of a large number of individual datasets describing a number of aspects of patients' care, primary care encounters and secondary care utilisation (see Table 40) in addition to datasets describing mortality, and socioeconomic status. A number of data dictionaries, used to enhance human readability of the data, were also included with the CPRD-HES dataset.

All data tables were imported into FileMaker Pro Advanced V13 (FileMaker Inc., CA, USA), a database system allowing for the creation of complex relationships between tables (see Figure 20 for simplified version of database structure, fields provided in each table available in Appendices).

Sources	Data File	Number of Records*	Description
Primary Care (CPRD)	**Patient**	250,000	Basic patient demographics and registration details
	Practice	300	Basic practice details, including region
	Staff	864,782	Basic Practice staff details
	Consultation	89,789,150	Describes type of consultation as entered by the GP
	Clinical	66,953,678	Describes medical history; contains symptoms, signs and diagnoses
	Additional Clinical Details	20,814,560	Contains information entered in the structured data areas in the GP patient records
	Referral	2,662,350	Describes referrals to external care centres, including specialty and referral type
	Immunisation	2,399,603	Contains details of immunisation records
	Test	66,410,566	Contains records of test data on the GP system; three types of test records, involving 4, 7 or 8 data fields; data can denote either qualitative text based results or quantitative results involving a numeric value
	Therapy	109,650,559	Contains details of all prescriptions (both drugs and appliances) on the GP system
Secondary Care (HES)	**Patient**	194,861	Contains details of patients with both a primary care and secondary care record
	Augmented Care	20,635	Describes utilisation of augmented care (if any) during a spell
	Critical Care	4,065	Describes utilisation of critical care (if any) during a spell
	Diagnosis by Episode	5,161,269	Describes unique diagnoses associated with each in-patient episode
	Diagnosis by Hospitalisation	4,162,836	Describes unique diagnoses associated with each hospitalisation
	Primary Diagnosis by Hospitalisation	1,288,296	Describes primary diagnosis associated with each hospitalisation
	Episodes	1,461,652	Describes characteristics of each hospital episode
	Hospitalisations	1,245,139	Describes characteristics of each hospitalisation
	Maternity	66,508	Describes characteristics of pregnancies and births
	Procedures by Episode	1,797,149	Describes procedures performed during an episode
TOTAL		**375,197,958**	

Table 40. Data included in the CPRD-HES dataset utilised for analysis.

* = number of records incorporate both patients with and without diabetes

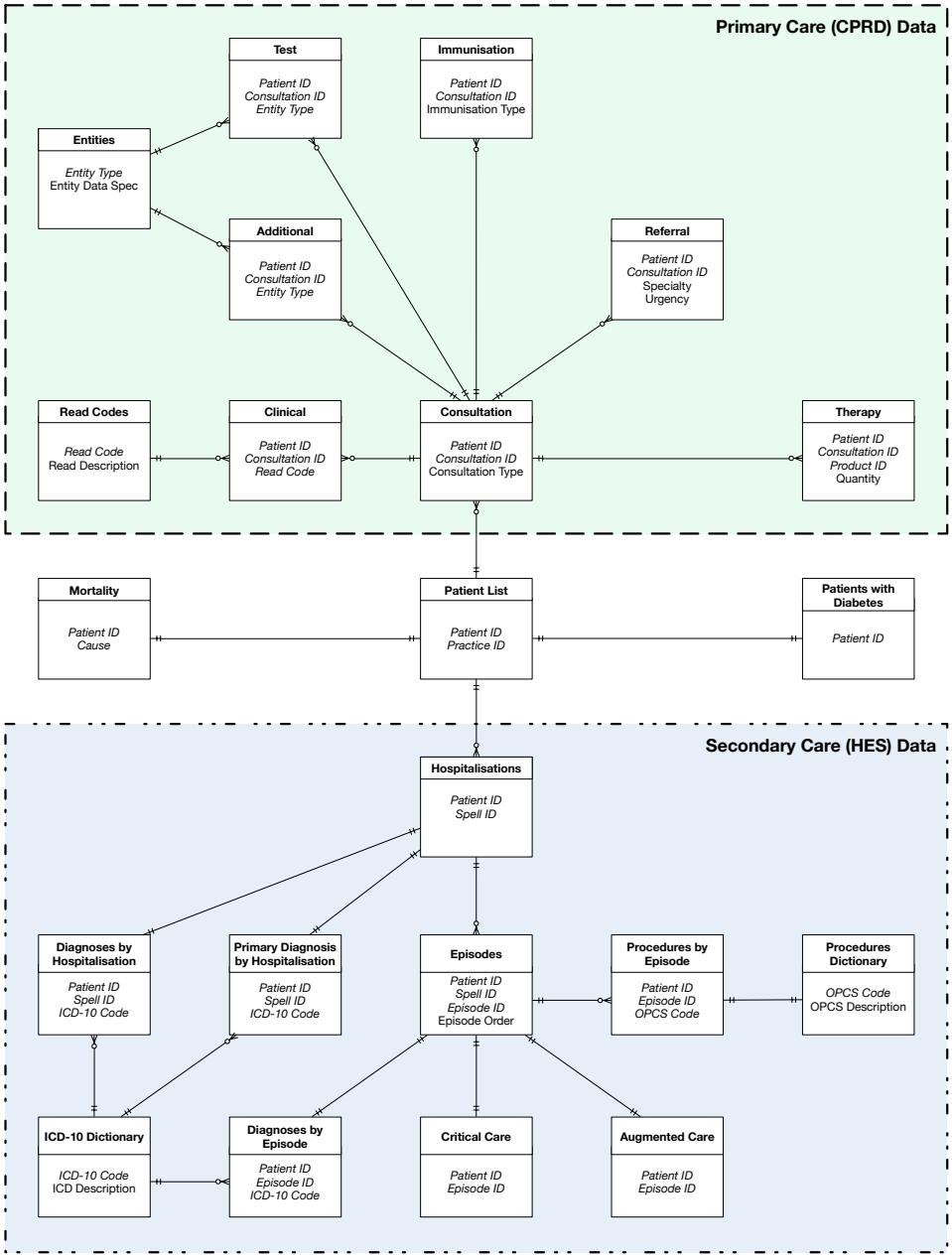


Figure 20. Simplified database structure for CPRD-HES data.

Fields in italics denote fields used to link tables; not all fields shown (see Appendix). Not all data dictionaries shown; no tables of data generated *post hoc* shown.

Assigning Diabetes Type

Although patients had been flagged as having a prior diagnosis of diabetes by the MHRA, according to the presence of any of the Read codes outlined in Table 39, no clear delineation was made between patients with T1DM and T2DM.

The list of diagnoses deemed by CPRD to reflect a diagnosis of diabetes was initially reviewed by myself (DCG) and Dr Panagiotis Anagnwstis (PA), an Endocrinology specialist. Both PA and myself independently assigned a code to each diagnosis to reflect whether it supported a diagnosis of T1DM, T2DM, either T1DM or T2DM or not T1DM or T2DM. Any disagreements were reviewed and adjudicated by Professor Azeem Majeed (AM); the agreed typing of CPRD diabetes diagnosis codes is shown in Table 41. Bar classification of Read codes, PA had no further role in data management, analysis or interpretation.

Read Code		Description	Read Code		Description	Read Code		Description
C10E.00	Type 1 diabetes mellitus	T1DM	**C109700**	Non-insulin dependent diabetes mellitus - poor control	T2DM	**66Ac.00**	Diabetic peripheral neuropathy screening	T1DM or T2DM
C100011	Insulin dependent diabetes mellitus	T1DM	**C10FC00**	Type 2 diabetes mellitus with nephropathy	T2DM	**66Aq.00**	Diabetic foot screen	T1DM or T2DM
C108.00	Insulin dependent diabetes mellitus	T1DM	**C10F600**	Type 2 diabetes mellitus with retinopathy	T2DM	**66AR.00**	Diabetes management plan given	T1DM or T2DM
C108.11	IDDM-Insulin dependent diabetes mellitus	T1DM	**C10F700**	Type 2 diabetes mellitus - poor control	T2DM	**66A5.00**	Diabetic on insulin	T1DM or T2DM
C108.12	Type 1 diabetes mellitus	T1DM	**C10F900**	Type 2 diabetes mellitus without complication	T2DM	**66AI.00**	Diabetic - good control	T1DM or T2DM
C10EM00	Type 1 diabetes mellitus with ketoacidosis	T1DM	**C10FN00**	Type 2 diabetes mellitus with ketoacidosis	T2DM	**66AQ.00**	Diabetes: shared care programme	T1DM or T2DM
66An.00	Diabetes type 1 review	T1DM	**C10FK00**	Hyperosmolar non-ketotic state in type 2 diabetes mellitus	T2DM	**66AD.00**	Fundoscopy - diabetic check	T1DM or T2DM
C100000	Diabetes mellitus, juvenile type, no mention of complication	T1DM	**C109400**	Non-insulin dependent diabetes mellitus with ulcer	T2DM	**66Ai.00**	Diabetic 6 month review	T1DM or T2DM
C108.13	Type I diabetes mellitus	T1DM	**C109900**	Non-insulin-dependent diabetes mellitus without complication	T2DM	**66A9.00**	Understands diet - diabetes	T1DM or T2DM
C10E.12	Insulin dependent diabetes mellitus	T1DM	**C102.00**	Diabetes mellitus with hyperosmolar coma	T2DM	**66Ab.00**	Diabetic foot examination	T1DM or T2DM
C108900	Insulin dependent diabetes maturity onset	T1DM	**C10FQ00**	Type 2 diabetes mellitus with exudative maculopathy	T2DM	**66AU.00**	Diabetes care by hospital only	T1DM or T2DM
C108800	Insulin dependent diabetes mellitus - poor control	T1DM	**C10F000**	Type 2 diabetes mellitus with renal complications	T2DM	**66A1.00**	Initial diabetic assessment	T1DM or T2DM
C10EK00	Type 1 diabetes mellitus with persistent proteinuria	T1DM	**C10F911**	Type II diabetes mellitus without complication	T2DM	**66AW.00**	Diabetic foot risk assessment	T1DM or T2DM
C10ED00	Type 1 diabetes mellitus with nephropathy	T1DM	**C106100**	Diabetes mellitus, adult onset, + neurological manifestation	T2DM	**66A8.00**	Has seen dietician - diabetes	T1DM or T2DM
C10E700	Type 1 diabetes mellitus with retinopathy	T1DM	**C10FB00**	Type 2 diabetes mellitus with polyneuropathy	T2DM	**66AA.11**	Injection sites - diabetic	T1DM or T2DM
C10EL00	Type 1 diabetes mellitus with persistent microalbuminuria	T1DM	**C10F200**	Type 2 diabetes mellitus with neurological complications	T2DM	**66AH.00**	Diabetic treatment changed	T1DM or T2DM
C108700	Insulin dependent diabetes mellitus with retinopathy	T1DM	**C10FH00**	Type 2 diabetes mellitus with neuropathic arthropathy	T2DM	**C106.12**	Diabetes mellitus with neuropathy	T1DM or T2DM
C108500	Insulin dependent diabetes mellitus with ulcer	T1DM	**C109600**	Non-insulin-dependent diabetes mellitus with retinopathy	T2DM	**C106.00**	Diabetes mellitus with neurological manifestation	T1DM or T2DM
C10E800	Type 1 diabetes mellitus - poor control	T1DM	**C10FE00**	Type 2 diabetes mellitus with diabetic cataract	T2DM	**66Af.00**	Patient diabetes education review	T1DM or T2DM
C10E.11	Type I diabetes mellitus	T1DM	**C105100**	Diabetes mellitus, adult onset, + ophthalmic manifestation	T2DM	**C104.11**	Diabetic nephropathy	T1DM or T2DM
C10EN00	Type 1 diabetes mellitus with ketoacidotic coma	T1DM	**C10F400**	Type 2 diabetes mellitus with ulcer	T2DM	**C100.00**	Diabetes mellitus with no mention of complication	T1DM or T2DM
C10EQ00	Type 1 diabetes mellitus with gastroparesis	T1DM	**C10FJ11**	Insulin treated Type II diabetes mellitus	T2DM	**66AM.00**	Diabetic - follow-up default	T1DM or T2DM
C101000	Diabetes mellitus, juvenile type, with ketoacidosis	T1DM	**C10F711**	Type II diabetes mellitus - poor control	T2DM	**C105.00**	Diabetes mellitus with ophthalmic manifestation	T1DM or T2DM
C10EE00	Type 1 diabetes mellitus with hypoglycaemic coma	T1DM	**C10FL11**	Type II diabetes mellitus with persistent proteinuria	T2DM	**C104.00**	Diabetes mellitus with renal manifestation	T1DM or T2DM
C108400	Unstable insulin dependent diabetes mellitus	T1DM	**C109C00**	Non-insulin dependent diabetes mellitus with nephropathy	T2DM	**66AJz00**	Diabetic - poor control NOS	T1DM or T2DM
66A4.00	Diabetic on oral treatment	T2DM	**C10F100**	Type 2 diabetes mellitus with ophthalmic complications	T2DM	**66AJ.11**	Unstable diabetes	T1DM or T2DM
66A3.00	Diabetic on diet only	T2DM	**66AS.00**	Diabetic annual review	T1DM or T2DM	**66AK.00**	Diabetic - cooperative patient	T1DM or T2DM
C100111	Maturity onset diabetes	T2DM	**C101.00**	Diabetes mellitus with ketoacidosis	T1DM or T2DM	**C100z00**	Diabetes mellitus NOS with no mention of complication	T1DM or T2DM
66AV.00	Diabetic on insulin and oral treatment	T2DM	**66AT.00**	Annual diabetic blood test	T1DM or T2DM	**66AN.00**	Date diabetic treatment start	T1DM or T2DM
C10C.11	Maturity onset diabetes in youth	T2DM	**66AY.00**	Diabetic diet - good compliance	T1DM or T2DM	**66Ak.00**	Diabetic monitoring - lower risk albumin excretion	T1DM or T2DM
C10F.00	Type 2 diabetes mellitus	T2DM	**66Aa.00**	Diabetic diet - poor compliance	T1DM or T2DM	**C104z00**	Diabetes mellitus with nephropathy NOS	T1DM or T2DM
C100112	Non-insulin dependent diabetes mellitus	T2DM	**C107.00**	Diabetes mellitus with peripheral circulatory disorder	T1DM or T2DM	**C107.11**	Diabetes mellitus with gangrene	T1DM or T2DM
C109.00	Non-insulin dependent diabetes mellitus	T2DM	**C103.00**	Diabetes mellitus with ketoacidotic coma	T1DM or T2DM	**66AL.00**	Diabetic-uncooperative patient	T1DM or T2DM
C109.12	Type 2 diabetes mellitus	T2DM	**C10D.00**	Diabetes mellitus autosomal dominant type 2	T1DM or T2DM	**C106z00**	Diabetes mellitus NOS with neurological manifestation	T1DM or T2DM
C100100	Diabetes mellitus, adult onset, no mention of complication	T2DM	**C101z00**	Diabetes mellitus NOS with ketoacidosis	T1DM or T2DM	**66Al.00**	Diabetic monitoring - higher risk albumin excretion	T1DM or T2DM
66Ao.00	Diabetes type 2 review	T2DM	**66AG.00**	Diabetic drug side effects	T1DM or T2DM	**C105z00**	Diabetes mellitus NOS with ophthalmic manifestation	T1DM or T2DM
C10FJ00	Insulin treated Type 2 diabetes mellitus	T2DM	**C107z00**	Diabetes mellitus NOS with peripheral circulatory disorder	T1DM or T2DM	**66AO.00**	Date diabetic treatment stopp.	T1DM or T2DM
C10FM00	Type 2 diabetes mellitus with persistent microalbuminuria	T2DM	**66A..00**	Diabetic monitoring	T1DM or T2DM	**C107.12**	Diabetes with gangrene	T1DM or T2DM
C109.13	Type II diabetes mellitus	T2DM	**C10..00**	Diabetes mellitus	T1DM or T2DM	**C106.13**	Diabetes mellitus with polyneuropathy	T1DM or T2DM
C109.11	NIDDM - Non-insulin dependent diabetes mellitus	T2DM	**66A2.00**	Follow-up diabetic assessment	T1DM or T2DM	**C10z.00**	Diabetes mellitus with unspecified complication	T1DM or T2DM
C109J00	Insulin treated Type 2 diabetes mellitus	T2DM	**66AP.00**	Diabetes: practice programme	T1DM or T2DM	**C10B.00**	Diabetes mellitus induced by steroids	Not T1DM or T2DM
C10FL00	Type 2 diabetes mellitus with persistent proteinuria	T2DM	**66AZ.00**	Diabetic monitoring NOS	T1DM or T2DM	**C10B000**	Steroid induced diabetes mellitus without complication	Not T1DM or T2DM
C10F.11	Type II diabetes mellitus	T2DM	**66AJ.00**	Diabetic - poor control	T1DM or T2DM	**C10A100**	Malnutrition-related diabetes mellitus with ketoacidosis	Not T1DM or T2DM

Table 41. Classification of diabetes diagnoses used by the MHRA to identify people with diabetes in the CPRD-HES dataset.

Patients were assigned the diabetes type according to the presence of the various Read codes discussed above in their medical history as cited in the 'Clinical' CPRD table; patients who had codes that all indicated the same diagnosis type were classified as such. Patients with codes suggesting more than one diabetes type or solely had codes denoting 'either T1DM or T2DM' were classified as per Figure 21.

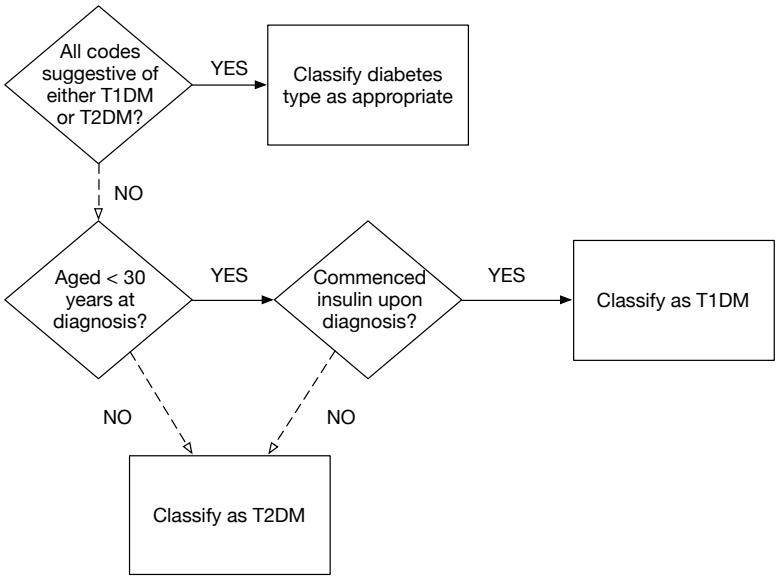


Figure 21. Algorithm for assigning diabetes type in individuals for whom diagnosis codes are inconclusive.

The accuracy of the algorithm for determining diabetes type in individuals where there was uncertainty of their diabetes type was validated against the pool of patients of a known diabetes type.

Determination of Smoking Status and History

Details on smoking status are recorded as entity type 4 in the 'Additional Clinical Details' table of the CPRD-HES dataset. The data associated with smoking status is recorded using the following codes: 1 = current smoker; 2 = ex-smoker; 3 = non-smoker; 4 = not asked.

There was considerable potential for inconsistent recording of smoking status, which may not reflect a patient's historical smoking status – for example, an individual who used to smoke has the potential to be recorded as either an ex-smoker or a non-smoker.

Accordingly, and to maximise data accuracy, the entire recorded smoking histories for each patient were reviewed and their smoking status determined as of 1st April 2005 according to the algorithm detailed in Figure 22. Patients whose most recent smoking status was recorded as 'not asked' had their smoking status determined according to their most recent specified smoking status; patients who had no other classification of smoking statuses of 'not asked' or had missing data were classified as being of unknown smoking status.

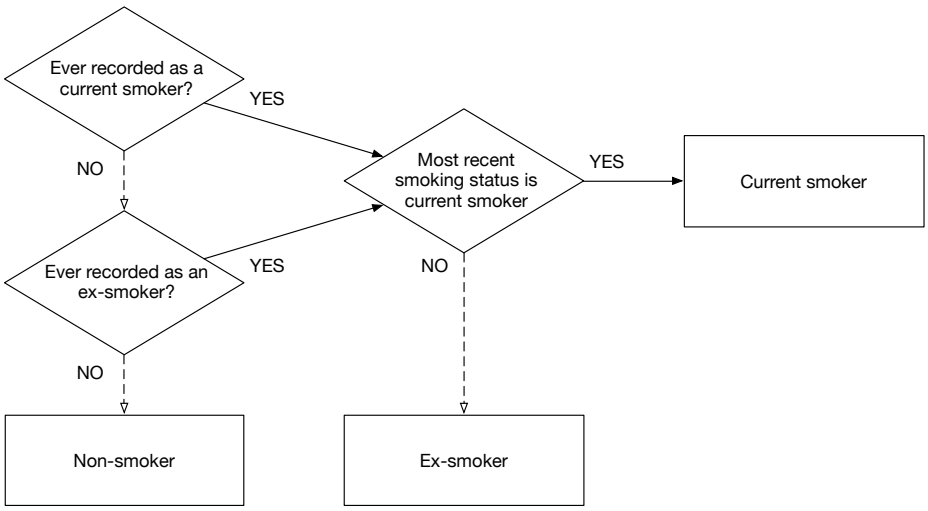


Figure 22. Algorithm for assigning smoking status.

Determination of Co-Morbidities

The presence of diabetes is associated with a markedly elevated risk of a number of other chronic diseases, such as coronary heart disease, peripheral arterial disease and chronic renal failure.[76, 94] Individuals with diabetes are also subject to the same risks and development of other diseases which may impact on an individual's health and quality of life. The net effect for people with diabetes is that they are likely to face increased levels of co-morbidity over time, which may be in excess of that which would be expected from their age, gender and ethnicity alone.

Increasing levels of co-morbidity have been demonstrated to be associated with an elevated risk of death in the adult population across a number of developed countries[205-207] and are associated with greater use of primary care resources.[208] In individuals with diabetes, co-morbidity has been shown to be associated with increased risks of preventable hospital admissions and mortality.[209-211]

The Charlson Comorbidity Index (CCI)[205] is one method by which the level of co-morbidity can be quantified for a patient through summation of weighted scores for categories of chronic conditions. The CCI was initially developed in the 1980s and was primarily calibrated for patients admitted to hospital; the CCI has subsequently been adapted and validated for use in English primary care services.[206] It could be argued that the disease weights in the CCI are no longer representative of the outcomes that could be expected from contemporary medical practice, particularly for diseases such as acquired auto- immune deficiency syndrome (AIDS); as such, an updated series of weights has recently been developed and validated.[207] CCI disease categories and their weights are described in Table 42.

Condition	Original Weight	Updated Weight	Change
Myocardial infarction	1	0	-1
Congestive heart failure	1	2	+1
Peripheral arterial disease	1	0	-1
Cerebrovascular disease	1	0	-1
Dementia	1	2	+1
Chronic pulmonary disease	1	1	0
Rheumatological disease	1	1	0
Peptic ulcer disease	1	0	-1
Mild liver disease	1	2	+1
Diabetes mellitus without chronic complications	1	0	-1
Hemi- or paraplegia	2	2	0
Renal disease	2	1	-1
Diabetes mellitus with chronic complications	2	1	-1
Any malignancy, including leukaemia and lymphoma	2	2	0
Moderate / severe liver disease	3	4	+1
Metastatic solid tumour(s)	6	6	0
AIDS / HIV	6	4	-2
Maximum Possible Score	29	24	-5

Table 42. Charlson co-morbidity index disease categories and their associated original and updated weights.

For the purposes of investigating the impact of co-morbidity on mortality in diabetic and non-diabetic cohorts, the observation start date for the entire cohort was determined as 1st April 2005; the failure variable was set as the occurrence of death (of any cause), with patients being censored at the last data collection date from their practice.

Patients were classified as diabetic according to whether their clinical records contained Read codes, determined by CPRD, that were deemed indicative of a diagnosis of diabetes (see Table 39). Patients with diabetes were further classified as prevalent or incident cases according to whether their diabetes diagnosis date was before or after their observation start date. All patients identified as having diabetes were matched 1:1 with individuals deemed to be non-diabetic by age (± 2 years), gender and practice by the MHRA.

As only the year of birth was available for each patient, and to take account of the likelihood of a non-linear relationship between age and hazard of death, patients were grouped into age bands for their approximate age at the start of observation (< 25y, 25–44y, 45—54y, 55—64y, 65—74y and ≥ 75y). It should be noted that, as only the year of birth was available for each patient, calculated ages may be up to ± 1 year of their true value. In order to quantify socioeconomic deprivation, patients were assigned to the English national fifth of IMD score into which their LSOA of residence fell, with the first fifth representing the most deprived LSOAs in England.

The burden of co-morbidity for each patient was determined from cross-referencing all recorded primary care diagnoses (entries with an entity type of 'diagnosis' entered into the clinical table of the CPRD dataset) with a validated list of Medical Codes mapped to CCI diagnosis categories[206] with updated co-morbidity weights derived from a recent multi-national study (Table 42).[207] Disease categories for each patient were only counted once even if multiple diagnoses within a given category were recorded; it was assumed that co-morbid diseases were non-reversible.

Each patient's CCI score at the start of observation was recorded; additionally, all diagnoses following the start of observation were reviewed and, should the diagnosis of a new condition alter their CCI score, dates of change and updated CCI scores were also recorded. Two pairs of categories implied progression from one disease state to another, more advanced state. The pairs in question were mild liver disease and moderate/severe liver disease and cancer and metastatic tumour; in order to avoid double-counting of CCI should such progression occur, the CCI score of the less severe form of condition was subtracted from a patient's total CCI score before adding the score associated with the more severe version.

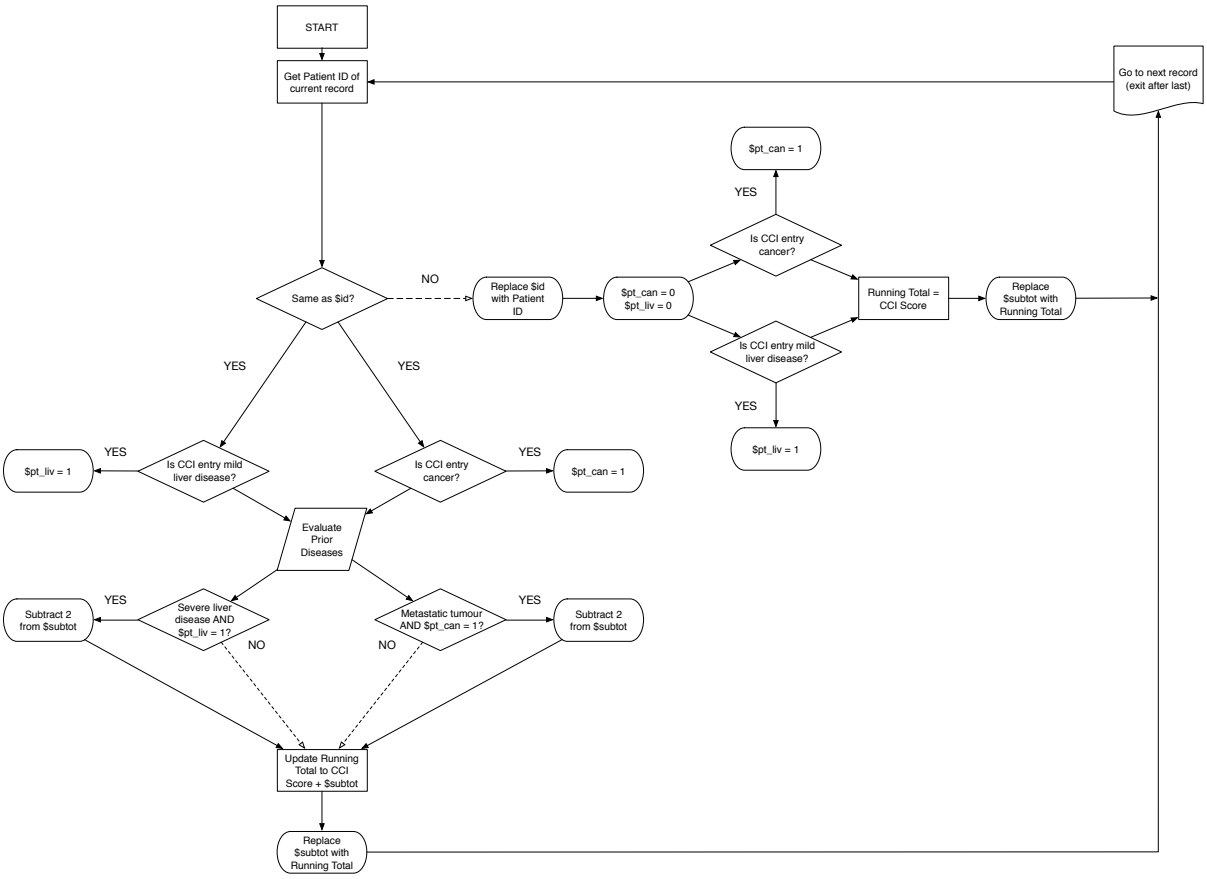


Figure 23. Algorithm for calculating running totals of Charlson co-morbidity score (using updated weights) for individual patients.

All diagnoses sorted by date prior to execution of algorithm; $id = temporary variable for storage of patient ID; $pt_liv = flag for identification of a patient with mild liver disease; $pt_can = flag for identification of a patient with cancer

Due to the relatively small count of patients with higher CCI scores, patients were allocated to CCI groups of CCI = 0, CCI = 1, CCI = 2, CCI = 3 and CCI ≥ 4; dates of change of CCI group were also recorded.

Defining Emergency Admissions and Readmissions

Emergency admissions and readmissions are both examples of unscheduled and potentially preventable secondary care utilisation that may indicate the receipt of suboptimal care or a lack of engagement with, or access to, services.[9,158,172,212-215] Potentially preventable emergency admissions and readmissions are both costly and prevalent and represent a significant opportunity cost to the health service[216] and negatively impact quality of life for patients and their families.[217,218] As it could be argued that some readmissions result from inadequate discharge planning or other failures in care quantity or quality within hospitals, current NHS policy is not to reimburse secondary and tertiary care providers for the care delivered for admissions classed as readmissions, pending a clinical review of the avoidability of such admissions.[219]

As with the other analyses discussed in this chapter, the primary data source for defining emergency admissions and readmissions is the bespoke CPRD-HES dataset supplied by the MHRA. Emergency admissions were defined as those admissions cited with an admission method (*admimeth*) of 21 – 24 or 28[220]; readmissions were defined in accordance with the Payment by Results business rules as set out by the Department of Health.

For the purposes of these analyses, a readmission is defined as an emergency admission (*admimeth* = 21 – 24, 28) within 30 days of a prior admission, except those with any of the following criteria (see Figure 24 for algorithm used to identify such admissions), adapted from the PbR rules in order to fit the constraints of recorded data:

- Cancer, where the initial admission / readmission has a primary diagnosis of cancer (ICD-10 codes C00 – C97 and D37 – D48, primary diagnosis field of HES primary diagnosis by hospitalisation table); admissions for cancer were not considered as an index event from which time to the next admission was calculated

- Patients who are readmitted following self-discharge against medical advice (*dismeth* = 2 in HES hospitalisations table)

- Patient is in receipt of renal replacement therapy (ICD-10 codes N180, Z490, Z491, Z492, Z992 in primary diagnosis field of HES primary diagnosis by hospitalisation table or OPCS codes M011-M015, M018, M019, X401-X409 in HES procedures by episode table); admissions for RRT were not considered as an index event from which time to the next admission was calculated

- Patient is still in hospital (*dismeth* = 8 in HES hospitalisations table)

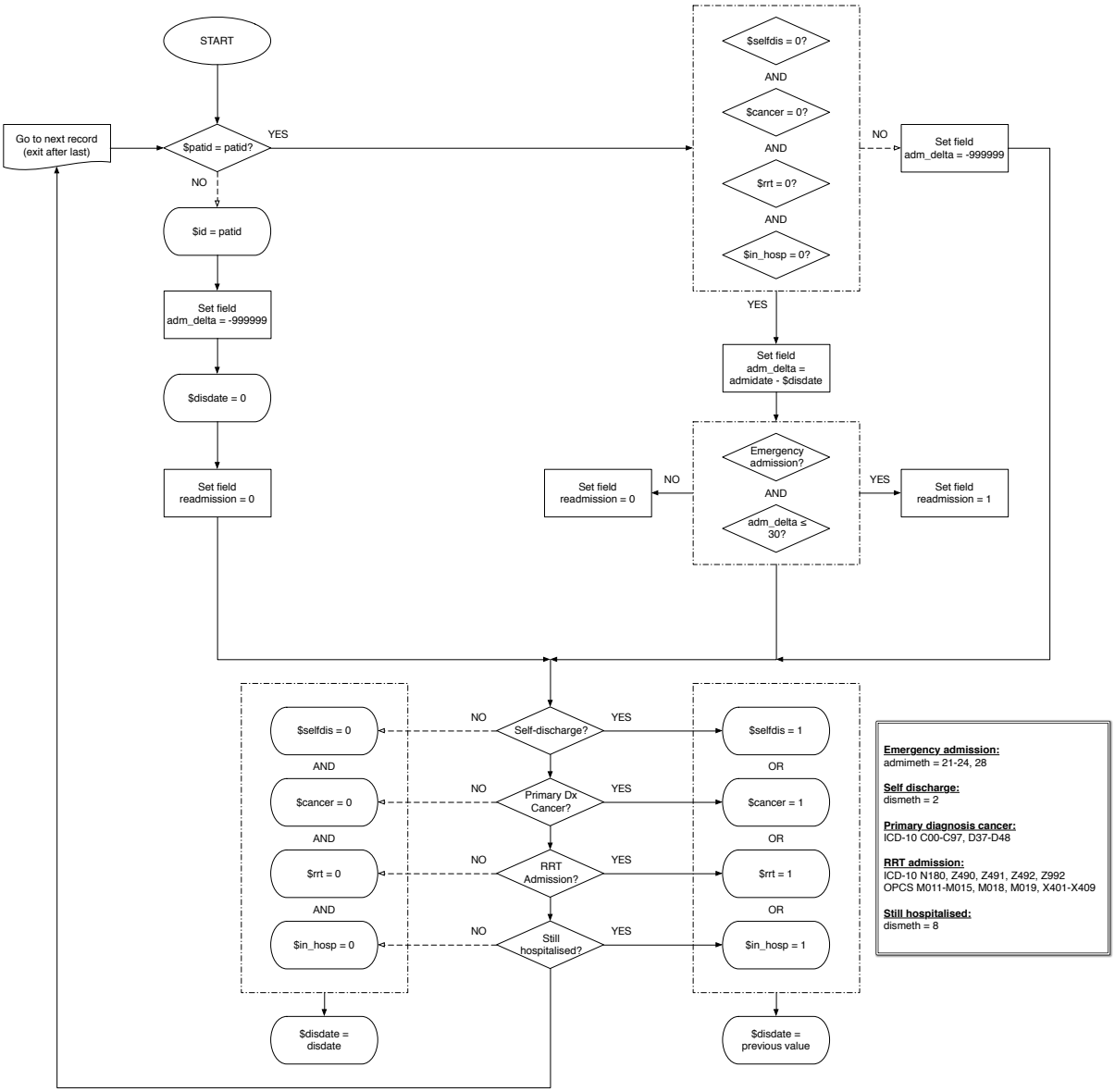


Figure 24. Algorithm for identifying readmissions by patient from CPRD-HES data.

Admissions were sorted by patient ID and admission date prior to running this algorithm; $selfdis = flag for prior admission ending in self-discharge; $cancer = flag for presence of cancer; $rrt = flag for admission for renal replacement therapy; $in_hosp = flag for indicating patient is still in hospital

Measures of Diabetes Care Quality

The CPRD data supplied by the MHRA contains all primary care events for all of the included patients, allowing for quantification of whether a given patient has met a particular treatment target, from which the quality of care received by a patient can be inferred.

Whilst the CPRD data is an excellent tool for measuring events at the level of patients, the data only contains a randomised sample of patients, which may not be representative of practice populations as a whole, and has replaced the standard practice identifiers with anonymised codes. Overall practice performance with respect to markers of quality cannot be aggregated from available data nor be matched from additional datasets describing practice-level performance.

For the purposes of these analyses, quality of care received by a patient was according to whether specific 2005/06 QOF targets were met and National Diabetes Audit (NDA) care processes were performed.

The following QOF targets were examined: DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol), DM12 (BP ≤ 145/85) and DM17 (TC ≤ 5.0 mmol/L). For these QOF indicators, the most recent value in the 15 months prior to the end of the QOF year (1st January 2005 - 31st March 2006 inclusive) were utilised for the purposes of determining whether a given target was met; individuals with missing measurements or no measurements relevant to a given target within the eligibility timeframe were assumed to have not met the target for the 2005/06 QOF year. Data pertaining to achievement of the selected QOF indicators was extracted from the CPRD data as detailed in Table 43.

All 9 NDA care processes, pertaining to whether certain annual checks had taken place (HbA1c, BP, cholesterol, serum creatinine, urine albumin, foot surveillance, BMI, smoking status and retinopathy screening) were also analysed.

Although there are similarities between the NDA care processes and a number of QOF indicators describing processes of care (see Table 16, page 67), NDA process measures were chosen in preference to QOF indicators for the following reasons:

The primary purpose of the NDA is to report on the care received by patients; the primary purpose of QOF, which measures practice-level performance based on aggregated patient data, is for incentivisation of and remuneration for specific clinical activities;

- The NDA process measures consider all individuals with diabetes as opposed to QOF, which allows for exceptions;
- The associated Read codes for identification of completion of certain NDA processes are more stringent than their QOF counterparts – for example, the NDA foot check process specifies checking of peripheral pulses and sensory loss;
- NDA recording of smoking status is diabetes-specific. In QOF, recording of smoking status is for patients with one of many chronic diseases, of which diabetes is one, precluding isolation of diabetes-specific data;
- All NDA care processes require the specified action to have been carried out in the past 12 months as opposed to within the last 15 months, necessitating annual review of people with diabetes.

Indicator	Source Data Table	Source Entity Type	Read Codes Cited by Entity Type
DM06 HbA1c ≤ 7.4% / 57.4 mmol/mol	Test	275	44TB.00, 42W..00, 42W4.00, 42W..11, 42W..12, 42W5.00
DM12 BP ≤ 145/85	Additional Clinical Details	1	N/A
DM17 TC ≤ 5.0 mmol/L	Test	163	44P9.00, 44OE.00, 44P..00, 44P3.00, 44P1.00, 44PK.00, 44P2.00, 44P4.00, 44PJ.00, 44PH.00, 44PZ.00

Table 43. Description of data sources for determination of patient-level attainment of selected QOF targets.

The Read codes utilised by the NDA to identify whether a patient had experienced specific processes were used to identify pertinent clinical events from the clinical table of the CPRD dataset that had occurred within the 12 months prior to the end of the 2005/06 QOF year (1st April 2005 – 31st March 2006).[221]

For the purposes of this study, additional Read codes were utilised to identify patients who had had their HbA1c checked (42W..11, 42W..12, 42W..00, 42W4.00, 44TC.00, 66Ae.00, 66Ae000) to maximise event capture rates. Furthermore, examination of weight (Read codes 22A..00, 22A4.00, 22AZ.00, 22A3.00, 22A1.00, 22A2.00, 22A5.0) was assumed to equate to measurement of BMI, as BMI values may be calculated on demand when patient records are accessed and not formally recorded as a BMI value in some electronic patient record systems (Table 44). Individuals who did not have records containing the Read codes relevant to a particular care process within the eligibility timeframe were assumed to have not met that care process for 2005/06. A comparison of the proportion of people with diabetes receiving individual NDA care processes from the cohort used for analysis and that which was observed nationally in the 2005/06 NDA is shown in Table 45.

Identifying and Classifying Death

Data pertaining to patient deaths was extracted from the Office for National Statistics mortality dataset that was included as part of the bespoke CPRD-HES utilised for analysis. The ONS mortality dataset, as supplied, contains data specifying the date of death and up to 15 causes of death coded using the ICD-10 scheme, one of which is cited as the proximal cause of death (i.e. that condition which directly led to death). The data contained within the ONS dataset is drawn directly from death certificates; however, the ONS were unable to provide clarification on how the 15 cause of death fields map to the fields on a standard English death certificate prior to analysis.[222]

The date of death, recorded as the date of death entered on the death certificate, and proximal cause of death was extracted for all patients with diabetes. Deaths were flagged as potentially diabetes-related if the proximal cause of death contained any of the ICD-10 codes listed in Table 46.

Deaths as recorded in the ONS dataset were cross-checked with CPRD primary care records; the ONS date of death took primacy over the date of death recorded in CPRD should the dates not match. Patients who were recorded as having died in the CPRD data but were not present in the ONS mortality dataset were completely excluded from analysis.

NDA Process	Read Codes Used by NDA	Additional Read Codes
Blood Pressure Measurement	246.., 2461., 2462., 2463., 2464., 2465., 2466., 2467., 2468., 2469., 246A., 246B., 246C., 246D., 246E., 246F., 246G., 246H., 246I., 246J., 246N., 246P., 246Q., 246R., 246S., 246T., 246V., 246W., 246X., 246Y., 246Z., 246a., 246b., 246c., 246d., 246e., 246f., 246g.	None
BMI Measurement	22K.., 22K1., 22K2., 22K3., 22K4., 22K5., 22K6., 22K7., 22K8., 22K9., 22K90, 22KB.	22A..00, 22A4.00, 22AZ.00, 22A3.00, 22A1.00, 22A2.00, 22A5.0
Foot Check	24E1., 24E6., 24E7., 24E8., 24E9., 24EA., 24EB., 24EC., 24ED., 24EE., 24EF., 24F1., 24F6., 24F7., 24F8., 24F9., 24FA., 24FB., 24FC., 24FD., 24FE., 24FF., 29B1., 29B2., 29B20 29B21 29B3., 29B7., 29B8., 29B9., 29BA., 29BB., 29BC., 29BD., 29BE., 29BF., 29BG., 29BH., 29BJ., 29BK., 29BL., 29BM., 29BN., 29BP., 29BQ., 29BR., 29BS., 29BT., 29BV., 29H1., 29H2., 29H3., 29H4., 29H5., 29H6., 29H7., 29H8., 29H9., 29HA., 29HB., 2G5A., 2G5B., 2G5E., 2G5F., 2G5G., 2G5H., 2G5I., 2G5J., 2G5K., 2G5L., 585V., 585W., 585X., 585Y., 585a., 585b., 585c., 585d., 585e., 66AE., 66AW., 66Ab., 66Ac., 66Aq., 8H7r., 9NND., 2G5d., 2G5e.	None
HbA1c Measurement	42W5.	42W..11, 42W..12, 42W..00, 42W4.00, 44TC.00, 66Ae.00, 66Ae000
Retinopathy Screening	31283, 3129., 312F., 58C1., 68A7., 68A8., 9N2f.	None
Serum Cholesterol Measurement	44P.., 44P1., 44P2., 44P3., 44P4., 44PH., 44OE., 44PJ., 44PK	None
Serum Creatinine Measurement	44J3., 44J30, 44J31, 44J32, 44J33, 44J3z, 44JC., 44JD., 44JF.	None
Smoking Status Review	137.., 1371., 1372., 1373., 1374., 1375., 1376., 1377., 1378., 1379., 137A., 137B., 137C., 137D., 137F., 137G., 137H., 137J., 137K., 137K0 137L., 137M., 137N., 137O., 137P., 137Q., 137R., 137S., 137T., 137V., 137X., 137Y., 137Z., 137a., 137b., 137c., 137d., 137e., 137f., 137h., 137j., 137l., 137m., 137o.	None
Urinary Albumin Measurement	44J6., 44J7., 44lD., 46N4., 46N5., 46N6., 44JG., 46TC., 46TD.	None

Table 44. Read codes used to extract data pertaining to NDA care process achievement, 2005/06.

	England	CPRD-HES Data
NDA BMI	80.76%	75.77%
NDA BP	86.45%	83.00%
NDA Cholesterol	81.05%	77.13%
NDA Creatinine	82.67%	78.76%
NDA Foot	63.76%	68.40%
NDA HbA1c	82.54%	58.45%
NDA Retinal Screen	60.66%	23.51%
NDA Smoking Status	79.38%	39.92%
NDA Urinary Albumin	48.20%	16.74%

Table 45. Comparison of receipt of NDA care process in England and in CPRD-HES dataset, 2005/06.

Disease Category	ICD-10 Codes
Diabetes Mellitus	E10, E11, E13, E14
Hypoglycaemia	E16.0, E16.1
Vascular Syndromes of Brain	G45, G46
Cardio- and Other Cerebrovascular Disease	I10 – I79, I95 – I99
Renal Failure	N17 – N19
Hyperglycaemia	R73.9
Poisoning by Insulin or Oral Hypoglycaemic agents	T38.3

Table 46. ICD-10 codes used to identify deaths potentially related to diabetes mellitus from proximal causes of death.

Statistical Analysis

Co-Morbidity and Survival

For this analysis, all 250,000 patients (125,000 individuals with diabetes and the 125,000 controls) were included; of these, 9,112 (3.64%) could not be included in the co-morbidity analysis dataset due to missing data with respect to date of death, death prior to the observation start date, death after the observation end date or an age at death that was less than their age at the start of observation

The final dataset of 240,888 patients was analysed using Cox regression utilising the Breslow method for ties. Models were adjusted for age group, diabetes status (none, incident, prevalent), gender, deprivation fifth and smoking status.

Two analyses were performed; one that utilised each patient's CCI score at the start of observation and a series of separate models for strata of CCI score to take account of potential increases in CCI score over time for each patient. For the second series of models, utilising strata of CCI, patient observation start and end dates were recalculated according to the dates where a CCI score change led to a change in their CCI grouping; the patient in question would be censored from their original CCI model on a date one day prior to their CCI change and entered into the relevant CCI model with an observation start date that is equal to the date of their CCI change.

In addition to CCI score, the other independent variables included in this model were diabetes status (non-diabetic, incident or prevalent diabetes), gender, smoking status as of 1st April 2005 (determined using the methodology discussed on page 123), the age group of the patient at their observation start date, IMD fifth and broad region of residence. Statistical significance was assumed at $\alpha = 0.05$. The database was stored on and records extracted from FileMaker Pro Advanced V13 for Mac OS X (FileMaker Inc., CA, USA) and analyses were performed using STATA/MP V12.1 for Mac OS X (StataCorp, TX, USA).

Quality of Primary Care Diabetes Management, Emergency Admissions and Readmissions

The effects of quality of diabetes management in primary care on emergency admissions and readmissions were modelled via zero-inflated negative binomial regression. The source population for this analysis was the 125,000 individuals identified as having diabetes. Patients were eligible for inclusion in this analysis if they had received a diagnosis of diabetes before and were alive on 1st April 2005.

The count of emergency admissions and readmissions were tallied over a number of time periods that were aligned with the start and end dates of the QOF year (1st April - 31st March); the time periods used were 2005/06 (index year), 2005/06 - 2006/07 (index year + 1), 2005/06 - 2007/08 (index year + 2), 2005/06 - 2008/09 (index year + 3) and 2005/06 - 2009/10 (index year + 4). Quality of care was defined as whether a patient achieved the aforementioned QOF targets and NDA processes during QOF year 2005/06 (pages 129 – 131), each expressed as a binary variable.

Zero-inflated negative binomial models were utilised as opposed to standard negative binomial models and Poisson models on the grounds of the variance of admission counts exceeding the mean and the predominance of patients who experienced zero admissions in all years of observation (Table 47). Predictors of zero counts were set as all independent variables bar quality targets. The quality of fit for all models were assessed relative to standard negative binomial and zero-inflated Poisson models.

Models were constructed *a priori*, with the dependent variable set as either emergency admission or readmission count, the independent variables set as the quality target of interest, patient gender, age group, diabetes type (T1DM, T2DM), years since diagnosis of diabetes, smoking status (non-smoker, ex-smoker, current smoker, unknown, CCI score category (CCI = 0, CCI = 1, CCI = 2, CCI = 3 or CCI ≥ 4) and fifth of IMD quintile. Where relevant, calculation of independent variables was as previously described in this chapter.

Univariate models for each predictor were constructed prior to multiple-variable modelling. Separate multiple-variable models were then constructed for each combination of admission type (emergency admissions / readmissions), time period and quality target. Finally, full models were constructed that included all predictor variables; four separate versions of these models were constructed, utilising the various combinations of the chosen individual QOF targets *versus* attainment of all three QOF targets and receipt of individual NDA care processes *versus* the count of NDA care processes received.

The database was stored on and records extracted from FileMaker Pro Advanced V13 for Mac OS X (FileMaker Inc., CA, USA) and analyses were performed using STATA/MP V12.1 for Mac OS X (StataCorp, TX, USA).

	2005/06				2005/06 – 2006/07			
	Mean	Variance	Zero Adm	% Zero Adm*	Mean	Variance	Zero Adm	% Zero Adm*
Emergency Admissions	0.396	0.999	35,510	49.52%	0.782	2.533	28,811	40.18%
Readmissions	0.090	0.264	43,439	60.58%	0.176	0.640	41,529	57.92%

	2005/06 – 2007/08				2005/06 – 2008/09			
	Mean	Variance	Zero Adm	% Zero Adm*	Mean	Variance	Zero Adm	% Zero Adm*
Emergency Admissions	1.160	4.417	23,581	32.89%	1.557	6.579	19,058	26.58%
Readmissions	0.261	1.155	39,783	55.48%	0.353	1.761	37,980	52.97%

	2005/06 – 2009/10			
	Mean	Variance	Zero Adm	% Zero Adm*
Emergency Admissions	1.954	8.925	15,230	21.24%
Readmissions	0.445	2.332	36,385	50.74%

Table 47. Distribution characteristics of emergency admissions and readmissions, cumulative totals, CPRD-HES dataset 2005/06 - 2009/10.

* = Number of people with diabetes by 1st April 2005 = 71,703

Quality of Primary Care Diabetes Management and Mortality

The effects of quality of diabetes management in primary care on the odds of mortality, both all-cause and potentially diabetes-related, were modelled via logistic regression. The source population for this analysis was the 125,000 individuals identified as having diabetes. Patients were eligible for inclusion in this analysis if they had received a diagnosis of diabetes before and were alive on 1st April 2005.

The occurrence of death due to any cause or death due to a cause potentially related to diabetes were recorded according to which time period of interest in which they occurred; these time periods were the same as for the analyses examining emergency admissions and readmissions (page 134). Quality of care, was defined as whether a patient achieved the aforementioned QOF targets and NDA processes during QOF year 2005/06 (pages 129 – 131), each expressed as a binary variable.

Logistic regression, modelling the odds of death, was chosen in preference to modelling of survival with Cox regression on the grounds of visual inspection of log-log plots of survival for each of the QOF indicators and NDA care processes indicating non-proportional hazards, thereby violating the assumptions of Cox regression (see Appendix). The calculated odds ratios for the death due to any cause models relates to the odds of dying during the various follow-up periods, with an OR > 1 denoting increased odds of death and an OR < 1 denoted decreased odds of death.

Those quoted for the models examining deaths potentially related to diabetes express the odds of dying from a cause related to diabetes *versus* death due to another cause; as such, an OR > 1 for these models indicates an association with increased odds of dying of a potentially diabetes-related cause, whereas an OR < 1 indicates that patients with a particular characteristic may have decreased odds of dying of a potentially diabetes-related cause (i.e. they are more likely to die of something unrelated to diabetes).

Univariate models for each predictor were constructed prior to multiple-variable modelling. Separate multiple-variable models were constructed for all-cause and potentially diabetes-related mortality, time period and quality target. Models were constructed *a priori*, with the independent variables set as the quality target of interest, patient gender, age group, diabetes type (T1DM, T2DM), years since diagnosis of diabetes, smoking status (non-smoker, ex-smoker, current smoker, unknown), CCI score category (CCI = 0, CCI = 1, CCI = 2, CCI = 3 or CCI ≥ 4) and fifth of IMD quintile. Finally, full models were constructed that included all predictor

variables; four separate versions of these models were constructed, utilising the various combinations of the chosen individual QOF targets *versus* attainment of all three QOF targets and receipt of individual NDA care processes *versus* the count of NDA care processes received. Where relevant, calculation of independent variables was as previously described in this chapter.

The database was stored on and records extracted from FileMaker Pro Advanced V13 for Mac OS X (FileMaker Inc., CA, USA) and analyses were performed using STATA/MP V12.1 for Mac OS X (StataCorp, TX, USA).

Results

Allocation of Diabetes Type

Of the 125,000 patients identified as having a diagnosis of diabetes, a total of 118,971 had diagnosis Read codes that matched the list used by the MHRA; the remainder (6,029) were assumed to have diabetes by virtue of their medication history alone and were therefore not suitable for the algorithm used to allocate diabetes type in these analyses.

109,938 (92.4%) of the eligible patients identified as having diabetes had codes that all agreed upon either T1DM or T2DM; 9,033 (7.6%) patients had codes that either did not specify a diabetes type or had multiple diabetes types indicated by the codes present in their medical history. Only 219 patients had codes that did not indicate a diabetes type of interest.

The algorithm used to assign diabetes type for patients in whom diabetes type was uncertain was validated against the 109,938 patients of known diabetes type; this yielded a positive predictive value of 96.22% for T1DM and 94.94% for T2DM (Table 48).

		Original Type		
		T1DM	T2DM	TOTAL
Type from Algorithm	T1DM	3,664	144	3,808
	T2DM	5,375	100,755	106,130
	TOTAL	**9,039**	**100,899**	**109,938**

Table 48. Validation of algorithm to assign patients a diabetes against patients with a known diabetes type.

Of the 9,033 patients who could be assigned a diabetes type via the algorithm, 8,756 (96.9%) were declared as T2DM, with the remaining 277 (3.1%) patients assigned as T1DM (Table 49).

	Before	After	Delta
T1DM	9,039	9,316	277
T2DM	100,899	109,655	8,756
Mixed/Unknown	9,033	0	-9,033

Table 49. Diabetes type assignation and final totals by diabetes type for CPRD-HES dataset.

Co-Morbidity and Diabetes Status

A total of 240,888 patients were eligible for this analysis; characteristics of each patient group are shown in Table 50. Of these, 121,445 (50.42%) had received no diagnosis of diabetes mellitus, 66,942 (27.79%) had received a diagnosis of diabetes mellitus before 1st April 2005 and 52,501 (21.79%) were diagnosed with diabetes after 1st April 2005 but before the end of observation; total observation times for each group were 721,407.6, 374,737.3 and 315,800.4 person-years respectively. During the observation period, 13,458 people without diabetes died, 13,435 people with prevalent diabetes died and 5,276 people with incident diabetes died, giving rise to crude death rates (per 1,000 PY) of 18.655, 5.852 and 16.707 respectively (Table 51).

Crude death rates for each stratum of diabetes status and co-morbidity grouping are shown in Table 52 and Figure 25. Crude death rates increased with increasing co-morbidity across all patient groups; patients with prevalent diabetes had the highest crude mortality rates across all levels of co-morbidity and those with incident diabetes had the lowest crude mortality rates across all levels of co-morbidity.

In the multiple-variable Cox regression where the co-morbidity of patients was determined at the start of observation (1st April 2005) and remained fixed (Table 53), individuals with prevalent diabetes were subject to a significantly increased hazard of death compared to individuals without diabetes (HR = 1.459, $p \leq 0.001$).

Adjusted hazard ratios for co-morbidity maintained the pattern observed in crude mortality rates, namely increased hazard of death with increased burden of co-morbidity. There was some evidence of a dose-response relationship between increasing co-morbidity and hazard of death, with the hazard of death for individuals with a CCI of 4 or more was approximately 238% that of those with a CCI of 0 (Table 53).

			No DM	Prevalent DM	Incident DM
Co-Morbidity Grouping	CCI = 0	n	98,639	46,055	41,590
		%	81.22%	68.80%	79.22%
	CCI = 1	n	15,338	13,265	7,598
		%	12.63%	19.82%	14.47%
	CCI = 2	n	5,593	5,127	2,427
		%	4.61%	7.66%	4.62%
	CCI = 3	n	1,375	1,718	636
		%	1.13%	2.57%	1.21%
	CCI ≥ 4	n	500	777	250
		%	0.41%	1.16%	0.48%
Male		n	64,625	36,813	26,876
		%	53.21%	54.99%	51.19%
Age Group	< 25y	n	2,521	778	1,722
		%	2.08%	1.16%	3.28%
	25 - 44y	n	16,990	6,905	9,946
		%	13.99%	10.31%	18.94%
	45 - 64y	n	45,844	23,898	21,367
		%	37.75%	35.70%	40.70%
	65 - 74y	n	29,312	17,778	11,159
		%	24.14%	26.56%	21.25%
	≥ 75y	n	26,778	17,583	8,307
		%	22.05%	26.27%	15.82%
IMD Fifth (1 = Most Deprived)	1	n	17,006	10,820	9,140
		%	14.00%	16.16%	17.41%
	2	n	23,271	14,108	11,141
		%	19.16%	21.07%	21.22%
	3	n	24,984	13,685	10,518
		%	20.57%	20.44%	20.03%
	4	n	28,689	15,129	11,398
		%	23.62%	22.60%	21.71%
	5	n	27,212	13,016	10,083
		%	22.41%	19.44%	19.21%
Smoking Status	Non-Smoker	n	54,192	24,881	17,523
		%	44.62%	37.17%	33.38%
	Ex-Smoker	n	34,118	26,662	13,908
		%	28.09%	39.83%	26.49%
	Current Smoker	n	21,828	9,564	8,476
		%	17.97%	14.29%	16.14%
	Unknown	n	11,307	5,835	12,594
		%	9.31%	8.72%	23.99%

(table continued on next page)

			No DM	Prevalent DM	Incident DM
Region	North East	n	2,833	1,486	1,305
		%	2.33%	2.22%	2.49%
	North West	n	20,696	11,495	8,874
		%	17.04%	17.17%	16.90%
	Yorkshire	n	5,823	3,057	2,635
		%	4.79%	4.57%	5.02%
	East Midlands	n	3,857	2,156	1,642
		%	3.18%	3.22%	3.13%
	West Midlands	n	14,404	7,625	6,553
		%	11.86%	11.39%	12.48%
	East of England	n	13,586	7,890	5,446
		%	11.19%	11.79%	10.37%
	South West	n	15,559	8,630	6,647
		%	12.81%	12.89%	12.66%
	South Central	n	13,687	7,553	5,894
		%	11.27%	11.28%	11.23%
	London	n	16,388	9,110	7,070
		%	13.49%	13.61%	13.47%
	South East	n	14,612	7,940	6,435
		%	12.03%	11.86%	12.26%

Table 50. Characteristics of patients included in co-morbidity survival analysis.

		No DM	Prevalent DM	Incident DM
Patients	n	121,445	66,942	52,501
	%	50.42%	27.79%	21.79%
Observation Time (Years)	Total	721,407.6	374,737.3	315,800.4
	Mean	5.940	5.598	6.015
	Minimum	0.003	0.003	0.008
	Maximum	6.478	6.478	6.478
Deaths	n	13,458	13,435	5,276
	%	11.08%	20.07%	10.05%
Crude Death Rate per 1,000 PY		18.655	35.852	16.707

Table 51. Total patients, observation times and deaths by diabetes status.

The hazard of death for individuals who developed diabetes during the observation period did not significantly differ from that of individuals without diabetes (HR = 1.003, p = 0.835). Increasing hazard of death was also associated with a history of smoking, increasing age, deprivation and with residence in some, but not all, regions of England (Table 53).

As described earlier, additional analyses were performed that allowed for the movement of patients between co-morbidity groupings – and hence different stratified models – over time. Crude death rates and Cox regression results for co-morbidity groupings and diabetes status where patient co-morbidity could change over time are presented in Table 54 and Table 55.

Comorbidity	No DM			Prevalent DM			Incident DM		
	Deaths	Person-Years (1,000)	Rate per 1,000 PY	Deaths	Person-Years	Rate per 1,000 PY	Deaths	Person-Years	Rate per 1,000 PY
CCI = 0	8,820	593.377	14.864	7,224	265.475	27.212	3,481	252.274	13.798
CCI = 1	2,124	89.764	23.662	2,839	73.871	38.432	865	45.466	19.025
CCI = 2	1,751	29.126	60.118	2,042	24.819	82.275	631	13.412	47.047
CCI = 3	543	6.765	80.264	860	7.528	114.241	206	3.383	60.887
CCI ≥ 4	220	2.376	92.605	470	3.044	154.403	93	1.265	73.532

Table 52. Crude death rates by diabetes status and co-morbidity grouping.

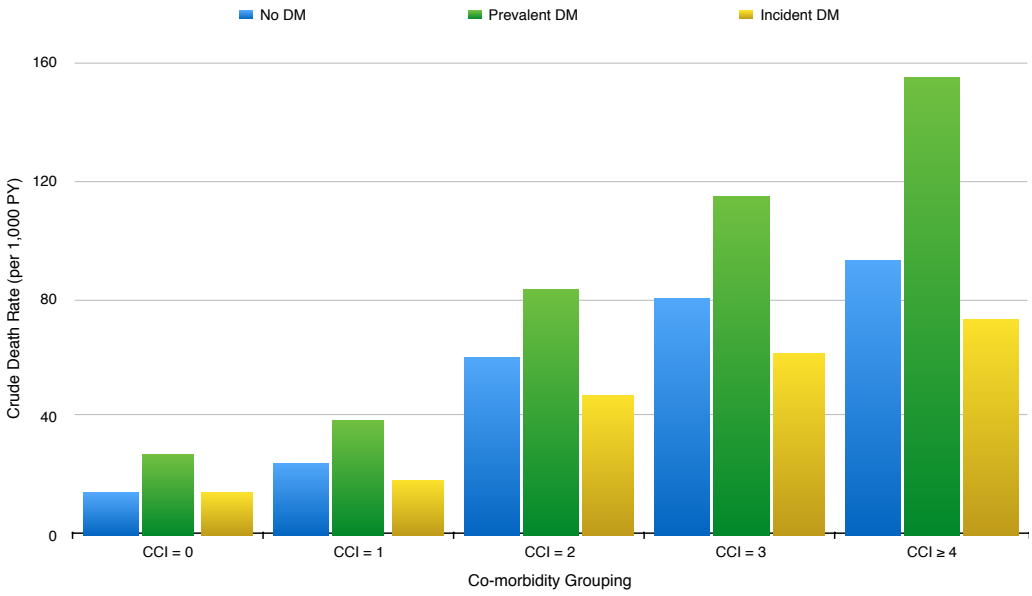


Figure 25. Crude death rates by diabetes status and co-morbidity grouping.

		HR	*p*
Diabetes Status	**No DM**	*Reference Group*	
	Prevalent DM	1.459	**< 0.001**
	Incident DM	1.003	0.835
Gender	**Male**	*Reference Group*	
	Female	0.853	**< 0.001**
Smoking Status	**Non-smoker**	*Reference Group*	
	Ex-Smoker	1.135	**< 0.001**
	Current Smoker	1.735	**< 0.001**
	Unknown	1.314	**< 0.001**
Age Group	**< 25y**	*Reference Group*	
	25 - 44y	2.912	**< 0.001**
	45 - 64y	10.450	**< 0.001**
	65 - 74y	31.745	**< 0.001**
	≥ 75y	105.815	**< 0.001**
IMD Fifth (1 = Most Deprived)	**1**	*Reference Group*	
	2	0.898	**< 0.001**
	3	0.850	**< 0.001**
	4	0.795	**< 0.001**
	5	0.729	**< 0.001**
Region of England	**North East**	*Reference Group*	
	North West	1.089	**0.025**
	Yorkshire	1.136	**0.003**
	East Midlands	1.038	0.441
	West Midlands	1.040	0.314
	East of England	1.043	0.286
	South West	1.028	0.478
	South Central	1.070	0.090
	London	0.913	**0.023**
	South East	1.015	0.704
Co-morbidity Grouping	**CCI = 0**	*Reference Group*	
	CCI = 1	1.084	**< 0.001**
	CCI = 2	2.001	**< 0.001**
	CCI = 3	2.402	**< 0.001**
	CCI ≥ 4	3.383	**< 0.001**

Table 53. Results of multiple-variable Cox regression examining the effects of diabetes status and co-morbidity on hazard of death.

HR = Hazard ratio; CCI = Charlson Co-morbidity Index

Comorbidity	No DM			Prevalent DM			Incident DM		
	Deaths	Person-Years (1,000)	Rate per 1,000 PY	Deaths	Person-Years	Rate per 1,000 PY	Deaths	Person-Years	Rate per 1,000 PY
CCI = 0	7,916	582.502	13.590	4,446	205.630	21.621	2,876	238.554	12.056
CCI = 1	1,223	76.699	15.945	1,536	53.162	28.893	410	35.308	11.612
CCI = 2	1,204	23.827	50.532	1,259	17.002	74.052	364	9.520	38.237
CCI = 3	391	5.612	69.677	583	5.292	110.158	120	2.389	50.225
CCI ≥ 4	220	2.376	92.605	470	3.044	154.403	93	1.265	73.532

Table 54. Crude death rates by co-morbidity grouping and diabetes status for analysis where patient co-morbidity was not fixed over time.

CCI = Charlson Co-morbidity Index; PY = Person-Years

		CCI = 0		CCI = 1		CCI = 2		CCI = 3		CCI ≥ 4	
		HR	*p*	HR	*p*	HR	*p*	HR	*p*	HR	*p*
Diabetes Status	**No DM**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Prevalent DM	1.559	**< 0.001**	1.767	**< 0.001**	1.586	**< 0.001**	1.651	**< 0.001**	1.570	**< 0.001**
	Incident DM	1.104	**< 0.001**	0.953	0.409	0.917	0.154	0.857	0.142	0.817	0.106

Table 55. Results for multiple-variable Cox regression for strata of co-morbidity grouping examining the effect of diabetes status on hazard of death.

Estimates of hazard ratios additionally adjusted, but coefficients not shown, for gender, smoking status at start of observation (non-, ex-, current smoker or unknown), age group (< 25y, 25 -44y, 45 -64y, 65 - 74y, ≥ 75y), fifth of IMD score for LSOA of residence and broad region of England.

HR = Hazard ratio; CCI = Charlson Co-morbidity Index

As with the analysis where patient CCI was fixed at the start of observation, patients with prevalent diabetes experienced both higher crude mortality rates and adjusted hazards of death across all levels of co-morbidity. Patients who developed diabetes during the observation period experienced a higher adjusted hazard of death in comparison to individuals without diabetes where CCI was 0, but were subject to hazards of death similar to individuals without diabetes for all other groupings of co-morbidity.

Quality of Primary Care Diabetes Management and Emergency Admissions

A total of 68,002 individuals had received a diagnosis of diabetes by 1st April 2005; of these, 67,919 (99.9%) had been determined to have either T1DM or T2DM and were therefore eligible for analysis. Details of patient demographics, years with diabetes, deprivation, smoking status and co-morbidity are shown in Table 56.

DM17 (TC ≤ 5.0mmol/L) was the most commonly achieved target, attained by 44,310 (65.24%) patients; 41,185 patients (60.64%) achieved DM12 (BP ≤ 145/85), 31,818 (46.85%) achieved DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol) and 18,970 (27.67%) achieving all three of these targets (Table 57).

		n / Mean	%
DM Type	**T1DM**	6,760	9.94%
	T2DM	61,159	89.94%
	Unknown*	83	0.12%
Age (years)		63.957	N/A
Age Group	**< 25y**	778	1.15%
	25 – 44y	6,913	10.18%
	45 – 64y	24,081	35.46%
	65 – 74y	18,086	26.63%
	≥ 75y	18,061	26.59%
Gender	**Male**	37,342	54.98%
	Female	30,577	45.02%
Years With DM		5.743	N/A
Deprivation Fifth (1 = Most Deprived)	**1**	10,982	16.17%
	2	14,320	21.08%
	3	13,914	20.49%
	4	15,337	22.58%
	5	13,180	19.41%
	Missing	186	0.27%
Smoking Status	**Non-Smoker**	25,177	37.07%
	Ex-Smoker	27,079	39.87%
	Current Smoker	9,728	14.32%
	Unknown	5,935	8.74%
CCI Group	**CCI = 0**	43,114	63.48%
	CCI = 1	14,452	21.28%
	CCI = 2	6,348	9.35%
	CCI = 3	2,578	3.80%
	CCI ≥ 4	1,427	2.10%

Table 56. Demographics, smoking status and co-morbidity for patients included in analysis of emergency admissions, readmissions and mortality as of 1st April 2005.

* = The 83 patients of unknown diabetes type were not included in any analyses or taken account of in any of the other subtotals in this table; this total is simply presented for information

T1DM = Type 1 diabetes mellitus; T2DM = Type 2 diabetes mellitus; CCI = Charlson co-morbidity index

QOF Indicator(s)		n	%
DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol)	**Not achieved**	36,101	53.15%
	Achieved	31,818	46.85%
DM12 (BP ≤ 145/85)	**Not achieved**	26,734	39.36%
	Achieved	41,185	60.64%
DM17 (TC ≤ 5.0 mmol/L)	**Not achieved**	23,609	34.76%
	Achieved	44,310	65.24%
DM06 + DM12 + DM17	**Not achieved**	49,129	72.33%
	Achieved	18,790	27.67%

Table 57. Achievement of selected QOF targets by patients included in analysis of emergency admissions, readmissions and mortality, 2005/06.

QOF = Quality and outcomes framework; HbA1c = Glycated haemoglobin; BP = Blood pressure; TC = Total cholesterol

Relatively few patients achieved all 9 NDA care processes, with only 1,343 patients (1.98%) doing so in 2005/06; the modal number of processes achieved was 7 (Table 58 and Figure 26). The most commonly achieved NDA care processes was checking of blood pressure, with 56,372 patients (83.00%) receiving this care process; the least commonly achieved was checking of urinary albumin, with only 11,372 (16.74%) receiving this process (Table 58).

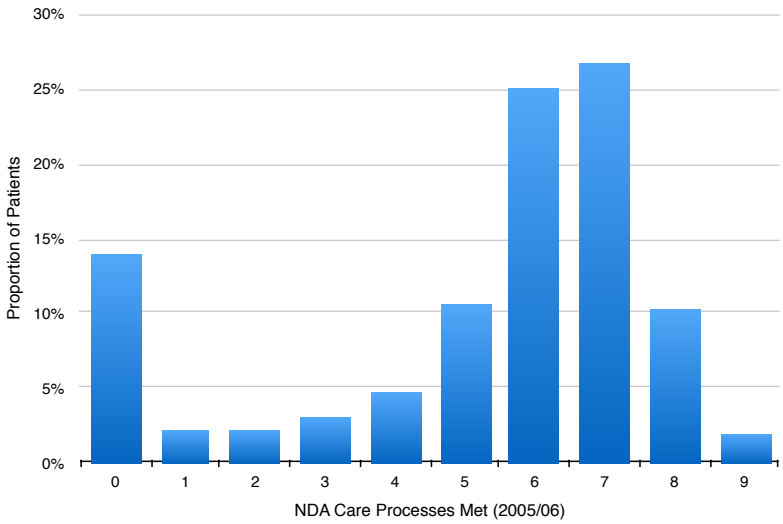


Figure 26. NDA care processes achieved by patients, 2005/06.

NDA = National Diabetes Audit

NDA Process(es) of Care		n	%
Number of NDA Processes Met	0	9,348	13.76%
	1	1,509	2.22%
	2	1,476	2.17%
	3	2,053	3.02%
	4	3,111	4.58%
	5	7,200	10.60%
	6	16,909	24.90%
	7	18,044	26.57%
	8	6,926	10.20%
	9	1,343	1.98%
NDA BMI	Not achieved	16,459	24.23%
	Achieved	51,460	75.77%
NDA BP	Not achieved	11,547	17.00%
	Achieved	56,372	83.00%
NDA Cholesterol	Not achieved	15,531	22.87%
	Achieved	52,388	77.13%
NDA Creatinine	Not achieved	14,425	21.24%
	Achieved	53,494	78.76%
NDA Foot	Not achieved	21,465	31.60%
	Achieved	46,454	68.40%
NDA HbA1c	Not achieved	28,218	41.55%
	Achieved	39,701	58.45%
NDA Retinal Screen	Not achieved	51,952	76.49%
	Achieved	15,967	23.51%
NDA Smoking Status	Not achieved	40,806	60.08%
	Achieved	27,113	39.92%
NDA Urinary Albumin	Not achieved	56,547	83.26%
	Achieved	11,372	16.74%

Table 58. Achievement of NDA care processes by patients included in analysis of emergency admissions, readmissions and mortality, 2005/06.

NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin

During the first year of observation (2005/06), the mean number of emergency admissions per patient was 0.266, rising to 1.315 over the longest follow-up period (2005/06 – 2009/10); the proportion of patients experiencing zero emergency admissions was 84.83% in 2005/06 and 55.03% in 2005/06 – 2009/10 (Table 59).

All zero-inflated negative binomial models presented in this section exhibited a significantly superior fit in comparison to Poisson and standard negative binomial models ($p < 0.001$ for both).

Univariate analyses of all predictor variables indicated that increased emergency admission rates across all lengths of follow-up were associated with T1DM, number of years with diabetes mellitus, female gender, increasing deprivation, increasing co-morbidity and having any smoking status other than non-smoker (Table 60).

Achieving any of the QOF targets in 2005/06 was associated with decreased emergency admissions, with the exception of DM12 (BP ≤ 145/85) for emergency admissions occurring in 2005/06 and 2005/06 – 2006/07; attaining all of the selected QOF targets did not seem to yield any additional benefit *versus* attainment of individual targets in univariate analyses (Table 60).

		2005/06	2005/06 - 2006/07	2005/06 - 2007/08	2005/06 - 2008/09	2005/06 - 2009/10
Mean		0.266	0.526	0.780	1.047	1.315
Zero Emergency Admissions	**n**	57,618	50,934	45,712	41,200	37,374
	%	84.83%	74.99%	67.30%	60.66%	55.03%

Table 59. Emergency admissions from individuals with diabetes by 1st April 2005 by follow-up period.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	***p***	**IRR**	***p***	**IRR**	***p***	**IRR**	***p***	**IRR**	***p***
DM Type	**T1DM**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.882	**0.011**	0.828	**< 0.001**	0.828	**< 0.001**	0.845	**< 0.001**	0.856	**< 0.001**
Years With DM		1.008	**< 0.001**	1.010	**< 0.001**	1.011	**< 0.001**	1.011	**< 0.001**	1.011	**< 0.001**
Gender	**Male**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	1.036	0.224	1.064	**0.003**	1.071	**< 0.001**	1.065	**< 0.001**	1.068	**< 0.001**
Age Group	**< 25y**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	1.023	0.886	0.895	0.305	0.928	0.408	0.904	0.206	0.862	**0.043**
	45 – 64y	0.874	0.364	0.766	**0.010**	0.771	**0.002**	0.765	**< 0.001**	0.756	**< 0.001**
	65 – 74y	0.988	0.935	0.858	0.136	0.858	0.072	0.849	**0.031**	0.832	**0.009**
	≥ 75y	1.165	0.297	1.031	0.767	1.063	0.468	1.060	0.438	1.032	0.652
Deprivation Fifth (1 = Most Deprived)	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.822	**< 0.001**	0.816	**< 0.001**	0.821	**< 0.001**	0.838	**< 0.001**	0.840	**< 0.001**
	3	0.815	**< 0.001**	0.768	**< 0.001**	0.770	**< 0.001**	0.780	**< 0.001**	0.796	**< 0.001**
	4	0.819	**< 0.001**	0.769	**< 0.001**	0.765	**< 0.001**	0.778	**< 0.001**	0.783	**< 0.001**
	5	0.765	**< 0.001**	0.729	**< 0.001**	0.718	**< 0.001**	0.712	**< 0.001**	0.713	**< 0.001**
CCI Group	**CCI = 0**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.227	**< 0.001**	1.305	**< 0.001**	1.335	**< 0.001**	1.324	**< 0.001**	1.318	**< 0.001**
	CCI = 2	1.448	**< 0.001**	1.474	**< 0.001**	1.512	**< 0.001**	1.491	**< 0.001**	1.437	**< 0.001**
	CCI = 3	1.733	**< 0.001**	1.848	**< 0.001**	1.824	**< 0.001**	1.779	**< 0.001**	1.709	**< 0.001**
	CCI ≥ 4	2.059	**< 0.001**	2.064	**< 0.001**	2.047	**< 0.001**	1.962	**< 0.001**	1.817	**< 0.001**
Smoking Status	**Non-Smoker**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.069	**0.049**	1.123	**< 0.001**	1.130	**< 0.001**	1.126	**< 0.001**	1.106	**< 0.001**
	Current Smoker	1.086	0.070	1.152	**< 0.001**	1.147	**< 0.001**	1.153	**< 0.001**	1.165	**< 0.001**
	Unknown	1.158	**0.007**	1.290	**< 0.001**	1.367	**< 0.001**	1.404	**< 0.001**	1.399	**< 0.001**
DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol)		0.820	**< 0.001**	0.822	**< 0.001**	0.831	**< 0.001**	0.830	**< 0.001**	0.833	**< 0.001**
DM12 (BP ≤ 145/85)		0.987	0.588	0.973	0.134	0.955	**0.003**	0.927	**< 0.001**	0.920	**< 0.001**
DM17 (TC ≤ 5.0 mmol/L)		0.769	**< 0.001**	0.819	**< 0.001**	0.831	**< 0.001**	0.834	**< 0.001**	0.847	**< 0.001**
DM06 + DM12 + DM17		0.858	**< 0.001**	0.863	**< 0.001**	0.867	**< 0.001**	0.857	**< 0.001**	0.854	**< 0.001**

(continued on next page...)

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	*p*	IRR	*p*	IRR	*p*	IRR	*p*	IRR	*p*
Number of NDA Processes Met	0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	1	1.506	**< 0.001**	1.272	**< 0.001**	1.136	**0.012**	1.031	0.513	0.990	0.811
	2	1.725	**< 0.001**	1.412	**< 0.001**	1.249	**< 0.001**	1.139	**0.005**	1.080	0.079
	3	1.476	**< 0.001**	1.326	**< 0.001**	1.178	**< 0.001**	1.081	0.060	1.036	0.364
	4	1.379	**< 0.001**	1.313	**< 0.001**	1.186	**< 0.001**	1.089	**0.016**	1.062	0.070
	5	0.936	0.144	0.989	0.756	0.944	0.064	0.907	**< 0.001**	0.897	**< 0.001**
	6	0.715	**< 0.001**	0.819	**< 0.001**	0.828	**< 0.001**	0.823	**< 0.001**	0.828	**< 0.001**
	7	0.626	**< 0.001**	0.748	**< 0.001**	0.791	**< 0.001**	0.800	**< 0.001**	0.821	**< 0.001**
	8	0.588	**< 0.001**	0.709	**< 0.001**	0.734	**< 0.001**	0.759	**< 0.001**	0.791	**< 0.001**
	9	0.470	**< 0.001**	0.627	**< 0.001**	0.713	**< 0.001**	0.743	**< 0.001**	0.784	**< 0.001**
NDA BMI		0.546	**< 0.001**	0.655	**< 0.001**	0.712	**< 0.001**	0.745	**< 0.001**	0.775	**< 0.001**
NDA BP		0.763	**< 0.001**	0.840	**< 0.001**	0.856	**< 0.001**	0.859	**< 0.001**	0.869	**< 0.001**
NDA Cholesterol		0.597	**< 0.001**	0.728	**< 0.001**	0.779	**< 0.001**	0.804	**< 0.001**	0.829	**< 0.001**
NDA Creatinine		0.757	**< 0.001**	0.848	**< 0.001**	0.873	**< 0.001**	0.878	**< 0.001**	0.889	**< 0.001**
NDA Foot		0.559	**< 0.001**	0.680	**< 0.001**	0.741	**< 0.001**	0.774	**< 0.001**	0.805	**< 0.001**
NDA HbA1c		0.780	**< 0.001**	0.853	**< 0.001**	0.874	**< 0.001**	0.888	**< 0.001**	0.905	**< 0.001**
NDA Retinal Screen		0.667	**< 0.001**	0.738	**< 0.001**	0.785	**< 0.001**	0.814	**< 0.001**	0.834	**< 0.001**
NDA Smoking Status		0.862	**< 0.001**	0.973	0.149	1.001	0.954	1.018	0.207	1.033	**0.013**
NDA Urinary Albumin		0.768	**< 0.001**	0.863	**< 0.001**	0.905	**< 0.001**	0.936	**< 0.001**	0.961	**0.021**

Table 60. Results, by follow-up period, of univariate zero-inflated negative binomial regression modelling of emergency admission counts.

T1DM = Type 1 diabetes mellitus; T2DM = Type 2 diabetes mellitus; CCI = Charlson co-morbidity index; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin

The total number of NDA processes achieved in 2005/06 exhibited a somewhat unexpected relationship with emergency admission rates in univariate analyses, with patients achieving 1 – 4 processes exhibiting increased emergency admission rates (versus achieving no processes) for admissions occurring in the first three follow-up periods. Receiving any of the individual care processes in 2005/06 was generally protective of emergency admissions across all follow-up periods, with the exception of smoking status review (Table 60).

Multiple-variable analysis of attainment of QOF targets in isolation in 2005/06 indicated that reaching the targets for DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol) and DM17 (TC ≤ 5.0 mmol/L) were protective of emergency admissions across all follow-up periods; the benefits of attaining DM12 (BP ≤145/85) did not demonstrate a significant association with reduced emergency admission rates until the follow-up period was extended to three or more years.

Attaining multiple QOF targets in 2005/06 did not appear to confer markedly improved benefits versus attainment of single targets for the majority of follow-up periods in these multiple-variable models. As expected, associations of QOF target achievement with reduced admission rates experienced some dilution with increasing follow-up period (Table 61, full regression tables available in Appendices).

	2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
	IRR	***p***	**IRR**	***p***	**IRR**	***p***	**IRR**	***p***	**IRR**	***p***
DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol)	0.826	**< 0.001**	0.830	**< 0.001**	0.845	**< 0.001**	0.847*	**< 0.001**	0.849	**< 0.001**
DM12 (BP ≤ 145/85)	0.981	0.430	0.976	0.185	0.968	**0.044**	0.942	**< 0.001**	0.939	**< 0.001**
DM17 (TC ≤ 5.0 mmol/L)	0.761	**< 0.001**	0.817	**< 0.001**	0.840	**< 0.001**	0.850	**< 0.001**	0.869	**< 0.001**
DM06 + DM12 + DM17	0.861	**< 0.001**	0.867	**< 0.001**	0.878	**< 0.001**	0.870	**< 0.001**	0.868	**< 0.001**

Table 61. Results from multiple-variable zero-inflated negative binomial regression of selected QOF indicators against emergency admissions.

* = Model failed to converge after 1,000 iterations

Results denote separate models for each QOF indicator(s) and follow-up period; all models also adjusted, but coefficients not shown, for diabetes type, gender, years post-diabetes diagnosis, age group, IMD fifth, smoking status and co-morbidity grouping.

IRR = Incidence rate ratio; HbA1c = Glycated haemoglobin; BP = Blood pressure; TC = Total cholesterol

Associations between receiving NDA processes of care in 2005/06 and emergency admission rates in multiple-variable analysis were similar to those observed in univariate analysis. Receiving 1 – 4 processes was associated with a significant increase in emergency admission rates versus receiving no NDA processes; however, receiving 6 – 9 processes was associated with decreased emergency admission rates, with evidence of a dose-response relationship between increasing process attainment and decreasing emergency admission rates.

Receipt of the NDA care processes pertaining to cholesterol checks, creatinine checks, foot checks, HbA1c measurement and retinopathy screening in 2005/06 were significantly associated with decreased emergency admission rates across all follow-up periods, with the greatest benefits associated with BMI and foot checks; review of smoking status in 2005/06 was associated with decreased emergency

admission rates for up to two years of follow-up and checking of urinary albumin in 2005/06 was associated with decreased emergency admission rates for up to three years of follow-up. As expected, associations of receiving NDA care processes in 2005/06 with emergency admission rates experienced some dilution with increasing follow-up period (Table 62, full tables available in Appendix).

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	***p***	**IRR**	***p***	**IRR**	***p***	**IRR**	***p***	**IRR**	***p***
Number of NDA Processes Met	**0**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	1	1.484	**< 0.001**	1.286	**< 0.001**	1.164	**0.003**	1.055	0.264	1.011	0.810
	2	1.745	**< 0.001**	1.449	**< 0.001**	1.284	**< 0.001**	1.178	**0.001**	1.115	**0.015**
	3	1.447	**< 0.001**	1.330	**< 0.001**	1.194	**< 0.001**	1.106	**0.019**	1.068	0.099
	4	1.351	**< 0.001**	1.317	**< 0.001**	1.217	**< 0.001**	1.135	**0.001**	1.115	**0.002**
	5	0.926	0.099	1.013	0.720	0.996	0.891	0.972	0.348	0.970	0.279
	6	0.707	**< 0.001**	0.838	**< 0.001**	0.873	**< 0.001**	0.883	**< 0.001**	0.897	**< 0.001**
	7	0.604	**< 0.001**	0.743	**< 0.001**	0.813	**< 0.001**	0.834	**< 0.001**	0.866	**< 0.001**
	8	0.574	**< 0.001**	0.713	**< 0.001**	0.769	**< 0.001**	0.803	**< 0.001**	0.847	**< 0.001**
	9	0.458	**< 0.001**	0.631	**< 0.001**	0.741	**< 0.001**	0.784	**< 0.001**	0.829	**< 0.001**
NDA BMI		0.548	**< 0.001**	0.666	**< 0.001**	0.739	**< 0.001**	0.782	**< 0.001**	0.819	**< 0.001**
NDA BP		0.762	**< 0.001**	0.864	**< 0.001**	0.902	**< 0.001**	0.917	**< 0.001**	0.934	**< 0.001**
NDA Cholesterol		0.592	**< 0.001**	0.734	**< 0.001**	0.805	**< 0.001**	0.843	**< 0.001**	0.875	**< 0.001**
NDA Creatinine		0.747	**< 0.001**	0.857	**< 0.001**	0.905	**< 0.001**	0.922	**< 0.001**	0.941	**0.001**
NDA Foot		0.557	**< 0.001**	0.688	**< 0.001**	0.763	**< 0.001**	0.806	**< 0.001**	0.843	**< 0.001**
NDA HbA1c		0.784	**< 0.001**	0.859	**< 0.001**	0.891	**< 0.001**	0.909	**< 0.001**	0.929	**< 0.001**
NDA Retinal Screen		0.683	**< 0.001**	0.760	**< 0.001**	0.819	**< 0.001**	0.852	**< 0.001**	0.874	**< 0.001**
NDA Smoking Status		0.824	**< 0.001**	0.936	**0.003**	0.977	0.236	1.000	0.989	1.024	0.142
NDA Urinary Albumin		0.782	**< 0.001**	0.886	**< 0.001**	0.934	**0.001**	0.965	0.061	0.991	0.585

Table 62. Results from multiple-variable zero-inflated negative binomial regression of total NDA processes achieved and individual NDA processes against emergency admissions.

Results denote separate models for each QOF indicator(s) and follow-up period; all models also adjusted, but coefficients not shown, for diabetes type, gender, years post-diabetes diagnosis, age group, IMD fifth, smoking status and co-morbidity grouping.

IRR = Incidence rate ratio; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

In addition to the multiple-variable models that examined QOF indicators or NDA process in isolation, full models were run that included all predictors of interest (Tables 63 – 66). The findings of these full models, where the effect of individual quality measures will have been adjusted for the effects of attainment of others amongst all other predictors of interest, diverged somewhat from the previous multiple-variable analysis with respect to some indicators and processes.

Attainment of DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol) in 2005/06 maintained a significantly protective association with respect to emergency admission rates across all follow-up periods in all fully-adjusted models, albeit with some attenuation of effect (IRR 0.868 – 0.924). DM12 (BP ≤ 145/85) was no longer associated with a protective effect with respect to emergency admissions in the full models and instead was associated with an increased emergency admission rate for the first two years of follow-up (IRR 1.054 – 1.123). The associations observed for DM17 (TC ≤ 5.0 mmol/L) and attainment of all selected QOF indicators in the fully-adjusted models were similar in nature to those observed in the previous multiple-variable analysis, albeit only statistically significant for follow-up periods of two to five years with some attenuation of effect (IRR 0.901 – 0.939 and IRR 0.891 – 0.936 respectively).

Associations between the receipt of a number of NDA care processes in 2005/06 in the fully-adjusted model were similar to those observed in the previous multiple-variable analysis for BMI checks, cholesterol checks, foot checks and retinal screening. The associations observed between emergency admission rates and receipt of the NDA BP check and creatinine check were reversed in comparison to the previous multiple-variable models, with receipt of these processes being associated with an increased emergency admission rate in the fully-adjusted analysis (IRR 1.189 – 1.557 and IRR 1.190 – 1.483 respectively). Receipt of the urinary albumin check care process was associated with an increased emergency admission rate in the fifth year of follow-up (IRR 1.040 – 1.044) and no significant associations between the NDA HbA1c check and emergency admissions were observed in the fully-adjusted model.

Associations in the fully-adjusted models between the total number of NDA care processes received in 2005/06 and emergency admission rates were broadly similar to those observed in the previous multiple-variable analysis for the first three years of follow-up, with receipt of four or fewer care processes being associated with increased emergency admission rates (IRR 1.167 – 1.745) and receipt of seven or more care processes having an association with decreased admission rates (IRR 0.459 – 0.910) in comparison to receiving no care processes.

In the fully-adjusted model utilising achievement of individual QOF indicators, the protective associations with decreased emergency admission rates for patients achieving seven or more NDA care processes became, for the most part, insignificant. Associations between the number of NDA care processes achieved for the fully-adjusted model utilising achievement of all three selected QOF indicators were broadly compatible with those from the partially adjusted multiple-variable models.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	***p***	**IRR**	***p***	**IRR**	***p***	**IRR**	***p***	**IRR**	***p***
DM Type	**T1DM**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.868	**0.016**	0.813	**< 0.001**	0.819	**< 0.001**	0.835	**< 0.001**	0.850	**< 0.001**
Years With DM		1.004	**0.023**	1.004	**0.002**	1.005	**< 0.001**	1.004	**0.001**	1.004	**< 0.001**
Gender	**Male**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	1.005	0.869	1.036	0.101	1.032	0.080	1.025	0.121	1.027	0.069
Age Group	**< 25y**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	1.160	0.380	1.018	0.879	1.060	0.545	1.034	0.690	0.971	0.701
	45 – 64y	1.082	0.638	0.967	0.775	0.982	0.852	0.968	0.696	0.935	0.380
	65 – 74y	1.157	0.389	1.077	0.531	1.094	0.351	1.084	0.344	1.044	0.580
	≥ 75y	1.190	0.303	1.178	0.163	1.287	**0.009**	1.328	**0.001**	1.307	**0.001**
Deprivation Fifth (1 = Most Deprived)	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.833	**< 0.001**	0.817	**< 0.001**	0.819	**< 0.001**	0.838	**< 0.001**	0.839	**< 0.001**
	3	0.799	**< 0.001**	0.753	**< 0.001**	0.754	**< 0.001**	0.766	**< 0.001**	0.785	**< 0.001**
	4	0.795	**< 0.001**	0.743	**< 0.001**	0.742	**< 0.001**	0.753	**< 0.001**	0.759	**< 0.001**
	5	0.767	**< 0.001**	0.715	**< 0.001**	0.707	**< 0.001**	0.707	**< 0.001**	0.710	**< 0.001**
CCI Group	**CCI = 0**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.225	**< 0.001**	1.320	**< 0.001**	1.327	**< 0.001**	1.317	**< 0.001**	1.316	**< 0.001**
	CCI = 2	1.412	**< 0.001**	1.483	**< 0.001**	1.478	**< 0.001**	1.449	**< 0.001**	1.404	**< 0.001**
	CCI = 3	1.703	**< 0.001**	1.874	**< 0.001**	1.765	**< 0.001**	1.705	**< 0.001**	1.648	**< 0.001**
	CCI ≥ 4	1.957	**< 0.001**	2.067	**< 0.001**	1.969	**< 0.001**	1.869	**< 0.001**	1.746	**< 0.001**
Smoking Status	**Non-Smoker**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.022	0.558	1.066	**0.020**	1.071	**0.003**	1.069	**0.002**	1.044	**0.027**
	Current Smoker	1.089	0.100	1.148	**< 0.001**	1.142	**< 0.001**	1.147	**< 0.001**	1.149	**< 0.001**
	Unknown	1.026	0.652	1.203	**< 0.001**	1.294	**< 0.001**	1.338	**< 0.001**	1.334	**< 0.001**
QOF Indicator Achievement	**DM06**	0.922	**0.001**	0.878	**< 0.001**	0.878	**< 0.001**	0.873	**< 0.001**	0.868	**< 0.001**
	DM12	1.123	**< 0.001**	1.058	**0.005**	1.025	0.153	0.984	0.323	0.972	0.052
	DM17	0.984	0.589	0.939	**0.006**	0.920	**< 0.001**	0.912	**< 0.001**	0.917	**< 0.001**
Individual NDA Processes	**BMI Check**	0.625	**< 0.001**	0.675	**< 0.001**	0.730	**< 0.001**	0.768	**< 0.001**	0.797	**< 0.001**
	BP Check	1.496	**< 0.001**	1.424	**< 0.001**	1.326	**< 0.001**	1.279	**< 0.001**	1.236	**< 0.001**
	TC Check	0.626	**< 0.001**	0.765	**< 0.001**	0.833	**< 0.001**	0.877	**< 0.001**	0.904	**0.001**
	Creatinine Check	1.483	**< 0.001**	1.382	**< 0.001**	1.321	**< 0.001**	1.263	**< 0.001**	1.220	**< 0.001**
	Foot Check	0.680	**< 0.001**	0.779	**< 0.001**	0.835	**< 0.001**	0.869	**< 0.001**	0.895	**< 0.001**
	HbA1c Check	0.967	0.220	0.964	0.087	0.964	**0.044**	0.969	0.058	0.979	0.166
	Retinal Screen	0.784	**< 0.001**	0.820	**< 0.001**	0.865	**< 0.001**	0.888	**< 0.001**	0.902	**< 0.001**
	Smoking Status Check	1.101	**0.002**	1.122	**< 0.001**	1.117	**< 0.001**	1.117	**< 0.001**	1.124	**< 0.001**
	Urinary Albumin	0.940	0.054	0.993	0.788	1.011	0.619	1.029	0.136	1.044	**0.016**

Table 63. Results from full multiple-variable zero-inflated negative binomial regression of patient characteristics, QOF indicators achieved and individual NDA processes received against emergency admissions.

IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.851	**0.006**	0.799	**< 0.001**	0.805	**< 0.001**	0.824	**< 0.001**	0.840	**< 0.001**
Years With DM		1.005	**0.011**	1.005	**< 0.001**	1.005	**< 0.001**	1.004	**< 0.001**	1.004	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	1.003	0.933	1.037	0.090	1.035	0.055	1.029	0.071	1.030	**0.043**
Age Group	< 25y	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	1.160	0.382	1.022	0.853	1.066	0.508	1.042	0.625	0.979	0.779
	45 – 64y	1.081	0.645	0.964	0.757	0.981	0.845	0.969	0.707	0.938	0.398
	65 – 74y	1.150	0.409	1.060	0.623	1.078	0.436	1.069	0.432	1.032	0.683
	≥ 75y	1.181	0.324	1.157	0.215	1.264	**0.015**	1.306	**0.002**	1.287	**0.001**
Deprivation Fifth (1 = Most Deprived)	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.831	**< 0.001**	0.817	**< 0.001**	0.820	**< 0.001**	0.839	**< 0.001**	0.840	**< 0.001**
	3	0.798	**< 0.001**	0.754	**< 0.001**	0.755	**< 0.001**	0.766	**< 0.001**	0.785	**< 0.001**
	4	0.793	**< 0.001**	0.741	**< 0.001**	0.742	**< 0.001**	0.753	**< 0.001**	0.759	**< 0.001**
	5	0.765	**< 0.001**	0.715	**< 0.001**	0.706	**< 0.001**	0.706	**< 0.001**	0.709	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.232	**< 0.001**	1.325	**< 0.001**	1.333	**< 0.001**	1.324	**< 0.001**	1.322	**< 0.001**
	CCI = 2	1.415	**< 0.001**	1.482	**< 0.001**	1.480	**< 0.001**	1.450	**< 0.001**	1.405	**< 0.001**
	CCI = 3	1.721	**< 0.001**	1.888	**< 0.001**	1.777	**< 0.001**	1.717	**< 0.001**	1.661	**< 0.001**
	CCI ≥ 4	1.974	**< 0.001**	2.074	**< 0.001**	1.973	**< 0.001**	1.870	**< 0.001**	1.746	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.024	0.521	1.067	**0.017**	1.072	**0.003**	1.068	**0.002**	1.043	**0.029**
	Current Smoker	1.095	0.082	1.153	**< 0.001**	1.148	**< 0.001**	1.152	**< 0.001**	1.153	**< 0.001**
	Unknown	1.027	0.649	1.214	**< 0.001**	1.311	**< 0.001**	1.360	**< 0.001**	1.357	**< 0.001**
All Selected QOF Indicators		0.999	0.971	0.936	**0.002**	0.924	**< 0.001**	0.902	**< 0.001**	0.891	**< 0.001**
Individual NDA Processes	BMI Check	0.625	**< 0.001**	0.673	**< 0.001**	0.728	**< 0.001**	0.766	**< 0.001**	0.795	**< 0.001**
	BP Check	1.557	**< 0.001**	1.429	**< 0.001**	1.309	**< 0.001**	1.238	**< 0.001**	1.189	**< 0.001**
	TC Check	0.621	**< 0.001**	0.749	**< 0.001**	0.810	**< 0.001**	0.852	**< 0.001**	0.881	**< 0.001**
	Creatinine Check	1.472	**< 0.001**	1.356	**< 0.001**	1.294	**< 0.001**	1.233	**< 0.001**	1.190	**< 0.001**
	Foot Check	0.680	**< 0.001**	0.777	**< 0.001**	0.832	**< 0.001**	0.866	**< 0.001**	0.892	**< 0.001**
	HbA1c Check	0.963	0.164	0.957	**0.037**	0.956	**0.014**	0.961	**0.015**	0.971	0.054
	Retinal Screen	0.784	**< 0.001**	0.819	**< 0.001**	0.863	**< 0.001**	0.886	**< 0.001**	0.901	**< 0.001**
	Smoking Status Check	1.101	**0.002**	1.121	**< 0.001**	1.115	**< 0.001**	1.114	**< 0.001**	1.121	**< 0.001**
	Urinary Albumin	0.938	**0.046**	0.990	0.675	1.007	0.732	1.026	0.185	1.040	**0.026**

Table 64. Results from full multiple-variable zero-inflated negative binomial regression of patient characteristics, attainment of all three selected QOF indicators and individual NDA processes received against emergency admissions.

IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.868	**0.016**	0.817	**< 0.001**	0.822	**< 0.001**	0.837	**< 0.001**	0.851	**< 0.001**
Years With DM		1.004	**0.031**	1.004	**0.004**	1.005	**< 0.001**	1.004	**0.001**	1.004	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.989	0.705	1.025	0.250	1.026	0.154	1.021	0.201	1.023	0.114
Age Group	< 25y	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	1.207	0.267	1.076	0.531	1.097	0.337	1.062	0.481	0.995	0.947
	45 – 64y	1.155	0.392	1.054	0.651	1.036	0.708	1.012	0.889	0.970	0.695
	65 – 74y	1.259	0.174	1.193	0.134	1.171	0.103	1.146	0.110	1.096	0.235
	≥ 75y	1.296	0.123	1.321	0.018	1.384	**0.001**	1.412	**< 0.001**	1.377	**< 0.001**
Deprivation Fifth (1 = Most Deprived)	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.832	**< 0.001**	0.813	**< 0.001**	0.816	**< 0.001**	0.834	**< 0.001**	0.833	**< 0.001**
	3	0.810	**< 0.001**	0.757	**< 0.001**	0.757	**< 0.001**	0.766	**< 0.001**	0.784	**< 0.001**
	4	0.791	**< 0.001**	0.740	**< 0.001**	0.740	**< 0.001**	0.751	**< 0.001**	0.757	**< 0.001**
	5	0.757	**< 0.001**	0.707	**< 0.001**	0.699	**< 0.001**	0.700	**< 0.001**	0.703	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.243	**< 0.001**	1.327	**< 0.001**	1.336	**< 0.001**	1.323	**< 0.001**	1.319	**< 0.001**
	CCI = 2	1.443	**< 0.001**	1.501	**< 0.001**	1.500	**< 0.001**	1.465	**< 0.001**	1.415	**< 0.001**
	CCI = 3	1.735	**< 0.001**	1.891	**< 0.001**	1.791	**< 0.001**	1.726	**< 0.001**	1.665	**< 0.001**
	CCI ≥ 4	1.998	**< 0.001**	2.096	**< 0.001**	2.009	**< 0.001**	1.906	**< 0.001**	1.775	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.156	**< 0.001**	1.193	**< 0.001**	1.178	**< 0.001**	1.164	**< 0.001**	1.131	**< 0.001**
	Current Smoker	1.286	**< 0.001**	1.338	**< 0.001**	1.295	**< 0.001**	1.284	**< 0.001**	1.276	**< 0.001**
	Unknown	1.115	0.057	1.307	**< 0.001**	1.377	**< 0.001**	1.408	**< 0.001**	1.397	**< 0.001**
QOF Indicator Achievement	DM06	0.924	**0.002**	0.880	**< 0.001**	0.881	**< 0.001**	0.876	**< 0.001**	0.871	**< 0.001**
	DM12	1.111	**< 0.001**	1.054	**0.009**	1.027	0.135	0.988	0.461	0.976	0.098
	DM17	0.947	0.058	0.918	**< 0.001**	0.906	**< 0.001**	0.901	**< 0.001**	0.909	**< 0.001**
NDA Processes Received	0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	1	1.453	**< 0.001**	1.298	**< 0.001**	1.185	**0.001**	1.090	0.071	1.048	0.302
	2	1.702	**< 0.001**	1.480	**< 0.001**	1.335	**< 0.001**	1.253	**< 0.001**	1.195	**< 0.001**
	3	1.439	**< 0.001**	1.399	**< 0.001**	1.280	**< 0.001**	1.215	**< 0.001**	1.181	**< 0.001**
	4	1.354	**< 0.001**	1.412	**< 0.001**	1.331	**< 0.001**	1.275	**< 0.001**	1.257	**< 0.001**
	5	0.935	**0.197**	1.099	**0.024**	1.103	**0.008**	1.108	**0.002**	1.110	**0.001**
	6	0.714	**< 0.001**	0.911	**0.014**	0.973	0.408	1.013	0.665	1.034	0.235
	7	0.611	**< 0.001**	0.812	**< 0.001**	0.910	**0.005**	0.963	0.215	1.004	0.887
	8	0.582	**< 0.001**	0.784	**< 0.001**	0.866	**< 0.001**	0.932	**0.049**	0.989	0.729
	9	0.463	**< 0.001**	0.695	**< 0.001**	0.836	**0.005**	0.913	0.111	0.971	0.572

Table 65. Results from full multiple-variable zero-inflated negative binomial regression of patient characteristics, QOF indicators achieved and total number of NDA processes received against emergency admissions.

IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.853	**0.007**	0.803	**< 0.001**	0.808	**< 0.001**	0.825	**< 0.001**	0.840	**< 0.001**
Years With DM		1.005	**0.016**	1.005	**0.001**	1.005	**< 0.001**	1.004	**< 0.001**	1.004	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.989	0.726	1.028	0.195	1.030	0.098	1.025	0.115	1.027	0.068
Age Group	< 25y	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	1.210	0.261	1.083	0.499	1.104	0.304	1.068	0.441	1.000	0.996
	45 – 64y	1.153	0.397	1.049	0.678	1.034	0.727	1.008	0.921	0.968	0.667
	65 – 74y	1.246	0.193	1.170	0.181	1.150	0.147	1.125	0.168	1.078	0.332
	≥ 75y	1.282	0.140	1.293	**0.028**	1.356	**0.002**	1.382	**< 0.001**	1.349	**< 0.001**
Deprivation Fifth (1 = Most Deprived)	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.830	**< 0.001**	0.812	**< 0.001**	0.817	**< 0.001**	0.835	**< 0.001**	0.834	**< 0.001**
	3	0.809	**< 0.001**	0.757	**< 0.001**	0.758	**< 0.001**	0.767	**< 0.001**	0.784	**< 0.001**
	4	0.790	**< 0.001**	0.739	**< 0.001**	0.740	**< 0.001**	0.751	**< 0.001**	0.757	**< 0.001**
	5	0.755	**< 0.001**	0.707	**< 0.001**	0.698	**< 0.001**	0.699	**< 0.001**	0.702	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.249	**< 0.001**	1.332	**< 0.001**	1.341	**< 0.001**	1.330	**< 0.001**	1.326	**< 0.001**
	CCI = 2	1.447	**< 0.001**	1.500	**< 0.001**	1.501	**< 0.001**	1.466	**< 0.001**	1.416	**< 0.001**
	CCI = 3	1.752	**< 0.001**	1.904	**< 0.001**	1.802	**< 0.001**	1.738	**< 0.001**	1.677	**< 0.001**
	CCI ≥ 4	2.009	**< 0.001**	2.100	**< 0.001**	2.012	**< 0.001**	1.906	**< 0.001**	1.775	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.158	**< 0.001**	1.196	**< 0.001**	1.179	**< 0.001**	1.164	**< 0.001**	1.131	**< 0.001**
	Current Smoker	1.293	**< 0.001**	1.346	**< 0.001**	1.304	**< 0.001**	1.291	**< 0.001**	1.282	**< 0.001**
	Unknown	1.120	**0.048**	1.321	**< 0.001**	1.394	**< 0.001**	1.428	**< 0.001**	1.416	**< 0.001**
All Selected QOF Indicators		0.993	0.784	0.936	**0.001**	0.924	**< 0.001**	0.902	**< 0.001**	0.891	**< 0.001**
NDA Processes Received	0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	1	1.485	**< 0.001**	1.289	**< 0.001**	1.167	**0.003**	1.058	0.233	1.015	0.745
	2	1.745	**< 0.001**	1.455	**< 0.001**	1.290	**< 0.001**	1.185	**< 0.001**	1.124	**0.010**
	3	1.448	**< 0.001**	1.340	**< 0.001**	1.205	**< 0.001**	1.119	**0.009**	1.083	**0.048**
	4	1.353	**< 0.001**	1.335	**< 0.001**	1.235	**< 0.001**	1.158	**< 0.001**	1.139	**< 0.001**
	5	0.928	0.111	1.030	0.427	1.015	0.650	0.997	0.913	0.997	0.913
	6	0.708	**< 0.001**	0.853	**< 0.001**	0.892	**< 0.001**	0.908	**< 0.001**	0.926	**0.002**
	7	0.605	**< 0.001**	0.758	**< 0.001**	0.833	**< 0.001**	0.861	**< 0.001**	0.896	**< 0.001**
	8	0.575	**< 0.001**	0.729	**< 0.001**	0.789	**< 0.001**	0.831	**< 0.001**	0.880	**< 0.001**
	9	0.459	**< 0.001**	0.648	**< 0.001**	0.763	**< 0.001**	0.813	**< 0.001**	0.864	**0.004**

Table 66. Results from full multiple-variable zero-inflated negative binomial regression of patient characteristics, attainment of all three selected QOF indicators and total number of NDA processes received against emergency admissions.

IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

Quality of Primary Care Diabetes Management and Readmissions

The same patients that were eligible for the emergency admissions analysis were eligible for this analysis; their characteristics, QOF attainment and NDA process receipt are described in Table 56, Table 57 and Table 58 respectively. The vast majority of patients diagnosed with diabetes by 1st April 2005 experienced no readmissions over all lengths of follow up, with 58,492 (86.12%) not experiencing a readmission over the longest follow-up period (Table 67).

		2005/06	2005/06 - 2006/07	2005/06 - 2007/08	2005/06 - 2008/09	2005/06 - 2009/10
Mean		0.060	0.118	0.175	0.237	0.300
Zero Readmissions	**n**	65,528	63,626	61,884	60,084	58,492
	%	96.48%	93.68%	91.11%	88.46%	86.12%

Table 67. Readmissions from individuals with diabetes by 1st April 2005 by follow-up period.

All zero-inflated negative binomial models presented in this section exhibited a significantly superior fit in comparison to Poisson and standard negative binomial models ($p < 0.001$ for both).

Univariate analyses of all predictor variables indicated that increased readmission rates across all lengths of follow-up were associated with T1DM and increasing deprivation. Increasing time with diabetes was associated with increased readmission rates for follow-up periods of 2 years and longer; patients in the highest co-morbidity group experienced an increased rate of readmissions across all years. Paradoxically, individuals in the older age groups, relative to the youngest, generally experienced fewer readmissions for follow-up periods of 2 years and longer (Table 68).

Achievement of DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol) and DM17 (TC ≤ 5.0 mmol/L) in 2005/06 were associated with reduced readmission rates across all follow-up periods in univariate analyses, whereas achievement of DM12 (BP ≤ 145/85) in 2005/06 was associated with reduced admission rates over follow-up periods longer than two years. As with the univariate analyses of emergency admission counts, achievement of all three QOF targets in 2005/06 did not seem to confer additional benefits with respect to readmissions (Table 68).

The total number of NDA processes achieved in 2005/06 exhibited a similar relationship to that observed with emergency admission rates in univariate analyses of readmissions, insofar as associations between patients achieving 6 or more processes and reduced rates of readmissions was concerned across all follow-up periods. Receiving any of the individual care processes in 2005/06 was generally protective of readmissions across all follow-up periods, with the exception of receiving a smoking status review in 2005/06 and readmissions occurring over the longest follow-up period (Table 68).

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.692	**0.004**	0.612	**< 0.001**	0.565	**< 0.001**	0.572	**< 0.001**	0.611	**< 0.001**
Years With DM		1.002	0.563	1.006	**0.045**	1.008	**0.003**	1.007	**0.001**	1.007	**0.001**
Gender	**Male**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.995	0.950	1.062	0.236	1.081	0.059	1.037	0.304	1.024	0.452
Age Group	**< 25y**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	0.762	0.547	0.818	0.512	0.880	0.610	0.892	0.597	0.865	0.453
	45 – 64y	0.526	0.139	0.510	**0.022**	0.525	**0.008**	0.528	**0.002**	0.523	**< 0.001**
	65 – 74y	0.432	0.052	0.455	**0.007**	0.450	**0.001**	0.446	**< 0.001**	0.451	**< 0.001**
	≥ 75y	0.441	0.056	0.421	**0.003**	0.449	**0.001**	0.464	**< 0.001**	0.455	**< 0.001**
Deprivation Fifth (1 = Most Deprived)	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.789	**0.026**	0.822	**0.011**	0.792	**< 0.001**	0.817	**< 0.001**	0.800	**< 0.001**
	3	0.731	**0.005**	0.668	**< 0.001**	0.679	**< 0.001**	0.700	**< 0.001**	0.702	**< 0.001**
	4	0.794	**0.042**	0.708	**< 0.001**	0.662	**< 0.001**	0.698	**< 0.001**	0.723	**< 0.001**
	5	0.646	**< 0.001**	0.649	**< 0.001**	0.637	**< 0.001**	0.657	**< 0.001**	0.669	**< 0.001**
CCI Group	**CCI = 0**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.087	0.396	1.263	**0.001**	1.256	**< 0.001**	1.298	**< 0.001**	1.266	**< 0.001**
	CCI = 2	1.067	0.553	1.133	0.106	1.129	0.054	1.184	**0.002**	1.169	**0.001**
	CCI = 3	1.232	0.115	1.332	**0.003**	1.347	**< 0.001**	1.384	**< 0.001**	1.406	**< 0.001**
	CCI ≥ 4	1.559	**0.002**	1.660	**< 0.001**	1.672	**< 0.001**	1.636	**< 0.001**	1.587	**< 0.001**
Smoking Status	**Non-Smoker**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.059	0.499	1.151	**0.017**	1.129	**0.012**	1.110	**0.011**	1.100	**0.009**
	Current Smoker	1.044	0.704	1.214	**0.015**	1.158	**0.025**	1.111	0.057	1.180	**0.001**
	Unknown	1.384	**0.017**	1.500	**< 0.001**	1.582	**< 0.001**	1.614	**< 0.001**	1.662	**< 0.001**
DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol)		0.729	**< 0.001**	0.710	**< 0.001**	0.730	**< 0.001**	0.732	**< 0.001**	0.743	**< 0.001**
DM12 (BP ≤ 145/85)		0.955	0.371	0.949	**< 0.001**	0.898	**0.001**	0.863	**< 0.001**	0.864	**< 0.001**
DM17 (TC ≤ 5.0 mmol/L)		0.690	**< 0.001**	0.764	**< 0.001**	0.764	**< 0.001**	0.760	**< 0.001**	0.777	**< 0.001**
DM06 + DM12 + DM17		0.796	**< 0.001**	0.806	**< 0.001**	0.816	**< 0.001**	0.796	**< 0.001**	0.799	**< 0.001**

(continued on next page...)

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
Number of NDA Processes Met	0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	1	1.339	**0.051**	1.100	0.431	0.962	0.715	0.840	0.064	0.816	**0.020**
	2	1.446	**0.013**	1.212	0.110	0.978	0.837	0.845	0.075	0.803	**0.013**
	3	1.324	**0.038**	1.232	0.055	1.078	0.427	0.992	0.928	0.979	0.789
	4	1.431	**0.002**	1.330	**0.002**	1.150	0.084	1.021	0.774	0.964	0.583
	5	0.747	**0.003**	0.863	0.056	0.816	**0.002**	0.789	**< 0.001**	0.765	**< 0.001**
	6	0.574	**< 0.001**	0.714	**< 0.001**	0.699	**< 0.001**	0.684	**< 0.001**	0.685	**< 0.001**
	7	0.460	**< 0.001**	0.613	**< 0.001**	0.648	**< 0.001**	0.661	**< 0.001**	0.696	**< 0.001**
	8	0.359	**< 0.001**	0.494	**< 0.001**	0.537	**< 0.001**	0.563	**< 0.001**	0.602	**< 0.001**
	9	0.290	**< 0.001**	0.417	**< 0.001**	0.470	**< 0.001**	0.475	**< 0.001**	0.517	**< 0.001**
NDA BMI		0.432	**< 0.001**	0.569	**< 0.001**	0.625	**< 0.001**	0.666	**< 0.001**	0.702	**< 0.001**
NDA BP		0.617	**< 0.001**	0.728	**< 0.001**	0.729	**< 0.001**	0.734	**< 0.001**	0.741	**< 0.001**
NDA Cholesterol		0.495	**< 0.001**	0.656	**< 0.001**	0.695	**< 0.001**	0.715	**< 0.001**	0.738	**< 0.001**
NDA Creatinine		0.641	**< 0.001**	0.749	**< 0.001**	0.763	**< 0.001**	0.765	**< 0.001**	0.779	**< 0.001**
NDA Foot		0.455	**< 0.001**	0.599	**< 0.001**	0.659	**< 0.001**	0.696	**< 0.001**	0.724	**< 0.001**
NDA HbA1c		0.684	**< 0.001**	0.766	**< 0.001**	0.791	**< 0.001**	0.796	**< 0.001**	0.825	**< 0.001**
NDA Retinal Screen		0.575	**< 0.001**	0.661	**< 0.001**	0.736	**< 0.001**	0.770	**< 0.001**	0.795	**< 0.001**
NDA Smoking Status		0.786	**< 0.001**	0.906	**0.018**	0.922	**0.022**	0.935	**0.029**	0.971	0.289
NDA Urinary Albumin		0.674	**< 0.001**	0.789	**< 0.001**	0.832	**< 0.001**	0.869	**< 0.001**	0.889	**0.001**

Table 68. Results, by follow-up period, of univariate zero-inflated negative binomial regression modelling of readmission counts.

IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

Multiple-variable analysis of attainment of QOF targets in 2005/06 in isolation indicated that reaching the targets for DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol) and DM17 (TC ≤ 5.0 mmol/L) were protective of readmissions across all follow-up periods; the benefits of attaining DM12 (BP ≤145/85) did not demonstrate a significant association with reduced readmission rates until the follow-up period was extended to three or more years. Attaining all three selected QOF targets in 2005/06 did not appear to confer improved benefits versus attainment of single targets across all follow-up periods. As expected, associations of QOF target achievement with reduced admission rates experienced some dilution with increasing follow-up period (Table 69, full regression tables available in Appendices).

	2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
	IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol)	0.752	**< 0.001**	0.753	**< 0.001**	0.791	**< 0.001**	0.795	**< 0.001**	0.811	**< 0.001**
DM12 (BP ≤ 145/85)	0.976	0.640	0.981	0.631	0.950	0.125	0.916	**0.003**	0.922	**0.003**
DM17 (TC ≤ 5.0 mmol/L)	0.703	**< 0.001**	0.804	**< 0.001**	0.826	**< 0.001**	0.826	**< 0.001**	0.851	**< 0.001**
DM06 + DM12 + DM17	0.816	**< 0.001**	0.845	**< 0.001**	0.876	**< 0.001**	0.855	**< 0.001**	0.861	**< 0.001**

Table 69. Results from multiple-variable zero-inflated negative binomial regression of selected QOF indicators against readmissions.

Results denote separate models for each QOF indicator(s) and follow-up period; all models also adjusted, but coefficients not shown, for diabetes type, gender, years post-diabetes diagnosis, age group, IMD fifth, smoking status and co-morbidity grouping.

IRR = Incidence rate ratio; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

Associations between receiving NDA processes of care in 2005/06 and emergency admission rates in multiple-variable analysis were similar to those observed in univariate analysis. Receiving 6 – 9 processes was associated with decreased emergency admission rates, with evidence of a dose-response relationship between increasing process attainment and decreasing emergency admission rates.

For readmissions occurring in 2005/06, receiving 1 – 4 NDA processes in 2005/06 was associated with increased readmission rates. Receipt of the NDA care processes pertaining to cholesterol checks, creatinine checks, foot checks, HbA1c measurement and retinopathy screening in 2005/06 were significantly associated with decreased readmission rates across all follow-up periods, with the greatest benefits associated with BMI and foot checks; review of smoking status in 2005/06 was associated with decreased readmission rates for up to two years of follow-up and checking of urinary albumin in 2005/06 was associated with decreased emergency admission rates for up to four years of follow-up. As expected, associations of receiving NDA care processes in 2005/06 with readmission rates experienced some dilution with increasing follow-up period (Table 70, full regression tables available in Appendices).

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
Number of NDA Processes Met	0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	1	1.374	**0.036**	1.156	0.237	1.054	0.620	0.915	0.349	0.879	0.146
	2	1.501	**0.007**	1.262	0.055	1.055	0.620	0.926	0.422	0.896	0.221
	3	1.420	**0.011**	1.358	**0.005**	1.202	0.054	1.106	0.238	1.095	0.248
	4	1.496	**0.001**	1.427	**< 0.001**	1.272	**0.004**	1.138	0.080	1.086	0.231
	5	0.782	**0.016**	0.930	0.357	0.920	0.222	0.900	0.079	0.886	**0.031**
	6	0.590	**< 0.001**	0.767	**< 0.001**	0.785	**< 0.001**	0.780	**< 0.001**	0.797	**< 0.001**
	7	0.464	**< 0.001**	0.638	**< 0.001**	0.721	**< 0.001**	0.746	**< 0.001**	0.796	**< 0.001**
	8	0.354	**< 0.001**	0.506	**< 0.001**	0.594	**< 0.001**	0.635	**< 0.001**	0.688	**< 0.001**
	9	0.291	**< 0.001**	0.446	**< 0.001**	0.526	**< 0.001**	0.551	**< 0.001**	0.603	**< 0.001**
NDA BMI		0.429	**< 0.001**	0.571	**< 0.001**	0.652	**< 0.001**	0.705	**< 0.001**	0.753	**< 0.001**
NDA BP		0.639	**< 0.001**	0.781	**< 0.001**	0.816	**< 0.001**	0.836	**< 0.001**	0.854	**< 0.001**
NDA Cholesterol		0.500	**< 0.001**	0.682	**< 0.001**	0.750	**< 0.001**	0.784	**< 0.001**	0.823	**< 0.001**
NDA Creatinine		0.658	**< 0.001**	0.798	**< 0.001**	0.845	**< 0.001**	0.860	**< 0.001**	0.890	**0.001**
NDA Foot		0.453	**< 0.001**	0.607	**< 0.001**	0.692	**< 0.001**	0.742	**< 0.001**	0.778	**< 0.001**
NDA HbA1c		0.697	**< 0.001**	0.792	**< 0.001**	0.838	**< 0.001**	0.847	**< 0.001**	0.884	**< 0.001**
NDA Retinal Screen		0.590	**< 0.001**	0.684	**< 0.001**	0.778	**< 0.001**	0.815	**< 0.001**	0.840	**< 0.001**
NDA Smoking Status		0.763	**< 0.001**	0.882	**0.007**	0.926	0.055	0.956	0.205	0.998	0.946
NDA Urinary Albumin		0.673	**< 0.001**	0.815	**< 0.001**	0.873	**0.002**	0.921	**0.031**	0.946	0.111

Table 70. Results from multiple-variable zero-inflated negative binomial regression of total NDA processes achieved and individual NDA processes against readmissions.

Results denote separate models for each NDA process / count and follow-up period; all models also adjusted, but coefficients not shown, for diabetes type, gender, years post-diabetes diagnosis, age group, IMD fifth, smoking status and co-morbidity grouping.

IRR = Incidence rate ratio; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin

In addition to the multiple-variable models run for each QOF indicator or NDA process in isolation, full models were run that included all predictors of interest (Tables 71 – 74). The findings of these full models, where the effect of individual quality measures will have been adjusted for the effects of attainment of others amongst all other predictors of interest, diverged somewhat from the previous multiple-variable analysis with respect to some indicators and processes but were broadly similar to the changes in effect size and direction that were observed for the models examining emergency admission rates (see previous section, pages 145-159).

Attainment of DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol) in 2005/06 maintained a significantly protective association with respect to readmission rates across all follow-up periods in all fully-adjusted models (IRR 0.803 – 0.872). DM12 (BP ≤ 145/85) was no longer associated with a protective effect with respect to readmissions in the fully-adjusted models and instead was associated with an increased emergency admission rate for the first two years of follow-up (IRR 1.103 –

1.194). DM17 (TC ≤ 5.0 mmol/L) exhibited a statistically significant protective effect for follow-up periods of four and five years (IRR 0.920 – 0.927) in the fully-adjusted model utilising the count of NDA processes received, but not for the model utilising receipt of individual NDA care processes. Attainment of all selected QOF indicators was associated with reductions in readmissions for the fourth and fifth years of follow-up in all fully-adjusted models (IRR 0.900 – 0.905).

Associations between the receipt of a number of individual NDA care processes in 2005/06 in the fully-adjusted model were similar to those observed in the previous multiple-variable analysis for BMI checks, cholesterol checks, foot checks and retinal screening. The associations observed between readmission rates and receipt of the NDA BP check, creatinine check and smoking status check were reversed in comparison to the previous multiple-variable models, with receipt of these processes being associated with an increased readmission rate in the fully-adjusted models (IRR 1.168 – 1.502, IRR 1.229 – 1.548 and IRR 1.120 – 1.171 respectively). Receipt of the urinary albumin check care process was not associated with significant changes in readmission rates across any length of follow-up. Some significant associations between the NDA HbA1c check and reduced readmission rates were observed; patients receiving this care process exhibited reduced readmission rates for follow-up periods of two to four years in the fully-adjusted model utilising achievement of all three QOF indicators (IRR 0.908 – 0.925), but was only significantly associated with reduced readmission rates in the fourth year of follow-up in the model utilising achievement of individual QOF indicators (IRR = 0.929).

Associations in the fully-adjusted models between the total number of NDA care processes received in 2005/06 and readmission rates were broadly similar to those observed in the previous multiple-variable analysis insofar as receipt of six or more NDA care processes being associated with reduced readmission rates for the first three years of follow-up in the model utilising individual QOF indicators *versus*

receiving no care processes (OR 0.286 – 0.862). Significant reductions in emergency admission rates were observed for receipt of seven or more or eight or more care processes *versus* receipt of no care process were observed only for follow-up periods of four and five years in the fully-adjusted model utilising individual QOF indicators (IRR 0.650 – 0.867 and IRR 0.706 – 0.798 respectively).

Associations between the number of NDA care processes achieved for the fully-adjusted model utilising achievement of all three selected QOF indicators consistently showed associations between receipt of six or more NDA care processes in 2005/06 across all years of follow-up (IRR 0.291 – 0.822).

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.837	0.206	0.769	**0.009**	0.728	**< 0.001**	0.753	**< 0.001**	0.808	**0.002**
Years With DM		1.001	0.824	1.003	0.345	1.003	0.330	1.001	0.551	1.002	0.371
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.944	0.437	1.013	0.811	1.028	0.522	0.977	0.521	0.989	0.727
Age Group	< 25y	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	0.921	0.865	1.032	0.922	1.212	0.465	1.185	0.453	1.080	0.703
	45 – 64y	0.629	0.335	0.683	0.234	0.833	0.484	0.792	0.297	0.728	0.113
	65 – 74y	0.530	0.188	0.646	0.175	0.749	0.272	0.708	0.126	0.661	**0.039**
	≥ 75y	0.478	0.125	0.545	0.059	0.703	0.180	0.704	0.119	0.648	**0.031**
Deprivation Fifth (1 = Most Deprived)	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.951	0.632	0.879	0.089	0.829	**0.003**	0.844	**0.001**	0.829	**< 0.001**
	3	0.825	0.080	0.700	**< 0.001**	0.701	**< 0.001**	0.732	**< 0.001**	0.736	**< 0.001**
	4	0.953	0.676	0.795	**0.004**	0.729	**< 0.001**	0.738	**< 0.001**	0.759	**< 0.001**
	5	0.757	**0.020**	0.737	**< 0.001**	0.701	**< 0.001**	0.697	**< 0.001**	0.708	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.040	0.684	1.233	**0.002**	1.209	**< 0.001**	1.275	**< 0.001**	1.271	**< 0.001**
	CCI = 2	1.076	0.502	1.249	**0.005**	1.234	**0.001**	1.309	**< 0.001**	1.305	**< 0.001**
	CCI = 3	1.346	**0.023**	1.477	**< 0.001**	1.484	**< 0.001**	1.519	**< 0.001**	1.568	**< 0.001**
	CCI ≥ 4	1.561	**0.002**	1.740	**< 0.001**	1.755	**< 0.001**	1.735	**< 0.001**	1.719	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.011	0.905	1.130	0.060	1.108	0.057	1.081	0.095	1.058	0.175
	Current Smoker	0.870	0.250	1.008	0.929	0.965	0.624	0.936	0.286	0.998	0.972
	Unknown	1.032	0.824	1.265	**0.020**	1.344	**< 0.001**	1.365	**< 0.001**	1.416	**< 0.001**
QOF Indicator Achievement	DM06	0.867	**0.009**	0.803	**< 0.001**	0.834	**< 0.001**	0.835	**< 0.001**	0.841	**< 0.001**
	DM12	1.194	**0.002**	1.107	**0.018**	1.035	0.349	0.982	0.569	0.978	0.455
	DM17	1.025	**0.702**	0.993	0.887	0.964	0.384	0.933	0.060	0.938	0.057
NDA Process	BMI Check	0.532	**< 0.001**	0.601	**< 0.001**	0.666	**< 0.001**	0.717	**< 0.001**	0.767	**< 0.001**
	BP Check	1.399	**0.001**	1.388	**< 0.001**	1.274	**0.001**	1.253	**0.001**	1.168	**0.012**
	TC Check	0.615	**< 0.001**	0.789	**0.002**	0.845	**0.014**	0.880	**0.037**	0.901	0.069
	Creatinine Check	1.548	**< 0.001**	1.421	**< 0.001**	1.357	**< 0.001**	1.300	**< 0.001**	1.265	**< 0.001**
	Foot Check	0.617	**< 0.001**	0.738	**< 0.001**	0.805	**< 0.001**	0.846	**< 0.001**	0.860	**< 0.001**
	HbA1c Check	0.935	0.263	0.924	0.080	0.938	0.096	0.929	**0.029**	0.958	0.165
	Retinal Screen	0.723	**< 0.001**	0.762	**< 0.001**	0.843	**< 0.001**	0.869	**< 0.001**	0.884	**< 0.001**
	Smoking Status Check	1.171	**0.019**	1.130	**0.017**	1.125	**0.007**	1.128	**0.002**	1.151	**< 0.001**
	Urinary Albumin	0.877	0.069	0.936	0.212	0.963	0.393	0.999	0.985	1.013	0.725

Table 71. Results from full multiple-variable zero-inflated negative binomial regression of patient characteristics, QOF indicators achieved and individual NDA processes received against readmissions.

IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.805	0.124	0.750	**0.004**	0.711	**< 0.001**	0.740	**< 0.001**	0.794	**0.001**
Years With DM		1.002	0.668	1.004	0.178	1.004	0.182	1.002	0.350	1.003	0.209
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.938	0.391	1.010	0.842	1.030	0.492	0.982	0.625	0.993	0.820
Age Group	< 25y	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	0.932	0.885	1.052	0.876	1.228	0.435	1.202	0.415	1.092	0.662
	45 – 64y	0.635	0.346	0.693	0.252	0.844	0.517	0.801	0.322	0.733	0.121
	65 – 74y	0.540	0.203	0.650	0.181	0.750	0.273	0.704	0.120	0.656	**0.036**
	≥ 75y	0.483	0.130	0.543	0.057	0.698	0.169	0.694	0.105	0.638	**0.025**
Deprivation Fifth (1 = Most Deprived)	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.943	0.575	0.875	0.080	0.829	**0.003**	0.846	**0.002**	0.830	**< 0.001**
	3	0.823	0.075	0.699	**< 0.001**	0.703	**< 0.001**	0.735	**< 0.001**	0.738	**< 0.001**
	4	0.945	0.619	0.782	**0.002**	0.726	**< 0.001**	0.739	**< 0.001**	0.759	**< 0.001**
	5	0.758	**0.020**	0.734	**< 0.001**	0.700	**< 0.001**	0.697	**< 0.001**	0.708	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.056	0.577	1.251	**0.001**	1.225	**< 0.001**	1.289	**< 0.001**	1.285	**< 0.001**
	CCI = 2	1.080	0.479	1.258	**0.004**	1.238	**0.001**	1.310	**< 0.001**	1.306	**< 0.001**
	CCI = 3	1.371	**0.016**	1.501	**< 0.001**	1.502	**< 0.001**	1.541	**< 0.001**	1.590	**< 0.001**
	CCI ≥ 4	1.607	**0.001**	1.765	**< 0.001**	1.768	**< 0.001**	1.739	**< 0.001**	1.724	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.014	0.875	1.135	0.051	1.109	0.056	1.079	0.103	1.057	0.180
	Current Smoker	0.871	0.254	1.016	0.857	0.971	0.682	0.939	0.313	1.002	0.971
	Unknown	1.025	0.864	1.270	0.018	1.358	**< 0.001**	1.385	**< 0.001**	1.438	**< 0.001**
All Selected QOF Indicators		0.999	0.986	0.934	0.121	0.942	0.108	0.906	**0.003**	0.900	**0.001**
NDA Process	BMI Check	0.531	**< 0.001**	0.603	**< 0.001**	0.666	**< 0.001**	0.718	**< 0.001**	0.768	**< 0.001**
	BP Check	1.502	**< 0.001**	1.424	**< 0.001**	1.267	**0.001**	1.210	**0.003**	1.126	**0.050**
	TC Check	0.620	**< 0.001**	0.790	**0.002**	0.833	**0.006**	0.861	**0.013**	0.886	**0.032**
	Creatinine Check	1.524	**< 0.001**	1.379	**< 0.001**	1.318	**< 0.001**	1.258	**0.001**	1.229	**0.001**
	Foot Check	0.617	**< 0.001**	0.734	**< 0.001**	0.801	**< 0.001**	0.841	**< 0.001**	0.855	**< 0.001**
	HbA1c Check	0.926	0.197	0.908	**0.032**	0.925	**0.040**	0.916	**0.009**	0.945	0.068
	Retinal Screen	0.722	**< 0.001**	0.762	**< 0.001**	0.841	**< 0.001**	0.867	**< 0.001**	0.883	**< 0.001**
	Smoking Status Check	1.165	**0.023**	1.126	**0.021**	1.120	**0.010**	1.121	**0.003**	1.143	**< 0.001**
	Urinary Albumin	0.874	0.064	0.930	0.175	0.958	0.334	0.994	0.868	1.008	0.829

Table 72. Results from full multiple-variable zero-inflated negative binomial regression of patient characteristics, achievement of all three selected QOF indicators and individual NDA processes received against readmissions.

IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	**p**	**IRR**	**p**	**IRR**	**p**	**IRR**	**p**	**IRR**	**p**
DM Type	**T1DM**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.863	0.295	0.796	**0.023**	0.748	**0.001**	0.767	**< 0.001**	0.818	**0.003**
Years With DM		0.999	0.899	1.002	0.583	1.002	0.394	1.001	0.600	1.002	0.368
Gender	**Male**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.897	0.146	0.984	0.756	1.012	0.787	0.968	0.367	0.983	0.585
Age Group	**< 25y**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	0.876	0.785	1.019	0.953	1.173	0.546	1.158	0.517	1.097	0.647
	45 – 64y	0.595	0.278	0.703	0.270	0.823	0.456	0.795	0.306	0.749	0.148
	65 – 74y	0.520	0.174	0.672	0.217	0.752	0.279	0.721	0.148	0.691	0.066
	≥ 75y	0.458	0.103	0.574	0.083	0.707	0.186	0.718	0.141	0.677	0.052
Deprivation Fifth (1 = Most Deprived)	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.944	0.588	0.886	0.110	0.835	**0.004**	0.847	**0.002**	0.826	**< 0.001**
	3	0.850	0.141	0.713	**< 0.001**	0.713	**< 0.001**	0.738	**< 0.001**	0.739	**< 0.001**
	4	0.937	0.572	0.796	**0.004**	0.728	**< 0.001**	0.741	**< 0.001**	0.759	**< 0.001**
	5	0.743	**0.013**	0.734	**< 0.001**	0.700	**< 0.001**	0.697	**< 0.001**	0.708	**< 0.001**
CCI Group	**CCI = 0**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.080	0.425	1.250	**0.001**	1.226	**< 0.001**	1.284	**< 0.001**	1.277	**< 0.001**
	CCI = 2	1.121	0.290	1.259	**0.004**	1.247	**0.001**	1.315	**< 0.001**	1.305	**< 0.001**
	CCI = 3	1.345	**0.024**	1.482	**< 0.001**	1.484	**< 0.001**	1.520	**< 0.001**	1.573	**< 0.001**
	CCI ≥ 4	1.578	**0.002**	1.737	**< 0.001**	1.760	**< 0.001**	1.739	**< 0.001**	1.724	**< 0.001**
Smoking Status	**Non-Smoker**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.212	**0.027**	1.305	**< 0.001**	1.254	**< 0.001**	1.209	**< 0.001**	1.179	**< 0.001**
	Current Smoker	1.080	0.508	1.220	**0.016**	1.128	0.076	1.073	0.220	1.141	**0.011**
	Unknown	1.142	0.342	1.401	**0.001**	1.447	**< 0.001**	1.444	**< 0.001**	1.491	**< 0.001**
QOF Indicator Achievement	**DM06**	0.872	**0.012**	0.806	**< 0.001**	0.838	**< 0.001**	0.837	**< 0.001**	0.844	**< 0.001**
	DM12	1.168	**0.007**	1.103	**0.023**	1.039	0.302	0.992	0.793	0.987	0.662
	DM17	0.988	0.850	0.973	0.576	0.946	0.178	0.920	**0.021**	0.927	0.023
NDA Processes Received	**0**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	1	1.324	0.066	1.156	0.240	1.069	0.531	0.946	0.561	0.906	0.267
	2	1.423	**0.022**	1.254	0.068	1.084	0.461	0.985	0.881	0.957	0.629
	3	1.383	**0.023**	1.394	**0.003**	1.278	**0.013**	1.221	**0.023**	1.207	**0.021**
	4	1.458	**0.004**	1.498	**< 0.001**	1.377	**< 0.001**	1.289	**0.001**	1.221	**0.006**
	5	0.769	**0.022**	0.987	0.882	1.008	0.913	1.030	0.665	1.007	0.905
	6	0.578	**< 0.001**	0.810	**0.008**	0.862	**0.030**	0.899	0.078	0.911	0.096
	7	0.454	**< 0.001**	0.676	**< 0.001**	0.796	**0.001**	0.867	**0.019**	0.917	0.122
	8	0.348	**< 0.001**	0.541	**< 0.001**	0.659	**< 0.001**	0.741	**< 0.001**	0.798	**0.001**
	9	0.286	**< 0.001**	0.480	**< 0.001**	0.590	**< 0.001**	0.650	**< 0.001**	0.706	**0.001**

Table 73. Results from full multiple-variable zero-inflated negative binomial regression of patient characteristics, QOF indicators achieved and total NDA processes received against readmissions.

IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	**p**	**IRR**	**p**	**IRR**	**p**	**IRR**	**p**	**IRR**	**p**
DM Type	**T1DM**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.835	0.201	0.776	**0.012**	0.730	**< 0.001**	0.754	**< 0.001**	0.803	**0.001**
Years With DM		1.000	0.948	1.003	0.336	1.003	0.232	1.002	0.399	1.003	0.216
Gender	**Male**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.895	0.139	0.984	0.754	1.015	0.728	0.974	0.467	0.987	0.679
Age Group	**< 25y**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	0.896	0.821	1.051	0.877	1.196	0.497	1.176	0.474	1.106	0.617
	45 – 64y	0.607	0.297	0.720	0.303	0.838	0.498	0.802	0.325	0.751	0.150
	65 – 74y	0.532	0.189	0.681	0.232	0.755	0.286	0.716	0.138	0.683	0.058
	≥ 75y	0.465	0.110	0.575	0.084	0.703	0.179	0.706	0.123	0.664	**0.041**
IMD	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.935	0.526	0.882	0.100	0.834	**0.004**	0.848	**0.002**	0.827	**< 0.001**
	3	0.848	0.135	0.713	**< 0.001**	0.715	**< 0.001**	0.740	**< 0.001**	0.740	**< 0.001**
	4	0.931	0.537	0.785	**0.002**	0.724	**< 0.001**	0.741	**< 0.001**	0.759	**< 0.001**
	5	0.744	**0.013**	0.732	**< 0.001**	0.699	**< 0.001**	0.697	**< 0.001**	0.707	**< 0.001**
CCI Group	**CCI = 0**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.095	0.350	1.267	**< 0.001**	1.240	**< 0.001**	1.296	**< 0.001**	1.288	**< 0.001**
	CCI = 2	1.126	0.273	1.267	**0.003**	1.251	**< 0.001**	1.315	**< 0.001**	1.306	**< 0.001**
	CCI = 3	1.370	**0.017**	1.505	**< 0.001**	1.500	**< 0.001**	1.540	**< 0.001**	1.593	**< 0.001**
	CCI ≥ 4	1.611	**0.001**	1.757	**< 0.001**	1.769	**< 0.001**	1.742	**< 0.001**	1.727	**< 0.001**
Smoking Status	**Non-Smoker**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.209	**0.029**	1.308	**< 0.001**	1.254	**< 0.001**	1.206	**< 0.001**	1.177	**< 0.001**
	Current Smoker	1.079	0.516	1.229	**0.012**	1.134	0.063	1.077	0.200	1.144	**0.009**
	Unknown	1.139	0.354	1.409	**0.001**	1.463	**< 0.001**	1.462	**< 0.001**	1.510	**< 0.001**
All Selected QOF Indicators		0.993	0.911	0.936	0.134	0.942	0.109	0.905	**0.002**	0.900	**< 0.001**
NDA Processes Received	**0**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	1	1.375	**0.036**	1.158	0.231	1.055	0.614	0.916	0.361	0.881	0.153
	2	1.501	**0.007**	1.265	0.053	1.057	0.607	0.930	0.449	0.901	0.248
	3	1.421	**0.010**	1.367	**0.004**	1.210	**0.047**	1.117	0.196	1.106	0.200
	4	1.498	**0.001**	1.450	**< 0.001**	1.289	**0.002**	1.164	**0.041**	1.110	0.131
	5	0.783	**0.018**	0.946	0.488	0.934	0.324	0.921	0.179	0.908	0.088
	6	0.591	**< 0.001**	0.780	**< 0.001**	0.797	**< 0.001**	0.801	**< 0.001**	0.819	**< 0.001**
	7	0.465	**< 0.001**	0.651	**< 0.001**	0.735	**< 0.001**	0.770	**< 0.001**	0.822	**< 0.001**
	8	0.355	**< 0.001**	0.517	**< 0.001**	0.606	**< 0.001**	0.656	**< 0.001**	0.712	**< 0.001**
	9	0.291	**< 0.001**	0.460	**< 0.001**	0.539	**< 0.001**	0.572	**< 0.001**	0.627	**< 0.001**

Table 74. Results from full multiple-variable zero-inflated negative binomial regression of patient characteristics, achievement of all three selected QOF indicators and total NDA processes received against readmissions.

IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

Quality of Primary Care Diabetes Management and Mortality

The same patients that were eligible for the analyses of emergency admission and readmission rates analysis were eligible for analysis of odds of mortality; their characteristics, QOF attainment and NDA process receipt are described Table 56, Table 57 and Table 58 respectively. The numbers of patients who died, both due to any cause and those that are potentially diabetes-related (Table 46, page 133), during various lengths of follow-up are shown in Table 75. No deaths occurred in the group of patients who were younger than 25 years of age in 2005/06, meaning that these 778 individuals were excluded from the models for 2005/06.

		2005/06	2005/06 - 2006/07	2005/06 - 2007/08	2005/06 - 2008/09	2005/06 - 2009/10
Died (all cause)	**n**	2,444	4,792	7,214	9,545	11,878
	%	3.60%	7.06%	10.62%	14.05%	17.49%
Died (potentially DM-related)	**n**	1,215	2,292	3,418	4,460	5,527
	% (of patients)	1.79%	3.37%	5.03%	6.57%	8.14%
	% (of deaths)	49.71%	47.83%	47.38%	46.73%	46.53%

Table 75. Deaths occurring by follow-up period from individuals diagnosed with diabetes mellitus by 1st April 2005.

Univariate analyses of all-cause mortality suggested associations between T2DM, the number of years with diabetes, female gender increasing age, residence in the most deprived fifth of England, increasing co-morbidity and being an ex-smoker with increased odds of death across all follow-up periods (Table 76).

Attaining QOF target DM17 (TC ≤ 5.0 mmol/L) was most consistently associated with decreased odds of death in univariate analyses. Attaining QOF targets DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol) and DM12 (BP ≤ 145/85) were both associated with decreased odds of same-year death, but were only otherwise associated with increased odds of death over four- and five-year follow-up and two- to four-year follow-up respectively in univariate analyses (Table 76).

Receipt of 6 or more NDA care processes was associated with decreased odds of death compared to receiving no care processes across all time periods in univariate analyses, whereas receiving 1 – 3 care processes was associated with increased odds of death compared to receiving no care processes. Receipt of any single NDA care process, with the exception of smoking status review, in 2005/06 was associated with decreased odds of death across all follow-up periods in univariate analyses. Review of smoking status in 2005/06 was only associated with decreased odds of death for follow-up periods covering 1 to 3 years in univariate analyses (Table 76).

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	**p**	**OR**	**p**	**OR**	**p**	**OR**	**p**	**OR**	**p**
DM Type	**T1DM**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	1.809	**< 0.001**	1.984	**< 0.001**	2.251	**< 0.001**	2.450	**< 0.001**	2.463	**< 0.001**
Years With DM		1.019	**< 0.001**	1.016	**< 0.001**	1.017	**< 0.001**	1.019	**< 0.001**	1.020	**< 0.001**
Gender	**Male**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	1.072	0.092	1.102	**0.001**	1.109	**< 0.001**	1.106	**< 0.001**	1.111	**< 0.001**
Age Group	**< 25y**	*No Events**		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		2.034	0.232	1.306	**0.500**	1.585	0.211	1.715	0.101
	45 – 64y	3.726	**< 0.001**	5.556	**0.003**	3.677	**0.001**	4.559	**< 0.001**	4.773	**< 0.001**
	65 – 74y	11.924	**< 0.001**	16.180	**< 0.001**	11.116	**< 0.001**	13.246	**< 0.001**	13.990	**< 0.001**
	≥ 75y	38.462	**< 0.001**	54.826	**< 0.001**	38.633	**< 0.001**	49.670	**< 0.001**	54.800	**< 0.001**
IMD	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.007	0.917	0.904	**0.034**	0.890	**0.004**	0.912	**0.010**	0.916	**0.007**
	3	1.076	0.271	0.897	**0.025**	0.895	**0.006**	0.898	**0.003**	0.909	**0.004**
	4	0.952	0.467	0.868	**0.003**	0.896	**0.005**	0.920	**0.017**	0.926	**0.017**
	5	0.830	**0.009**	0.746	**< 0.001**	0.750	**< 0.001**	0.758	**< 0.001**	0.777	**< 0.001**
CCI Group	**CCI = 0**	*Reference Group¶*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.503	**< 0.001**	1.436	**< 0.001**	1.498	**< 0.001**	1.480	**< 0.001**	1.490	**< 0.001**
	CCI = 2	4.227	**< 0.001**	3.793	**< 0.001**	3.907	**< 0.001**	3.895	**< 0.001**	3.835	**< 0.001**
	CCI = 3	5.732	**< 0.001**	5.908	**< 0.001**	6.018	**< 0.001**	6.050	**< 0.001**	6.001	**< 0.001**
	CCI ≥ 4	10.034	**< 0.001**	9.326	**< 0.001**	9.449	**< 0.001**	9.924	**< 0.001**	10.147	**< 0.001**
Smoking Status	**Non-Smoker**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.234	**< 0.001**	1.305	**< 0.001**	1.354	**< 0.001**	1.379	**< 0.001**	1.388	**< 0.001**
	Current Smoker	0.900	0.116	0.996	0.933	1.039	0.341	1.025	0.491	1.053	0.114
	Unknown	0.321	**< 0.001**	0.422	**< 0.001**	0.601	**< 0.001**	0.740	**< 0.001**	0.867	**0.001**
DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol)		0.780	**< 0.001**	0.962	0.198	1.044	0.088	1.083	**< 0.001**	1.117	**< 0.001**
DM12 (BP ≤ 145/85)		0.909	**0.023**	1.095	**0.004**	1.094	**< 0.001**	1.069	**0.003**	1.041	0.054
DM17 (TC ≤ 5.0 mmol/L)		0.474	**< 0.001**	0.702	**< 0.001**	0.785	**< 0.001**	0.828	**< 0.001**	0.857	**< 0.001**
DM06 + DM12 + DM17		0.674	**< 0.001**	0.897	**0.002**	0.965	0.203	0.996	0.870	1.012	0.589

(continued on next page...)

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
Number of NDA Processes Met	0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	1	2.813	**< 0.001**	2.759	**< 0.001**	2.652	**< 0.001**	2.418	**< 0.001**	2.325	**< 0.001**
	2	2.943	**< 0.001**	2.961	**< 0.001**	2.914	**< 0.001**	2.650	**< 0.001**	2.536	**< 0.001**
	3	1.593	**< 0.001**	1.948	**< 0.001**	1.992	**< 0.001**	1.975	**< 0.001**	1.920	**< 0.001**
	4	1.094	0.253	1.504	**< 0.001**	1.613	**< 0.001**	1.553	**< 0.001**	1.584	**< 0.001**
	5	0.471	**< 0.001**	0.871	**0.014**	0.988	0.801	1.001	0.984	1.024	0.564
	6	0.222	**< 0.001**	0.516	**< 0.001**	0.680	**< 0.001**	0.733	**< 0.001**	0.787	**< 0.001**
	7	0.149	**< 0.001**	0.425	**< 0.001**	0.612	**< 0.001**	0.701	**< 0.001**	0.767	**< 0.001**
	8	0.098	**< 0.001**	0.359	**< 0.001**	0.544	**< 0.001**	0.630	**< 0.001**	0.697	**< 0.001**
	9	0.129	**< 0.001**	0.338	**< 0.001**	0.506	**< 0.001**	0.628	**< 0.001**	0.733	**< 0.001**
NDA BMI		0.173	**< 0.001**	0.322	**< 0.001**	0.413	**< 0.001**	0.463	**< 0.001**	0.506	**< 0.001**
NDA BP		0.306	**< 0.001**	0.545	**< 0.001**	0.676	**< 0.001**	0.739	**< 0.001**	0.794	**< 0.001**
NDA Cholesterol		0.188	**< 0.001**	0.388	**< 0.001**	0.510	**< 0.001**	0.574	**< 0.001**	0.625	**< 0.001**
NDA Creatinine		0.352	**< 0.001**	0.619	**< 0.001**	0.760	**< 0.001**	0.819	**< 0.001**	0.864	**< 0.001**
NDA Foot		0.166	**< 0.001**	0.352	**< 0.001**	0.467	**< 0.001**	0.528	**< 0.001**	0.576	**< 0.001**
NDA HbA1c		0.396	**< 0.001**	0.628	**< 0.001**	0.746	**< 0.001**	0.797	**< 0.001**	0.819	**< 0.001**
NDA Retinal Screen		0.293	**< 0.001**	0.472	**< 0.001**	0.570	**< 0.001**	0.627	**< 0.001**	0.661	**< 0.001**
NDA Smoking Status		0.416	**< 0.001**	0.740	**< 0.001**	0.884	**< 0.001**	0.961	0.081	1.016	0.441
NDA Urinary Albumin		0.293	**< 0.001**	0.548	**< 0.001**	0.658	**< 0.001**	0.724	**< 0.001**	0.783	**< 0.001**

Table 76. Results, by follow-up period, of univariate logistic regression modelling of deaths due to any cause.

¶ = group declared as empty by STATA

* = No deaths during follow-up period, 778 patients excluded for this year only; IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

In multiple-variable analyses of associations between attainment of individual QOF indicators in 2005/06 in isolation and death due to any cause, separate achievement of DM06 and DM12 were associated with decreased odds of death across all follow-up periods, albeit with some attenuation of effect with longer periods of follow-up. Attaining DM12 in 2005/06 was associated with decreased odds of same-year death, but associations were non-significant for all other follow-up periods in multiple-variable regression. Attaining all three selected QOF indicators in 2005/06 was associated with decreased odds of death across all time periods, but the magnitude of effect did not exceed the maximal effect associated with attaining one of the component indicators in isolation (Table 77, full regression tables available in Appendices).

Multi-variable analyses of associations between receipt of NDA care processes in 2005/06 in isolation and death due to any cause, receiving any individual care process was associated with decreased odds of death across all follow-up periods (Table 78, full regression tables available in Appendices).

As noted with the univariate analyses of total NDA care processes received and the multiple-variable regressions for emergency admissions and readmissions, there appeared to be a threshold of total NDA care processes below which associations with increased odds of death were observed and past which associations with decreased odds of death were seen. Receiving 5 or more NDA care processes in 2005/06 was associated with decreased odds of death across all follow-up periods compared to receiving no NDA care processes, whereas receiving 1 – 2 care processes in 2005/06 was associated with increased odds of death across all follow-up periods (Table 78, full regression tables available in Appendices).

	2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
	OR	p	OR	p	OR	p	OR	p	OR	p
DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol)	0.550	**< 0.001**	0.678	**< 0.001**	0.742	**< 0.001**	0.772	**< 0.001**	0.804	**< 0.001**
DM12 (BP ≤ 145/85)	0.777	**< 0.001**	0.961	0.228	0.984	0.569	0.977	0.362	0.963	0.113
DM17 (TC ≤ 5.0 mmol/L)	0.343	**< 0.001**	0.525	**< 0.001**	0.597	**< 0.001**	0.638	**< 0.001**	0.670	**< 0.001**
DM06 + DM12 + DM17	0.530	**< 0.001**	0.708	**< 0.001**	0.763	**< 0.001**	0.787	**< 0.001**	0.802	**< 0.001**

Table 77. Results from multiple-variable logistic regression of odds of death due to any cause for selected QOF indicators.

Results denote separate models for each QOF indicator(s) and follow-up period; all models also adjusted, but coefficients not shown, for diabetes type, gender, years post-diabetes diagnosis, age group, IMD fifth, smoking status and co-morbidity grouping.

BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
Number of NDA Processes Met	0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	1	1.853	**< 0.001**	1.938	**< 0.001**	2.025	**< 0.001**	1.936	**< 0.001**	1.984	**< 0.001**
	2	1.747	**< 0.001**	1.916	**< 0.001**	2.117	**< 0.001**	2.043	**< 0.001**	2.117	**< 0.001**
	3	0.905	0.269	1.230	**0.009**	1.400	**< 0.001**	1.507	**< 0.001**	1.585	**< 0.001**
	4	0.596	**< 0.001**	0.905	0.163	1.078	0.252	1.104	0.108	1.228	**0.001**
	5	0.254	**< 0.001**	0.518	**< 0.001**	0.643	**< 0.001**	0.687	**< 0.001**	0.752	**< 0.001**
	6	0.114	**< 0.001**	0.286	**< 0.001**	0.411	**< 0.001**	0.466	**< 0.001**	0.536	**< 0.001**
	7	0.069	**< 0.001**	0.211	**< 0.001**	0.332	**< 0.001**	0.404	**< 0.001**	0.474	**< 0.001**
	8	0.044	**< 0.001**	0.173	**< 0.001**	0.287	**< 0.001**	0.354	**< 0.001**	0.419	**< 0.001**
	9	0.055	**< 0.001**	0.148	**< 0.001**	0.242	**< 0.001**	0.322	**< 0.001**	0.404	**< 0.001**
NDA BMI		0.136	**< 0.001**	0.253	**< 0.001**	0.329	**< 0.001**	0.374	**< 0.001**	0.417	**< 0.001**
NDA BP		0.168	**< 0.001**	0.318	**< 0.001**	0.421	**< 0.001**	0.481	**< 0.001**	0.548	**< 0.001**
NDA Cholesterol		0.123	**< 0.001**	0.260	**< 0.001**	0.354	**< 0.001**	0.408	**< 0.001**	0.458	**< 0.001**
NDA Creatinine		0.202	**< 0.001**	0.375	**< 0.001**	0.487	**< 0.001**	0.544	**< 0.001**	0.597	**< 0.001**
NDA Foot		0.124	**< 0.001**	0.262	**< 0.001**	0.352	**< 0.001**	0.402	**< 0.001**	0.445	**< 0.001**
NDA HbA1c		0.312	**< 0.001**	0.501	**< 0.001**	0.608	**< 0.001**	0.658	**< 0.001**	0.682	**< 0.001**
NDA Retinal Screen		0.290	**< 0.001**	0.464	**< 0.001**	0.563	**< 0.001**	0.623	**< 0.001**	0.658	**< 0.001**
NDA Smoking Status		0.236	**< 0.001**	0.477	**< 0.001**	0.608	**< 0.001**	0.700	**< 0.001**	0.772	**< 0.001**
NDA Urinary Albumin		0.268	**< 0.001**	0.497	**< 0.001**	0.597	**< 0.001**	0.658	**< 0.001**	0.717	**< 0.001**

Table 78. Results from multiple-variable logistic regression of odds of death due to any cause for NDA care processes.

Results denote separate models for each NDA process / count and follow-up period; all models also adjusted, but coefficients not shown, for diabetes type, gender, years post-diabetes diagnosis, age group, IMD fifth, smoking status and co-morbidity grouping.

In addition to the multiple-variable models examining the odds of death due to any cause for each QOF indicator or NDA process in isolation, full models were run that included all predictors of interest (Tables 79 – 82).

A number of significant associations persisted in the fully-adjusted models of death due to any cause. Female gender and residing in the least deprived areas of England were associated with decreased odds of death across all follow-up periods in all models. Increasing levels of co-morbidity and being an ex- or current smoker were both associated with increased odds of death across all time periods in all models.

Individuals diagnosed with T2DM exhibited significantly decreased odds of death over the first three years of follow-up, but were non-significant for longer periods of follow-up. Increasing time with diabetes – measured as years with diabetes – was significantly associated with increased odds of death for follow-up periods of three to five years.

In the fully-adjusted models, associations between receipt of QOF indicator DM12 (BP ≤ 145/85) and increased odds of death were observed for all follow-up periods (OR 1.214 – 1.840), with the greatest odds of death observed over the shortest lengths of follow-up. In the full model considering receipt of individual NDA processes, achievement of DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol) was associated with increased odds of death over one year of follow-up (OR = 1.116); DM17 (TC ≤ 5.0 mmol/L) was associated with increased odds of death for the first two years of follow-up in the full model utilising individual NDA processes (OR 1.099 – 1.224) and with decreased odds of death for four and five years of follow-up in the full model utilising the total number of NDA care processes received (OR 0.914 – 0.928).

Achievement of all three selected QOF targets in 2005/06 was associated with increased odds of death over a follow-up period of one to two years in the fully-adjusted model utilising individual NDA processes (OR 1.085 – 1.118) and with borderline significance over a follow-up period of one year in the fully-adjusted model utilising the total number of NDA care processes received (OR = 1.123).

Insofar as associations with individual NDA care processes in the fully-adjusted models are concerned, BMI checks (OR 0.500 – 0.530), total cholesterol checks (OR 0.237 – 0.502), foot checks (OR 0.327 – 0.620), HbA1c checks (OR 0.779 – 0.896), retinal screening (OR 0.525 – 0.782) and urinary albumin checks (OR 0.579 – 0.881) were all associated with decreased odds of death across all follow-up periods; the patterns and magnitude of estimated ORs were similar across the separate fully-adjusted models utilising individual QOF targets and achievement of all three QOF targets.

Creatinine checks were associated with increased odds of death across all follow-up periods (OR 1.928 – 2.247); blood pressure checks showed no significant association with odds of death for follow-up periods of one and two years for the fully-adjusted model utilising achievement of separate QOF indicators, but was associated with increased odds of death for follow-up periods of three or more years (OR 1.167 – 1.370) in the fully-adjusted model using separate QOF indicators and was associated with an increased odds of death across all lengths of follow-up in the fully-adjusted model examining achievement of all three QOF indicators (OR

1.169 – 1.473). Review of smoking status was associated with significantly reduced odds of death over one year of follow up in (OR 0.724 – 0.728), but was associated with increased odds of death over four and five years of follow-up (OR 1.112 – 1.156) in both of the fully-adjusted models examining attainment of individual NDA care processes.

For the full models examining odds of death due to any cause that utilised the total number of NDA processes received (Table 81 and Table 82), a similar pattern of associations as that for multiple-variable models examining the number of NDA processes received without any additional adjustment for other quality metrics and the univariate model was observed.

Compared to receiving no processes of care, receipt of between 1 – 2 care processes (one year of follow-up) and 1 – 4 processes (five years of follow-up) were associated with increased odds of death in both fully-adjusted models. Receipt of 5 or more care processes was associated with decreased odds of death across all follow-up periods in comparison to receiving no NDA processes. Where a protective association was observed, the greatest magnitudes of associations were observed over the shortest period of follow-up; for individuals receiving all 9 processes, considerable associations with reduced odds of death versus individuals receiving no processes of care were observed over one year of follow-up (OR 0.035 – 0.052) that remained both clinically and statistically meaningful over five years of follow-up (OR 0.397 – 0.409).

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.702	**0.001**	0.741	**< 0.001**	0.844	**0.017**	0.925	0.227	0.909	0.106
Years With DM		1.003	0.325	1.001	0.546	1.005	**0.007**	1.008	**< 0.001**	1.011	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.788	**< 0.001**	0.830	**< 0.001**	0.833	**< 0.001**	0.823	**< 0.001**	0.820	**< 0.001**
Age Group	< 25y	*No Events**		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		2.414	0.140	1.415	0.383	1.639	0.182	1.777	0.082
	45 – 64y	5.820	**< 0.001**	8.884	**< 0.001**	4.864	**< 0.001**	5.430	**< 0.001**	5.706	**< 0.001**
	65 – 74y	19.990	**< 0.001**	26.560	**< 0.001**	14.882	**< 0.001**	15.835	**< 0.001**	16.988	**< 0.001**
	≥ 75y	50.117	**< 0.001**	77.994	**< 0.001**	46.605	**< 0.001**	55.140	**< 0.001**	63.345	**< 0.001**
Deprivation Fifth (1 = Most Deprived)	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.943	0.433	0.846	**0.002**	0.831	**< 0.001**	0.851	**< 0.001**	0.852	**< 0.001**
	3	0.982	0.812	0.799	**< 0.001**	0.792	**< 0.001**	0.784	**< 0.001**	0.790	**< 0.001**
	4	0.888	0.113	0.780	**< 0.001**	0.793	**< 0.001**	0.801	**< 0.001**	0.793	**< 0.001**
	5	0.792	**0.003**	0.689	**< 0.001**	0.681	**< 0.001**	0.671	**< 0.001**	0.677	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.415	**< 0.001**	1.301	**< 0.001**	1.363	**< 0.001**	1.355	**< 0.001**	1.374	**< 0.001**
	CCI = 2	2.452	**< 0.001**	2.261	**< 0.001**	2.411	**< 0.001**	2.459	**< 0.001**	2.459	**< 0.001**
	CCI = 3	2.850	**< 0.001**	3.127	**< 0.001**	3.299	**< 0.001**	3.417	**< 0.001**	3.463	**< 0.001**
	CCI ≥ 4	4.107	**< 0.001**	4.220	**< 0.001**	4.545	**< 0.001**	5.038	**< 0.001**	5.367	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.261	**< 0.001**	1.185	**< 0.001**	1.176	**< 0.001**	1.147	**< 0.001**	1.128	**< 0.001**
	Current Smoker	1.556	**< 0.001**	1.590	**< 0.001**	1.674	**< 0.001**	1.613	**< 0.001**	1.681	**< 0.001**
	Unknown	0.147	**< 0.001**	0.249	**< 0.001**	0.409	**< 0.001**	0.540	**< 0.001**	0.695	**< 0.001**
QOF Indicator Achievement	DM06	1.116	**0.045**	0.983	0.648	0.966	0.269	0.961	0.153	0.971	0.255
	DM12	1.840	**< 0.001**	1.580	**< 0.001**	1.400	**< 0.001**	1.303	**< 0.001**	1.214	**< 0.001**
	DM17	1.224	**0.001**	1.099	**0.035**	1.001	0.982	0.977	0.494	0.957	0.161
NDA Process	BMI Check	0.516	**< 0.001**	0.500	**< 0.001**	0.509	**< 0.001**	0.517	**< 0.001**	0.529	**< 0.001**
	BP Check	0.868	0.068	1.055	0.411	1.167	**0.010**	1.237	**< 0.001**	1.370	**< 0.001**
	TC Check	0.237	**< 0.001**	0.354	**< 0.001**	0.431	**< 0.001**	0.468	**< 0.001**	0.502	**< 0.001**
	Creatinine Check	2.040	**< 0.001**	2.142	**< 0.001**	2.093	**< 0.001**	2.002	**< 0.001**	1.928	**< 0.001**
	Foot Check	0.327	**< 0.001**	0.484	**< 0.001**	0.565	**< 0.001**	0.597	**< 0.001**	0.618	**< 0.001**
	HbA1c Check	0.779	**< 0.001**	0.832	**< 0.001**	0.877	**< 0.001**	0.896	**< 0.001**	0.876	**< 0.001**
	Retinal Screen	0.525	**< 0.001**	0.647	**< 0.001**	0.719	**< 0.001**	0.764	**< 0.001**	0.782	**< 0.001**
	Smoking Status Check	0.724	**< 0.001**	0.968	0.485	1.036	0.353	1.112	**0.002**	1.154	**< 0.001**
	Urinary Albumin	0.579	**< 0.001**	0.749	**< 0.001**	0.798	**< 0.001**	0.836	**< 0.001**	0.878	**< 0.001**

Table 79. Results from full multiple-variable logistic regression of patient characteristics, QOF indicators achieved and individual NDA processes received against death due to any cause.

* = No deaths during follow-up period, 778 patients excluded for this year only; IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.690	**< 0.001**	0.724	**< 0.001**	0.829	**0.008**	0.911	0.147	0.899	0.073
Years With DM		1.002	0.465	1.001	0.544	1.005	**0.006**	1.008	**< 0.001**	1.011	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.768	**< 0.001**	0.816	**< 0.001**	0.826	**< 0.001**	0.819	**< 0.001**	0.818	**< 0.001**
Age Group	< 25y	*No Events**		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		2.309	0.161	1.374	0.425	1.603	0.203	1.748	0.091
	45 – 64y	5.794	**< 0.001**	8.439	**< 0.001**	4.677	**< 0.001**	5.262	**< 0.001**	5.568	**< 0.001**
	65 – 74y	20.093	**< 0.001**	25.279	**< 0.001**	14.283	**< 0.001**	15.305	**< 0.001**	16.540	**< 0.001**
	≥ 75y	50.355	**< 0.001**	73.742	**< 0.001**	44.522	**< 0.001**	53.087	**< 0.001**	61.562	**< 0.001**
Deprivation Fifth (1 = Most Deprived)	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.945	0.445	0.846	**0.002**	0.830	**< 0.001**	0.850	**< 0.001**	0.851	**< 0.001**
	3	0.984	0.830	0.798	**< 0.001**	0.792	**< 0.001**	0.784	**< 0.001**	0.789	**< 0.001**
	4	0.889	0.113	0.778	**< 0.001**	0.792	**< 0.001**	0.800	**< 0.001**	0.792	**< 0.001**
	5	0.794	**0.004**	0.689	**< 0.001**	0.680	**< 0.001**	0.670	**< 0.001**	0.676	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.412	**< 0.001**	1.304	**< 0.001**	1.365	**< 0.001**	1.357	**< 0.001**	1.376	**< 0.001**
	CCI = 2	2.487	**< 0.001**	2.291	**< 0.001**	2.433	**< 0.001**	2.478	**< 0.001**	2.473	**< 0.001**
	CCI = 3	2.909	**< 0.001**	3.179	**< 0.001**	3.339	**< 0.001**	3.451	**< 0.001**	3.487	**< 0.001**
	CCI ≥ 4	4.254	**< 0.001**	4.326	**< 0.001**	4.622	**< 0.001**	5.104	**< 0.001**	5.416	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.267	**< 0.001**	1.189	**< 0.001**	1.178	**< 0.001**	1.148	**< 0.001**	1.129	**< 0.001**
	Current Smoker	1.545	**< 0.001**	1.592	**< 0.001**	1.679	**< 0.001**	1.618	**< 0.001**	1.685	**< 0.001**
	Unknown	0.132	**< 0.001**	0.235	**< 0.001**	0.397	**< 0.001**	0.529	**< 0.001**	0.687	**< 0.001**
All Selected QOF Indicators		1.188	**0.004**	1.085	**0.040**	1.026	0.431	1.002	0.935	0.981	0.476
NDA	BMI Check	0.524	**< 0.001**	0.504	**< 0.001**	0.511	**< 0.001**	0.519	**< 0.001**	0.530	**< 0.001**
	BP Check	1.169	**0.035**	1.291	**< 0.001**	1.338	**< 0.001**	1.371	**< 0.001**	1.473	**< 0.001**
	TC Check	0.250	**< 0.001**	0.363	**< 0.001**	0.430	**< 0.001**	0.464	**< 0.001**	0.495	**< 0.001**
	Creatinine Check	2.247	**< 0.001**	2.243	**< 0.001**	2.141	**< 0.001**	2.028	**< 0.001**	1.941	**< 0.001**
	Foot Check	0.332	**< 0.001**	0.488	**< 0.001**	0.567	**< 0.001**	0.599	**< 0.001**	0.620	**< 0.001**
	HbA1c Check	0.794	**< 0.001**	0.832	**< 0.001**	0.875	**< 0.001**	0.894	**< 0.001**	0.875	**< 0.001**
	Retinal Screen	0.537	**< 0.001**	0.651	**< 0.001**	0.720	**< 0.001**	0.765	**< 0.001**	0.781	**< 0.001**
	Smoking Status Check	0.728	**< 0.001**	0.970	0.512	1.038	0.334	1.114	**0.002**	1.156	**< 0.001**
	Urinary Albumin	0.593	**< 0.001**	0.756	**< 0.001**	0.803	**< 0.001**	0.840	**< 0.001**	0.881	**< 0.001**

Table 80. Results from full multiple-variable logistic regression of patient characteristics, achievement of all three selected QOF indicators and individual NDA processes received against death due to any cause.

* = No deaths during follow-up period, 778 patients excluded for this year only; IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.709	**0.001**	0.749	**< 0.001**	0.852	**0.023**	0.933	0.283	0.919	0.152
Years With DM		1.003	0.333	1.002	0.521	1.006	**0.006**	1.009	**< 0.001**	1.011	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.767	**< 0.001**	0.817	**< 0.001**	0.824	**< 0.001**	0.815	**< 0.001**	0.811	**< 0.001**
Age Group	< 25y	*No Events**		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		2.488	0.127	1.472	0.332	1.706	0.149	1.850	0.063
	45 – 64y	6.041	**< 0.001**	9.551	**< 0.001**	5.288	**< 0.001**	5.890	**< 0.001**	6.184	**< 0.001**
	65 – 74y	21.943	**< 0.001**	29.925	**< 0.001**	16.844	**< 0.001**	17.787	**< 0.001**	19.018	**< 0.001**
	≥ 75y	56.030	**< 0.001**	89.285	**< 0.001**	53.462	**< 0.001**	62.621	**< 0.001**	71.533	**< 0.001**
Deprivation Fifth (1 = Most Deprived)	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.941	0.415	0.842	**0.001**	0.826	**< 0.001**	0.846	**< 0.001**	0.846	**< 0.001**
	3	0.998	0.983	0.804	**< 0.001**	0.794	**< 0.001**	0.784	**< 0.001**	0.789	**< 0.001**
	4	0.873	0.067	0.766	**< 0.001**	0.779	**< 0.001**	0.788	**< 0.001**	0.782	**< 0.001**
	5	0.778	**0.001**	0.673	**< 0.001**	0.666	**< 0.001**	0.657	**< 0.001**	0.665	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.433	**< 0.001**	1.313	**< 0.001**	1.370	**< 0.001**	1.360	**< 0.001**	1.377	**< 0.001**
	CCI = 2	2.522	**< 0.001**	2.317	**< 0.001**	2.457	**< 0.001**	2.500	**< 0.001**	2.496	**< 0.001**
	CCI = 3	2.972	**< 0.001**	3.223	**< 0.001**	3.383	**< 0.001**	3.496	**< 0.001**	3.539	**< 0.001**
	CCI ≥ 4	4.307	**< 0.001**	4.378	**< 0.001**	4.678	**< 0.001**	5.165	**< 0.001**	5.494	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.382	**< 0.001**	1.376	**< 0.001**	1.363	**< 0.001**	1.346	**< 0.001**	1.337	**< 0.001**
	Current Smoker	1.761	**< 0.001**	1.940	**< 0.001**	2.037	**< 0.001**	1.993	**< 0.001**	2.098	**< 0.001**
	Unknown	0.161	**< 0.001**	0.284	**< 0.001**	0.470	**< 0.001**	0.621	**< 0.001**	0.803	**< 0.001**
QOF Indicator Achievement	DM06	1.127	**0.027**	0.985	0.694	0.966	0.267	0.960	0.144	0.967	0.199
	DM12	1.680	**< 0.001**	1.492	**< 0.001**	1.334	**< 0.001**	1.254	**< 0.001**	1.177	**< 0.001**
	DM17	1.052	0.394	1.002	0.956	0.941	0.088	0.928	**0.021**	0.914	**0.003**
NDA Processes Received	0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	1	1.488	**< 0.001**	1.683	**< 0.001**	1.862	**< 0.001**	1.827	**< 0.001**	1.918	**< 0.001**
	2	1.280	**0.011**	1.577	**< 0.001**	1.891	**< 0.001**	1.895	**< 0.001**	2.030	**< 0.001**
	3	0.641	**< 0.001**	1.003	0.974	1.256	**0.003**	1.409	**< 0.001**	1.537	**< 0.001**
	4	0.409	**< 0.001**	0.729	**< 0.001**	0.969	0.653	1.038	0.579	1.201	**0.004**
	5	0.171	**< 0.001**	0.413	**< 0.001**	0.577	**< 0.001**	0.647	**< 0.001**	0.739	**< 0.001**
	6	0.075	**< 0.001**	0.226	**< 0.001**	0.368	**< 0.001**	0.438	**< 0.001**	0.527	**< 0.001**
	7	0.045	**< 0.001**	0.166	**< 0.001**	0.297	**< 0.001**	0.380	**< 0.001**	0.466	**< 0.001**
	8	0.028	**< 0.001**	0.136	**< 0.001**	0.256	**< 0.001**	0.333	**< 0.001**	0.413	**< 0.001**
	9	0.035	**< 0.001**	0.116	**< 0.001**	0.215	**< 0.001**	0.301	**< 0.001**	0.397	**< 0.001**

Table 81. Results from full multiple-variable logistic regression of patient characteristics, QOF indicators achieved and total NDA processes received against death due to any cause.

* = No deaths during follow-up period, 778 patients excluded for this year only; IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.707	**0.001**	0.737	**< 0.001**	0.840	**0.013**	0.922	0.204	0.911	0.114
Years With DM		1.002	0.481	1.001	0.526	1.006	**0.005**	1.009	**< 0.001**	1.011	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.756	**< 0.001**	0.809	**< 0.001**	0.822	**< 0.001**	0.814	**< 0.001**	0.813	**< 0.001**
Age Group	< 25y	*No Events**		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		2.400	0.142	1.433	0.366	1.671	0.165	1.823	0.070
	45 – 64y	5.965	**< 0.001**	9.105	**< 0.001**	5.087	**< 0.001**	5.706	**< 0.001**	6.030	**< 0.001**
	65 – 74y	21.937	**< 0.001**	28.568	**< 0.001**	16.156	**< 0.001**	17.161	**< 0.001**	18.470	**< 0.001**
	≥ 75y	56.093	**< 0.001**	84.828	**< 0.001**	51.129	**< 0.001**	60.275	**< 0.001**	69.435	**< 0.001**
Deprivation Fifth (1 = Most Deprived)	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.943	0.433	0.842	**0.001**	0.825	**< 0.001**	0.845	**< 0.001**	0.845	**< 0.001**
	3	1.002	0.982	0.804	**< 0.001**	0.793	**< 0.001**	0.784	**< 0.001**	0.788	**< 0.001**
	4	0.873	0.067	0.765	**< 0.001**	0.778	**< 0.001**	0.787	**< 0.001**	0.782	**< 0.001**
	5	0.778	**0.001**	0.672	**< 0.001**	0.664	**< 0.001**	0.655	**< 0.001**	0.663	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.429	**< 0.001**	1.316	**< 0.001**	1.372	**< 0.001**	1.363	**< 0.001**	1.379	**< 0.001**
	CCI = 2	2.555	**< 0.001**	2.345	**< 0.001**	2.479	**< 0.001**	2.517	**< 0.001**	2.509	**< 0.001**
	CCI = 3	3.019	**< 0.001**	3.269	**< 0.001**	3.417	**< 0.001**	3.523	**< 0.001**	3.558	**< 0.001**
	CCI ≥ 4	4.411	**< 0.001**	4.462	**< 0.001**	4.740	**< 0.001**	5.218	**< 0.001**	5.533	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.380	**< 0.001**	1.376	**< 0.001**	1.363	**< 0.001**	1.347	**< 0.001**	1.337	**< 0.001**
	Current Smoker	1.730	**< 0.001**	1.934	**< 0.001**	2.040	**< 0.001**	1.999	**< 0.001**	2.105	**< 0.001**
	Unknown	0.149	**< 0.001**	0.273	**< 0.001**	0.461	**< 0.001**	0.614	**< 0.001**	0.800	**< 0.001**
All Selected QOF Indicators		1.123	**0.050**	1.056	0.170	1.008	0.809	0.988	0.668	0.969	0.245
NDA Processes Received	0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	1	1.842	**< 0.001**	1.933	**< 0.001**	2.024	**< 0.001**	1.937	**< 0.001**	1.987	**< 0.001**
	2	1.724	**< 0.001**	1.904	**< 0.001**	2.115	**< 0.001**	2.046	**< 0.001**	2.124	**< 0.001**
	3	0.887	0.187	1.219	**0.012**	1.398	**< 0.001**	1.510	**< 0.001**	1.592	**< 0.001**
	4	0.579	**< 0.001**	0.894	0.119	1.076	0.266	1.107	0.100	1.237	**< 0.001**
	5	0.245	**< 0.001**	0.510	**< 0.001**	0.641	**< 0.001**	0.689	**< 0.001**	0.759	**< 0.001**
	6	0.109	**< 0.001**	0.280	**< 0.001**	0.410	**< 0.001**	0.468	**< 0.001**	0.541	**< 0.001**
	7	0.066	**< 0.001**	0.206	**< 0.001**	0.331	**< 0.001**	0.405	**< 0.001**	0.479	**< 0.001**
	8	0.042	**< 0.001**	0.170	**< 0.001**	0.286	**< 0.001**	0.355	**< 0.001**	0.424	**< 0.001**
	9	0.052	**< 0.001**	0.145	**< 0.001**	0.242	**< 0.001**	0.323	**< 0.001**	0.409	**< 0.001**

Table 82. Results from full multiple-variable logistic regression of patient characteristics, achievement of all three selected QOF indicators and total NDA processes received against death due to any cause.

* = No deaths during follow-up period, 778 patients excluded for this year only; IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

For all the analyses pertaining to death due to a potentially-diabetes related cause, it should be noted that the source population is individuals who have died. Therefore the ORs reported pertain to the odds of dying due to a cause potentially related to diabetes *versus* dying due to any other cause; an OR < 1 infers that the presence of a given predictor is associated with decreased odds of death due to a diabetes-related cause, whereas an OR > 1 infers an association with an increased odds of death due to a diabetes-related cause.

Univariate analyses of potentially diabetes-related mortality indicated associations favouring a non-diabetes cause of death for T2DM for follow-up lengths of greater than 2 years, being an ex- or current smoker and for follow-up lengths of greater than 2 years. The number of years with diabetes was associated with increased odds of death due to a potentially diabetes-related cause (Table 83).

Attaining QOF targets DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol) and DM12 (BP ≤ 145/85) in 2005/06 were associated with decreased odds of death due to a potentially diabetes-related cause for follow-up lengths of two or more and three or more years respectively in univariate analyses. No significant associations between achieving DM17 (TC ≤ 5.0 mmol/L) and the odds of potentially diabetes-related death were observed. Unlike with other patient-level analyses, the estimated ORs for achieving all three of the selected QOF targets indicated a protective effect that outstripped any of the individual targets in univariate analyses (Table 83).

The total number of NDA care processes received in 2005/06 appeared to have no consistent association with the odds of death due to a potentially diabetes-related cause in univariate analyses. Receiving the NDA cholesterol check process in 2005/06 was, somewhat counterintuitively, associated with increased odds of death from a potentially diabetes-related cause for follow-up lengths of 1 – 2 years; any such associations were non-significant for longer follow-up periods. Receiving the NDA smoking status check was associated with decreased odds of death due to a potentially diabetes-related cause for follow-up periods of three or more years (Table 83).

Multiple-variable regression, where the effects of each individual quality indicator was adjusted for patient factors, for the odds of death due to a potentially diabetes-related cause yielded similar results to that observed for univariate regression. Associations with decreased odds of death due to a potentially diabetes-related cause were observed for DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol) and DM12 (BP ≤ 145/85) for follow-up lengths of three or more and four or more years respectively. Attaining all three selected QOF targets were associated with decreased odds of potentially diabetes-related death for periods of follow-up exceeding three years. As observed with the univariate analysis of diabetes-related death, the protective effect of achieving multiple targets generally exceeded those of the individual targets in isolation (Table 84).

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	**T1DM**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.722	0.061	0.715	**0.009**	0.655	**< 0.001**	0.709	**< 0.001**	0.697	**< 0.001**
Years With DM		1.018	**0.001**	1.015	**< 0.001**	1.016	**< 0.001**	1.017	**< 0.001**	1.016	**< 0.001**
Gender	**Male**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	1.073	0.383	1.072	0.232	1.080	0.104	1.081	0.059	1.061	0.106
Age Group	**< 25y**	*No Events**		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		1.375	0.800	0.917	0.913	1.119	0.881	0.841	0.792
	45 – 64y	1.683	0.314	1.701	0.665	1.125	0.878	1.379	0.661	0.793	0.714
	65 – 74y	1.845	0.227	1.708	0.663	1.064	0.935	1.288	0.729	0.757	0.661
	≥ 75y	2.084	0.144	1.911	0.597	1.272	0.753	1.553	0.547	0.932	0.912
IMD	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.058	0.669	1.059	0.534	1.013	0.867	1.011	0.863	0.986	0.811
	3	1.075	0.579	1.063	0.512	1.049	0.524	1.052	0.444	1.032	0.596
	4	0.918	0.517	0.934	0.457	0.967	0.655	0.941	0.350	0.918	0.143
	5	0.867	0.310	0.843	0.083	0.858	0.056	0.902	0.140	0.894	0.074
CCI Group	**CCI = 0**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	0.770	**0.023**	0.927	0.343	0.947	0.398	0.973	0.623	1.004	0.932
	CCI = 2	0.728	**0.004**	0.809	**0.008**	0.871	**0.033**	0.916	0.120	0.947	0.287
	CCI = 3	0.965	0.791	1.124	0.226	1.177	**0.042**	1.192	**0.013**	1.245	**0.001**
	CCI ≥ 4	0.649	**0.002**	0.830	0.082	0.855	0.084	0.900	0.195	0.922	0.280
Smoking Status	**Non-Smoker**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.901	0.241	0.852	**0.013**	0.886	**0.022**	0.890	**0.012**	0.913	**0.029**
	Current Smoker	0.787	0.070	0.743	**0.001**	0.724	**< 0.001**	0.737	**< 0.001**	0.751	**< 0.001**
	Unknown	1.149	0.581	0.870	0.385	1.004	0.971	1.024	0.793	0.992	0.919
DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol)		0.900	0.198	0.888	**0.041**	0.847	**< 0.001**	0.857	**< 0.001**	0.857	**< 0.001**
DM12 (BP ≤ 145/85)		0.987	0.875	0.960	0.497	0.919	0.081	0.892	**< 0.001**	0.891	**0.002**
DM17 (TC ≤ 5.0 mmol/L)		1.077	0.358	1.061	0.312	0.995	0.916	0.963	0.368	0.948	0.157
DM06 + DM12 + DM17		0.856	0.121	0.881	0.057	0.828	**< 0.001**	0.834	**< 0.001**	0.836	**< 0.001**

(continued on next page...)

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
Number of NDA Processes Met	0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	1	0.774	0.080	0.814	0.113	0.883	0.286	0.874	0.212	0.876	0.189
	2	0.876	0.360	0.866	0.262	0.949	0.645	0.931	0.501	0.896	0.267
	3	1.003	0.985	0.985	0.904	0.968	0.769	0.899	0.296	0.934	0.465
	4	1.063	0.686	1.124	0.328	1.132	0.228	1.102	0.296	1.046	0.596
	5	0.994	0.967	1.092	0.407	1.044	0.633	1.043	0.604	1.001	0.987
	6	1.083	0.577	1.120	0.240	1.082	0.325	1.007	0.921	0.975	0.685
	7	1.066	0.693	0.917	0.385	0.898	0.182	0.884	0.075	0.896	0.077
	8	1.310	0.357	0.832	0.207	0.798	**0.040**	0.765	**0.004**	0.799	**0.006**
	9	0.852	0.775	0.865	0.637	0.806	0.337	0.819	0.269	0.803	0.154
NDA BMI		1.085	0.332	0.998	0.966	0.922	0.090	0.906	**0.019**	0.910	0.015
NDA BP		1.044	0.601	1.040	0.549	0.999	0.982	0.979	0.671	0.982	0.690
NDA Cholesterol		1.224	**0.014**	1.150	**0.017**	1.093	0.074	1.047	0.298	1.013	0.748
NDA Creatinine		0.945	0.489	0.997	0.963	0.990	0.856	0.960	0.397	0.950	0.240
NDA Foot		1.144	0.138	1.036	0.537	0.964	0.440	0.936	0.109	0.938	0.087
NDA HbA1c		1.152	0.092	1.057	0.335	1.027	0.578	1.009	0.830	1.016	0.666
NDA Retinal Screen		0.992	0.953	0.927	0.377	0.903	0.117	0.886	**0.027**	0.925	0.107
NDA Smoking Status		1.079	0.433	0.903	0.095	0.848	**0.001**	0.860	**< 0.001**	0.866	**< 0.001**
NDA Urinary Albumin		1.178	0.348	0.992	0.936	0.961	0.581	0.938	0.293	0.951	0.341

Table 83. Results, by follow-up period, of univariate logistic regression modelling of deaths due to a potentially diabetes-related cause.

* = No deaths during follow-up period, 778 patients excluded for this year only; IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

	2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
	OR	p	OR	p	OR	p	OR	p	OR	p
DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol)	0.924	0.347	0.911	0.117	0.869	**0.004**	0.882	**0.003**	0.881	**0.001**
DM12 (BP ≤ 145/85)	1.014	0.865	0.978	0.710	0.935	0.172	0.911	**0.032**	0.904	**0.009**
DM17 (TC ≤ 5.0 mmol/L)	1.112	0.200	1.093	0.137	1.030	0.558	1.001	0.986	0.979	0.597
DM06 + DM12 + DM17	0.889	0.248	0.906	0.142	0.851	**0.003**	0.860	**0.001**	0.858	**< 0.001**

Table 84. Results from multiple-variable logistic regression of odds of death due to a potentially diabetes-related cause for selected QOF indicators.

Results denote separate models for each QOF indicator(s) and follow-up period; all models also adjusted, but coefficients not shown, for diabetes type, gender, years post-diabetes diagnosis, age group, IMD fifth, smoking status and co-morbidity grouping.

IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

Associations between receipt of NDA care processes in 2005/06 in multiple-variable regression were similar to those observed for univariate regression. There were no associations between the total number of NDA care processes received and the odds of death due to a potentially diabetes-related cause over any of lengths of follow-up in these analyses. Receipt of the NDA cholesterol check in 2005/06 was associated with increased odds of death due to a potentially diabetes-related cause for follow-up lengths of one to three years; associations for longer follow-up periods did not reach statistical significance.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
Number of NDA Processes Met	0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	1	0.782	0.099	0.814	0.118	0.887	0.310	0.885	0.263	0.874	0.189
	2	0.898	0.462	0.893	0.383	0.966	0.763	0.963	0.724	0.913	0.368
	3	1.054	0.738	1.007	0.955	0.984	0.890	0.920	0.419	0.948	0.580
	4	1.089	0.578	1.126	0.325	1.141	0.205	1.124	0.218	1.058	0.514
	5	1.010	0.948	1.102	0.366	1.058	0.542	1.064	0.448	1.011	0.885
	6	1.120	0.434	1.141	0.176	1.104	0.222	1.041	0.575	1.003	0.966
	7	1.126	0.473	0.971	0.773	0.958	0.606	0.949	0.472	0.956	0.498
	8	1.400	0.260	0.903	0.490	0.877	0.246	0.843	0.074	0.872	0.110
	9	0.961	0.945	0.990	0.973	0.896	0.631	0.918	0.639	0.889	0.454
NDA BMI		1.102	0.256	1.016	0.784	0.949	0.291	0.939	0.148	0.942	0.135
NDA BP		1.069	0.433	1.067	0.334	1.030	0.606	1.018	0.731	1.021	0.664
NDA Cholesterol		1.247	**0.009**	1.174	**0.007**	1.132	**0.015**	1.091	0.054	1.056	0.189
NDA Creatinine		0.968	0.694	1.030	0.648	1.029	0.611	1.003	0.958	0.989	0.805
NDA Foot		1.176	0.077	1.055	0.367	0.989	0.821	0.963	0.377	0.968	0.395
NDA HbA1c		1.157	0.087	1.068	0.265	1.045	0.359	1.029	0.495	1.035	0.367
NDA Retinal Screen		1.006	0.970	0.958	0.620	0.938	0.332	0.919	0.131	0.959	0.391
NDA Smoking Status		1.176	0.126	0.990	0.885	0.916	0.124	0.934	0.175	0.932	0.120
NDA Urinary Albumin		1.189	0.326	1.002	0.981	0.977	0.746	0.956	0.468	0.969	0.553

Table 85. Results from multiple-variable logistic regression of odds of death due to a potentially diabetes-related cause for NDA care processes.

Results denote separate models for each NDA process / count and follow-up period; all models also adjusted, but coefficients not shown, for diabetes type, gender, years post-diabetes diagnosis, age group, IMD fifth, smoking status and co-morbidity grouping.

IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

Full models, including all predictor variables, were also constructed for examining associations with the odds of death due to a diabetes related cause. As stated in the methodology section of this chapter, these models only contain individuals who have died; hence the estimated odds ratios describe the odds of dying from a diabetes-related cause versus death due to any other cause (Tables 86 – 89).

For the full models utilising individual NDA care processes (Table 86 and Table 87), few predictors demonstrated consistent associations with the odds of death due to a diabetes-related cause; only years with diabetes and the NDA total cholesterol check process had significant associations with differences in the odds of death due to a diabetes-related cause for all lengths of follow-up. Associations between odds of death due to a diabetes-related cause and the total number of NDA care processes received were, at best, sporadically statistically significant but generally showed no consistent associations with changes in the odds of diabetes-related death (Table 88 and Table 89).

Attaining DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol) in 2005/06 was associated with reduced odds of death due to a potentially diabetes-related cause for follow-up lengths of two to five years (OR 0.838 – 0.870); receipt of DM12 (BP ≤ 145/85) was associated with reduced odds of diabetes-related death for follow-up lasting four or five years (OR 0.891 – 0.905). No significant associations were observed between receipt of DM17 (TC ≤ 5.0 mmol/L) over any length of follow-up in any of the full models.

Attaining all three of the selected QOF indicators in 2005/06 was associated with reduced odds of death due to a potentially diabetes-related cause for follow-up periods of two to five years across all fully-adjusted models (OR 0.811 – 0.866), with estimates of the magnitude of effect exceeding that associated with any of the individual indicators.

Each additional year that a patient has had a diagnosis of diabetes for was significantly associated with increased odds of death due to a diabetes-related cause across all lengths of follow-up in all full models (OR 1.012 – 1.019). Receipt of the NDA total cholesterol check process was associated with increased odds of death due to a diabetes-related cause (OR 1.243 – 1.408).

Patients who with a recorded diabetes type of T2DM were associated with lower odds of death due to a diabetes-related cause than their peers with T1DM (OR 0.686 – 0.757) for follow-up periods of two or more years across all full models. Associations, for follow-up periods of two or more years, were observed with decreased odds of death due to a diabetes-related cause in patients residing in the most affluent fifth as compared to those in the least affluent fifth (OR 0.804 – 0.858) across all full models.

Sporadically statistically significant associations with increasing co-morbidity and reduced odds of death due to a diabetes-related cause were observed, but such associations were not consistent across lengths of follow-up; however, patients with the highest levels of co-morbidity were associated with decreased odds of death due to a diabetes-related cause for lengths of follow-up ranging from one to three years (OR 0.621 – 0.819) across all full models. Being a current smoker was also associated with decreased odds of death due to a diabetes-related cause; significant associations were observed for follow-up lengths of two to five years (OR 0.766 – 0.821) across all full models.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.726	0.083	0.747	**0.032**	0.693	**0.002**	0.752	**0.006**	0.738	**0.001**
Years With DM		1.017	**0.003**	1.013	**0.002**	1.013	**< 0.001**	1.013	**< 0.001**	1.013	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	1.043	0.631	1.010	0.871	1.012	0.810	1.011	0.796	0.998	0.966
Age Group	< 25y	*No Events**		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		1.412	0.786	0.921	0.919	1.140	0.864	0.896	0.868
	45 – 64y	1.929	0.216	1.941	0.594	1.293	0.742	1.567	0.545	0.947	0.932
	65 – 74y	2.140	0.147	2.000	0.577	1.247	0.777	1.480	0.598	0.912	0.886
	≥ 75y	2.380	0.096	2.212	0.523	1.465	0.624	1.739	0.456	1.104	0.877
Deprivation Fifth (1 = Most Deprived)	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.058	0.674	1.058	0.544	1.003	0.968	0.996	0.958	0.969	0.597
	3	1.070	0.613	1.038	0.689	1.003	0.971	1.009	0.895	0.993	0.913
	4	0.927	0.572	0.919	0.361	0.934	0.363	0.907	0.137	0.884	**0.037**
	5	0.833	0.206	0.811	0.037	0.806	**0.008**	0.858	**0.033**	0.847	**0.009**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	0.706	**0.003**	0.880	0.118	0.903	0.122	0.933	0.220	0.956	0.374
	CCI = 2	0.696	**0.001**	0.788	**0.003**	0.851	**0.014**	0.895	0.055	0.921	0.111
	CCI = 3	0.898	0.438	1.061	0.544	1.123	0.155	1.141	0.068	1.193	**0.008**
	CCI ≥ 4	0.627	**0.001**	0.798	**0.038**	0.814	**0.026**	0.862	0.072	0.884	0.106
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.923	0.428	0.891	0.124	0.957	0.483	0.950	0.355	0.977	0.641
	Current Smoker	0.784	0.100	0.782	**0.021**	0.797	**0.010**	0.801	**0.004**	0.821	**0.005**
	Unknown	1.084	0.752	0.848	0.312	0.983	0.885	0.985	0.871	0.958	0.598
QOF Indicator Achievement	DM06	0.859	0.105	0.865	**0.025**	0.839	**0.001**	0.866	**0.002**	0.869	**0.001**
	DM12	0.993	0.938	0.951	0.454	0.922	0.138	0.899	**0.026**	0.891	**0.007**
	DM17	1.029	0.788	1.043	0.578	0.998	0.974	0.984	0.770	0.975	0.598
NDA Process	BMI Check	0.975	0.826	0.923	0.334	0.874	0.057	0.883	0.051	0.892	**0.049**
	BP Check	1.022	0.852	1.088	0.389	1.122	0.182	1.150	0.077	1.180	**0.025**
	TC Check	1.408	**0.013**	1.370	**0.002**	1.396	**< 0.001**	1.342	**< 0.001**	1.243	**0.003**
	Creatinine Check	0.716	**0.006**	0.846	0.098	0.908	0.280	0.902	0.207	0.906	0.193
	Foot Check	1.069	0.582	1.019	0.812	0.984	0.807	0.961	0.496	0.977	0.665
	HbA1c Check	1.148	0.210	1.034	0.645	1.035	0.555	1.032	0.530	1.053	0.252
	Retinal Screen	0.930	0.634	0.929	0.412	0.932	0.300	0.922	0.155	0.963	0.454
	Smoking Status Check	1.066	0.606	0.928	0.355	0.886	0.062	0.929	0.191	0.931	0.157
	Urinary Albumin	1.117	0.547	0.975	0.802	0.971	0.698	0.965	0.571	0.983	0.762

Table 86. Results from full multiple-variable logistic regression of patient characteristics, QOF indicators achieved and individual NDA processes received against death due to a potentially diabetes-related cause.

* = No deaths during follow-up period, 778 patients excluded for this year only; IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.725	0.081	0.742	**0.028**	0.687	**0.001**	0.748	**0.005**	0.735	**0.001**
Years With DM		1.018	**0.002**	1.013	**0.001**	1.013	**< 0.001**	1.014	**< 0.001**	1.013	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	1.034	0.703	1.000	0.996	1.003	0.954	1.007	0.866	0.996	0.918
Age Group	< 25y	*No Events**		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		1.357	0.810	0.890	0.885	1.116	0.886	0.889	0.858
	45 – 64y	1.900	0.227	1.893	0.608	1.254	0.772	1.531	0.567	0.932	0.913
	65 – 74y	2.100	0.158	1.949	0.591	1.209	0.808	1.446	0.619	0.898	0.867
	≥ 75y	2.319	0.107	2.139	0.540	1.409	0.660	1.689	0.480	1.082	0.903
Deprivation Fifth (1 = Most Deprived)	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.049	0.725	1.051	0.593	0.999	0.985	0.994	0.925	0.967	0.571
	3	1.062	0.653	1.033	0.730	1.000	0.999	1.006	0.925	0.991	0.876
	4	0.915	0.511	0.909	0.306	0.928	0.325	0.904	0.125	0.881	**0.031**
	5	0.822	0.176	0.807	**0.033**	0.804	**0.008**	0.857	**0.031**	0.845	**0.009**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	0.709	**0.004**	0.881	0.123	0.904	0.126	0.934	0.223	0.958	0.387
	CCI = 2	0.706	**0.002**	0.790	**0.004**	0.850	**0.014**	0.894	**0.050**	0.919	0.104
	CCI = 3	0.904	0.469	1.062	0.537	1.123	0.156	1.139	0.071	1.192	**0.008**
	CCI ≥ 4	0.629	**0.002**	0.800	**0.040**	0.815	0.027	0.859	0.066	0.880	0.094
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.926	0.441	0.891	0.122	0.957	0.485	0.950	0.354	0.976	0.632
	Current Smoker	0.783	0.098	0.780	**0.020**	0.795	**0.009**	0.800	**0.004**	0.819	**0.004**
	Unknown	1.082	0.758	0.849	0.316	0.994	0.960	1.000	1.000	0.975	0.758
All Selected QOF Indicators		0.785	**0.028**	0.843	**0.018**	0.811	**< 0.001**	0.834	**< 0.001**	0.839	**< 0.001**
NDA Process	BMI Check	0.979	0.853	0.924	0.344	0.876	0.061	0.887	0.061	0.895	0.057
	BP Check	1.027	0.815	1.068	0.484	1.079	0.359	1.092	0.249	1.114	0.130
	TC Check	1.480	**0.002**	1.427	**< 0.001**	1.430	**< 0.001**	1.360	**< 0.001**	1.253	**0.001**
	Creatinine Check	0.704	**0.004**	0.830	0.064	0.880	0.152	0.876	0.103	0.878	0.085
	Foot Check	1.075	0.552	1.022	0.788	0.984	0.806	0.960	0.485	0.976	0.652
	HbA1c Check	1.129	0.265	1.020	0.783	1.023	0.696	1.022	0.660	1.044	0.337
	Retinal Screen	0.929	0.628	0.930	0.421	0.932	0.301	0.922	0.154	0.963	0.450
	Smoking Status Check	1.066	0.606	0.932	0.384	0.889	0.070	0.931	0.206	0.932	0.164
	Urinary Albumin	1.132	0.499	0.977	0.818	0.975	0.741	0.966	0.588	0.984	0.767

Table 87. Results from full multiple-variable logistic regression of patient characteristics, achievement of all three selected QOF indicators and individual NDA processes received against death due to a potentially diabetes-related cause.

* = No deaths during follow-up period, 778 patients excluded for this year only; IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.745	0.111	0.751	**0.035**	0.693	**0.002**	0.757	**0.008**	0.743	**0.001**
Years With DM		1.018	**0.002**	1.013	**0.002**	1.012	**< 0.001**	1.013	**< 0.001**	1.013	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	1.060	0.504	1.028	0.658	1.027	0.595	1.022	0.629	1.007	0.854
Age Group	< 25y	*No Events**		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		1.410	0.787	0.963	0.963	1.205	0.807	0.910	0.887
	45 – 64y	1.878	0.235	1.955	0.591	1.359	0.694	1.651	0.500	0.971	0.964
	65 – 74y	2.052	0.170	2.007	0.576	1.310	0.730	1.560	0.550	0.937	0.920
	≥ 75y	2.292	0.111	2.234	0.519	1.548	0.575	1.844	0.410	1.142	0.837
Deprivation Fifth (1 = Most Deprived)	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.036	0.791	1.055	0.567	1.003	0.967	0.999	0.990	0.970	0.614
	3	1.047	0.729	1.035	0.718	1.007	0.929	1.016	0.819	0.995	0.934
	4	0.902	0.439	0.911	0.317	0.933	0.357	0.908	0.141	0.882	**0.034**
	5	0.806	0.132	0.806	**0.031**	0.809	**0.010**	0.858	**0.031**	0.842	**0.007**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	0.711	**0.004**	0.882	0.127	0.906	0.134	0.936	0.239	0.959	0.403
	CCI = 2	0.695	**0.001**	0.789	**0.003**	0.849	**0.013**	0.894	0.051	0.920	0.107
	CCI = 3	0.882	0.367	1.049	0.623	1.115	0.183	1.135	0.079	1.186	**0.010**
	CCI ≥ 4	0.621	**0.001**	0.797	**0.037**	0.816	**0.028**	0.862	0.072	0.884	0.107
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.929	0.447	0.888	0.088	0.933	0.227	0.941	0.228	0.957	0.334
	Current Smoker	0.788	0.092	0.770	**0.009**	0.770	**0.001**	0.791	**0.001**	0.800	**0.001**
	Unknown	1.083	0.754	0.845	0.300	0.974	0.822	0.986	0.880	0.946	0.493
QOF Indicator Achievement	DM06	0.854	0.090	0.859	**0.019**	0.838	**0.001**	0.865	**0.002**	0.870	**0.001**
	DM12	0.997	0.975	0.961	0.556	0.926	0.158	0.905	**0.034**	0.902	**0.014**
	DM17	1.065	0.530	1.083	0.271	1.047	0.447	1.021	0.696	0.997	0.942
NDA Processes Received	0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	1	0.793	0.127	0.836	0.181	0.928	0.530	0.932	0.521	0.922	0.432
	2	0.922	0.596	0.927	0.568	1.035	0.774	1.043	0.704	0.996	0.967
	3	1.090	0.606	1.044	0.754	1.063	0.607	1.009	0.932	1.052	0.612
	4	1.125	0.483	1.172	0.226	1.248	**0.050**	1.245	**0.033**	1.189	0.066
	5	1.050	0.770	1.148	0.255	1.162	0.146	1.185	0.066	1.142	0.116
	6	1.150	0.395	1.184	0.139	1.212	**0.043**	1.161	0.077	1.139	0.092
	7	1.157	0.428	1.004	0.974	1.056	0.581	1.064	0.469	1.092	0.260
	8	1.438	0.241	0.942	0.710	0.968	0.798	0.943	0.586	0.994	0.950
	9	1.028	0.961	1.034	0.917	0.991	0.970	1.037	0.847	1.025	0.880

Table 88. Results from full multiple-variable logistic regression of patient characteristics, QOF indicators achieved and total number of NDA processes received against death due to a potentially diabetes-related cause.

* = No deaths during follow-up period, 778 patients excluded for this year only; IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.741	0.103	0.743	**0.029**	0.686	**0.001**	0.751	**0.006**	0.739	**0.001**
Years With DM		1.019	**0.001**	1.014	**0.001**	1.013	**< 0.001**	1.014	**< 0.001**	1.013	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	1.051	0.572	1.016	0.793	1.015	0.772	1.015	0.740	1.003	0.941
Age Group	< 25y	*No Events**		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		1.364	0.807	0.928	0.926	1.170	0.837	0.895	0.867
	45 – 64y	1.863	0.241	1.931	0.598	1.321	0.722	1.605	0.525	0.949	0.936
	65 – 74y	2.018	0.180	1.973	0.586	1.272	0.758	1.517	0.575	0.916	0.891
	≥ 75y	2.234	0.122	2.174	0.534	1.487	0.611	1.779	0.438	1.108	0.873
Deprivation Fifth (1 = Most Deprived)	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.028	0.834	1.048	0.614	0.998	0.984	0.996	0.952	0.968	0.588
	3	1.038	0.780	1.027	0.773	1.003	0.971	1.012	0.862	0.992	0.893
	4	0.891	0.390	0.903	0.270	0.928	0.323	0.906	0.131	0.880	**0.030**
	5	0.798	0.116	0.804	0.029	0.808	0.009	0.857	**0.030**	0.841	**0.007**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	0.715	**0.005**	0.885	0.137	0.908	0.141	0.937	0.245	0.960	0.417
	CCI = 2	0.703	**0.002**	0.790	**0.003**	0.848	**0.012**	0.892	**0.046**	0.918	0.100
	CCI = 3	0.890	0.399	1.052	0.602	1.116	0.177	1.135	0.079	1.186	**0.010**
	CCI ≥ 4	0.626	**0.001**	0.802	**0.042**	0.819	**0.030**	0.862	0.070	0.883	0.101
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.928	0.436	0.887	0.084	0.933	0.229	0.942	0.233	0.957	0.336
	Current Smoker	0.783	0.083	0.766	**0.007**	0.767	**0.001**	0.790	**0.001**	0.799	**< 0.001**
	Unknown	1.079	0.764	0.844	0.295	0.980	0.862	0.995	0.958	0.958	0.596
All Selected QOF Indicators		0.811	0.054	0.866	**0.043**	0.830	**0.001**	0.848	**0.001**	0.848	**< 0.001**
NDA Processes Received	0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	1	0.786	0.107	0.818	0.127	0.891	0.331	0.888	0.279	0.878	0.203
	2	0.914	0.540	0.904	0.436	0.982	0.873	0.977	0.827	0.927	0.455
	3	1.094	0.574	1.030	0.817	1.011	0.925	0.942	0.561	0.971	0.762
	4	1.148	0.376	1.167	0.205	1.191	0.097	1.167	0.105	1.098	0.284
	5	1.065	0.681	1.146	0.213	1.114	0.247	1.114	0.195	1.057	0.467
	6	1.192	0.239	1.195	0.075	1.171	0.058	1.096	0.210	1.056	0.411
	7	1.222	0.239	1.023	0.829	1.024	0.786	1.007	0.926	1.014	0.838
	8	1.524	0.163	0.956	0.764	0.943	0.613	0.894	0.252	0.926	0.373
	9	1.101	0.867	1.055	0.866	0.972	0.903	0.986	0.940	0.953	0.762

Table 89. Results from full multiple-variable logistic regression of patient characteristics, achievement of all three selected QOF indicators and total number of NDA processes received against death due to a potentially diabetes-related cause.

* = No deaths during follow-up period, 778 patients excluded for this year only; IRR = Incidence rate ratio; CCI = Charlson Co-morbidity Index; QOF = Quality and Outcomes Framework; NDA = National Diabetes Audit; BMI = Body mass index; BP = Blood pressure; HbA1c = Glycated haemoglobin; TC = Total cholesterol

Discussion

These analyses of patient-level data indicate the presence of an association between high-quality diabetes management in primary care and 'hard' clinical outcomes such as emergency admission rates, readmission rates and all-cause mortality over follow-up periods varying in length from one to five years. There is also some limited evidence that specific aspects of diabetes care may modulate the likelihood of death being due to causes linked to diabetes mellitus. Many of the associations observed persisted across increasingly complex models, from univariate models to fully-adjusted models. It is notable, however, that associations with deprivation, a factor that is outside of the sphere of influence of primary care, had the most consistent association with differences in survival, admission rates and odds of death.

Findings of Comorbidity Analyses

The Cox models describing the survival of individuals with and without diabetes indicated that prevalent diabetes – that is, diabetes diagnosed prior to the start of observation – is associated with increased hazards of death in comparison to individuals without diabetes. Individuals with newly-diagnosed diabetes were associated with significantly increased hazard of death compared to individuals without diabetes for Charlson Co-morbidity index of 0, but exhibited hazards of death that did not significantly differ from people without diabetes for all other levels of co-morbidity.

These findings, adjusted for a number of patient factors, imply that prevalent diabetes significantly impacts on survival regardless of the level of co-morbidity an individual has. In conjunction with evidence that newly-diagnosed diabetes has a negative impact on survival for individuals deemed not to have significant co-morbidity calls into question the rationale of diabetes (without complication) being assigned a weight of 0 in the updated Charlson disease weights by Quan *et al.*[207]

It should be noted that the selection of controls (i.e. individuals without a recorded history of diabetes) by the MHRA in the supplied CPRD-HES dataset could have favoured individuals who may be subject to an increased risk of vascular disease as the selection criteria stipulated these individuals as having at least one record of blood pressure, cholesterol, HbA1c or BMI. Hence, there may be a bias towards cardiovascular events in the control group which may have obfuscated any differences that may truly exist between them and individuals newly diagnosed with diabetes.

Main Findings of Quality and Outcomes Framework Analyses

In the full models of patient-level emergency admission rates, where all indicators of quality were adjusted for the effects of attainment of other indicators and additional patient characteristics, associations of a clinically significant magnitude were observed for attainment of QOF indicators DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol) in 2005/06 for all lengths of follow-up and DM17 (TC ≤ 5.0 mmol/L) in 2005/06 for lengths of follow-up between two and five years. The estimated relative reductions in emergency admission rates for patients achieving DM06 are in the order of 7.6% – 13.2%; patients achieving DM17 were subject to a 6.1% – 9.9% relative reduction in emergency admission rates. The estimated effects of receipt of all three of the selected QOF indicators, whilst protective with regards to emergency admission rates for follow-up periods of two to five years, did not exceed that of any of the individual QOF indicators in any of the follow-up periods.

The pattern of associations between achievement of the selected QOF indicators and readmission rates in the fully adjusted models indicated significant associations between achieving DM06 in 2005/06 and reduced readmission rates, with estimated relative rate reductions ranging between 12.8% – 19.7% across all follow-up periods. Achieving DM12 (BP ≤ 145/85) in 2005/06 was associated with significant increases in readmission rates for follow-up periods of one and two years in all models, with an estimated relative rate increase of 10.3% – 19.4%; this seemingly counterintuitive finding may result from the potentially harmful effects of overly aggressive treatment of hypertension[100,·101,·203,·204], with side-effects related to

commencement of antihypertensive therapy being a driver of readmissions. Associations between attainment of DM17 in 2005/06 and readmissions were only observed in the fully-adjusted model utilising the number of NDA processes achieved in 2005/06 for follow-up periods of four or five years, with estimated relative rate reductions of 7.3% – 8.0%. The lack of association between DM17 attainment and readmission rates in the fully-adjusted model utilising the count of NDA processes received may result from additional and explicit adjustment for receipt of the NDA process describing checking of total cholesterol, which may imply that engagement with care and the ancillary discussions pertaining to secondary and tertiary prevention may have a greater impact on readmissions than a specific treatment target.

Findings for the fully adjusted models for the odds of all-cause death were somewhat unexpected, insofar as the majority statistically significant findings indicated associations between attaining QOF targets and increased odds of death; the sole exception was attainment of DM17 (TC ≤ 5.0 mmol/L) for follow-up periods of four and five years in the fully-adjusted model utilising the count of NDA processes received; DM17 was associated with increased odds of death for follow-up lengths of one and two years (OR 1.099 – 1.224).

As these QOF targets are all based upon attaining a result that is below a certain cut-off, the population of individuals who have achieved these targets may have a range of values; as discussed before, overly aggressive control of blood pressure, glycaemic load and total cholesterol have been associated with poorer outcomes in other studies.[100,·101,·203,·204]

Another potential explanation is selection bias, whereby individuals who are judged to be at greater risk may be more likely to have these variables tested and, consequently, receive treatment to control their blood pressure, glycaemic load or cholesterol levels; although these individuals may achieve these targets, the follow-up period for this study may be insufficient to detect any benefit resulting from reductions in risk conferred by control of these physiological parameters.

In the fully adjusted models of odds of death due to potentially diabetes-related causes, attaining DM06 in 2005/06 was associated with reduced odds of potentially diabetes-related death for follow-up periods of two to five years, with relative reductions in the odds of death ranging between 13.0% – 16.2%. Whilst such a finding supports the benefits of adequate glycaemic control in people with diabetes, there is the potential for this observation to be compromised by the presence of selection bias, whereby healthier individuals are more likely to have their HbA1c regularly checked and their glycaemic control actively managed.

Achievement of DM12 in 2005/06 was associated with reduced odds of death due to a potentially diabetes-related cause for follow-up periods of four and five years, with relative reductions in odds ranging between 9.5% – 10.9% over these follow-up periods. Again, as with the findings for DM06, such associations may be subject to a degree of selection bias; the lack of association between attaining a blood pressure of ≤ 145/85 until four or more years of follow-up may also reflect a degree of lag between reduction of mean vascular stress and subsequent reduction of atherogenesis and risk of cardiovascular death.

Attaining all three of the selected QOF targets in 2005/06 only exerted an additional benefit – that is, an estimated effect that exceeded any of the individual associations between individual QOF targets and outcomes – with respect to the odds of potentially diabetes-related death. Such a finding indicates that attaining multiple diabetes-related intermediate targets may indeed reduce the incidence of life-threatening complications of diabetes, allowing patients to survive to the point where they are more likely to die of a non-related cause. However, the lack of additional benefit with respect to emergency admissions, readmissions and all-cause mortality may indicate that other unmeasured factors obviate any synergy between achievement of multiple treatment targets with respect to these outcomes.

Main Findings of National Diabetes Audit Analyses

The care processes measured by the NDA do not specify clinical targets; they simply measure whether a specified activity has taken place, which could be argued to be a proxy measure of engagement with care.

Receipt of a number of the individual NDA care processes – BMI checks, total cholesterol checks, foot review and retinal screening – in 2005/06 were associated with reduced rates of emergency admissions across all time periods. Conversely, three of the care processes – BP checks, creatinine checks and smoking status checks – were actually associated with increased rates of emergency admissions across all follow-up periods.

Receipt of HbA1c checks in 2005/06 only exhibited a significant association with reduced emergency admission rates over three years of follow up, with no significant associations with changes in emergency admission rates across other follow-up periods. Receipt of urinary albumin testing in 2005/06 was associated with a significant increase in emergency admission rates over the longest period of follow-up, five years; associations with emergency admission rates across other, shorter, follow-up periods were non-significant.

The pattern of associations between individual NDA care processes and changes in readmission rates was similar to that observed for emergency admissions in terms of NDA processes and follow-up periods. Receipt of BMI checks, total cholesterol checks, foot review or retinal screening in 2005/06 were all associated with decreased readmission rates. Receipt of BP checks, creatinine checks and smoking status checks in 2005/06 were associated with increased readmission rates. No consistent associations between receipt of HbA1c checks, bar for readmissions over four years of follow up, were observed. No significant associations between urinary albumin checks and changes in readmission rates were observed for any length of follow-up.

Once again, a potential explanation for the seemingly counterintuitive observation that certain NDA care processes are associated with increased, rather than decreased, emergency admission rates could be one of selection bias and confounding by indication. Physicians may be more likely to perform certain checks on individuals who they deem to be of higher risk, meaning that the sub-population who received these checks represent a somewhat different risk pool.

A slightly different pattern of associations were observed between receipt of individual NDA care processes and death due to any cause were observed. Receipt of the NDA care processes pertaining to BMI checks, total cholesterol checks, foot checks, HbA1c checks, retinal screening or urinary albumin checks in 2005/06 were all associated with decreased odds of death across all follow-up periods. The apparent protection with respect to odds of death may reflect that this particular group of checks prompt delivery of secondary and tertiary prevention. Conversely, the fact that receipt of creatinine checks in 2005/06 was associated with increased odds of death across all time periods may reflect that individuals with established chronic renal failure are more likely to have their renal function regularly checked.

Checks of smoking status in 2005/06 exhibited a slightly more complex association with odds of death, with receipt of this care process associated with a significant reduction in odds of death over one year of follow-up, but a significant increase in those odds over four and five years of follow-up. It should be noted that the NDA smoking status check does not explicitly require referral to any smoking cessation activities in order to be recorded as received. In the short-term, therefore, receipt of this process may lead to a change in smoking behaviour that results in a reduction in risk of respiratory disease; the increased in odds observed in the longer term may result either from resumption of smoking or the onset of respiratory disease resulting from long-term smoking. Some degree of selection bias is also likely to exist, with individuals who have a history of smoking being more likely to have their current smoking status checked.

Receipt of the NDA total cholesterol check in 2005/06 was associated with increased odds of death due to a potentially diabetes-related cause across all lengths of follow-up. As the list of causes of death considered potentially diabetes-related in these analyses comprised of a number of cardio- and cerebrovascular diseases, such a finding may support the theory that individuals viewed to be at increased risk of vascular disease are more likely to have this particular care process carried out. Although there were significant associations with changes in the odds of dying due a potentially diabetes-related cause for the longest follow-up period in these analyses and receipt of the BMI or BP checks in 2005/06, the associated significance levels ($p = 0.049$ and $p = 0.025$ respectively) are arguably of borderline relevance in light of the number of variables included in the full model.

For the fully-adjusted models that utilised the number of NDA processes received as opposed to receipt of individual processes, a common feature of the pattern of associations with the various outcomes was that of a 'cut-off' in the number of processes received below which associations with outcomes conferred an increased admission rates or odds of death. As previously discussed, this seemingly paradoxical finding may result from selection bias and confounding by indication. Individuals with increased prior odds of unfavourable outcomes as a result of the progression of their diabetes may be more likely to receive a greater number of care processes. Conversely, those who receive relatively few (or no) care processes may represent a subgroup of individuals who are very unlikely to experience an unfavourable outcome. The net effect of such a phenomenon, should it hold true, would be the counterintuitive association between receipt of a low number of care processes and improved outcomes, as observed in these analyses.

For the models examining emergency admission and readmission rates, receipt of four to five or fewer NDA care processes was associated with increased admission rates in comparison to individuals receiving no care process across the majority of follow-up periods. Receipt of eight or nine care processes in 2005/06 was protective of readmissions across all lengths of follow-up, but significant reductions in emergency admission rates were only observed at up to three years of follow-up.

There were significant associations with the number of NDA processes received in 2005/06 and odds of death across all follow-up periods in the fully adjusted models. As with the associations observed for emergency admissions and readmissions, a 'cut-off' point with respect to favourable outcomes was evident. Receipt of five or more NDA care processes was associated with reduced odds of death in comparison to individuals receiving no care processes over all lengths of follow-up; conversely, receipt of only one or two care processes was associated with increased odds of death across all follow-up periods.

There appeared to be little in the way of consistent associations between the number of NDA care processes received and the odds of death due to a potentially diabetes-related cause; some associations did reach significance at the 95% confidence level but, as stated previously, such associations should be interpreted with caution in the context of the number of predictors included in the fully adjusted models.

Taken as a whole, the findings of the associations (or, indeed, relevant lack of certain associations) for NDA care processes suggest that engagement with care processes reduce the risk of acute illness, as implied by the findings for emergency admission rates, readmission rates and death due to any cause. It is important to note that these outcomes are not limited to diabetes-specific events; on the other hand, the general lack of association between NDA care processes in the fully adjusted models, either individually or as a whole, with changes in the odds of potentially diabetes-related death, in contrast to the reductions in odds of such deaths with achievement of DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol) and DM12 (BP ≤ 145/85) imply that actioning concerns raised during regular reviews, of which compliance with process measures may be a proxy measure of, is vital to reducing the risk posed by diabetes and that engagement with care in and of itself may not be sufficient to reduce the likelihood of death resulting from diabetes.

Patients who received no NDA processes may view themselves, and be viewed by their primary care team, to be of acceptably low risk of unscheduled care and mortality – meaning that regular review is subjectively viewed as a low priority. As such, the case mix of individuals in the group who received no NDA care processes is more likely to represent a lower collective risk.

Those who have received some NDA care processes may well have an objectively and subjectively elevated risk but are, for whatever reason, poorly engaged with their ongoing care. Those who received the highest numbers of NDA care processes likely have a need for regular review, but are engaged with their care, unlocking opportunities for early intervention and secondary and tertiary prevention, thereby reducing the likelihood of emergency admissions and death.

Whilst the primary aim of these analyses have been to explore associations between markers of high-quality diabetes management in primary care and outcomes such as emergency admissions, readmissions and death, consistent and strong associations were observed between increasing deprivation and poor outcomes. The estimated benefits of living in the most affluent areas of England exceeded the magnitude of those associated with a number of quality indicators, emphasising the importance of socio-economic factors in influencing the outcomes that a patient may reasonably expect from high-quality primary care.

Strengths and Limitations

These analyses examining the relationships between the quality of diabetes management in primary care and a range of ‘hard’ outcomes (emergency admissions, readmissions and death) have a number of strengths. The highly granular, patient-level data allows for explicit links between primary care activity and outcomes to be made, eliminating any inference from metrics of practice-level performance on the quality of care a specific patient has actually received. The resolution to which primary care consultation data was provided also allowed for accurate identification of eligible patients, further reducing bias.

There were, however, a number of shortcomings of both the data provided and the analytical methods necessitated by some of these shortcomings. CPRD is a voluntary data collection system to which practices can opt to be a part of; as such, it is likely that the included practices are not wholly representative of English general practices and may be more likely to include well-organised, larger practices.[223] As such, the associations observed in these analyses may not be wholly generalisable to patients registered to English general practices.

The attainment of certain NDA care processes in the sample of patients with diabetes contained in the CPRD-HES dataset in 2005/06 differed considerably from that observed in England as a whole. This could reflect the possibility that the sample of patients with diabetes contained within the CPRD-HES dataset is not wholly representative of the whole of England, as the Read codes used for these studies were based upon those utilised for the original NDA data extraction. That is not to say that the CPRD dataset is not representative as a whole when considering the entire registered population; the differences in the population with diabetes in the dataset delivered by the MHRA could result from chance as a result of the random sampling process or, potentially, the sub-population with diabetes in their dataset not truly reflecting that of all individuals with diabetes in England.

From an analytical standpoint, the large sample sizes available lent considerable statistical power to the analyses performed. The appropriateness of models was also checked, and alternative methods employed where necessary to maximise the quality of inferences gleaned from analyses.

Whilst CPRD data was reviewed and declared fit-for-purpose and compatible with the CPRD 'Gold' standard by the MHRA prior to delivery of the dataset, erroneous data was identified in a small proportion of patient records. These analyses also had to assume that all entered data was, in fact, correct and that there was no differential measurement biases across individuals, patient groups or practices. However, such concerns would be pertinent to all studies utilising observational primary care data sourced from a number of practices.

The anonymisation of patient and practice data by the MHRA also introduced certain limitations, in particular the lack of ability to link additional datasets describing, for example, other environmental exposures, levels of practice staffing and global practice performance. As such, it is likely that a certain degree of residual confounding remains – but there was no practicable way to quantify the degree or reduce the impact of this confounding.

The lack of explicit classification of patients with diabetes into T1DM and T2DM necessitated estimation of each patient's actual diabetes type; however, the approach utilised for determination of diabetes was validated against the group of patients of unequivocal diabetes type.

Co-morbidity, an important potential confounder if left unaccounted for, was quantified through an adaption of the Charlson co-morbidity index.[205,·206] Whilst the updated weights for various disease categories had been validated in a multi-national study[207], whether these weights are appropriate estimates of the burden of co-morbidity in the CPRD practice population cannot be verified and, as highlighted in the analysis of the impact of co-morbidity by diabetes status, may not be entirely accurate. Furthermore, it could be argued that the impact of certain co-morbidities are dependent on not only primary and secondary care quality, but other socioeconomic and environmental factors, the measurement of which is beyond the scope of these analyses.

The intention of these analyses was to explore the effects of the quality of treatment actually received by a patient and, to that end, they purposefully did not exclude individuals flagged as QOF exceptions. This approach, whilst advantageous for examining 'real-world' effectiveness, may have included some individuals who were atypical in some fashion; for example, one such reason that an individual may have been declared as an exception is on the grounds of an underlying diagnosis of metastatic cancer.

It is likely that, under the assumption that regular checks and reviews for diabetes would have ceased on compassionate grounds, that these individuals would be classified as having not attained QOF targets or not receiving NDA care processes. Should this be the case, it is conceivable that the estimates of odds of death for achievement of quality targets and processes may overestimate the benefits of receipt of high-quality care.

Closing Summary

The findings from these patient-level analyses provide further insight into the associations observed in the practice-level analyses presented earlier in this thesis. The findings of these analyses not only indicate the importance of attaining intermediate clinical targets can have on minimising unfavourable outcomes, but also the central role that engagement with regular clinical reviews have on improving outcomes in people with diabetes.

Conclusions

Overview of Findings

The analyses presented in this thesis have consistently indicated that there are some aspects of primary care quality that can have a statistically and clinically significant impact on the outcomes of individuals with diabetes mellitus, lending credence to the classification of diabetes mellitus a as primary care sensitive condition.

Over the coming decades, the population of England will, on average, become older[224], a phenomenon that will likely increase pressure on health services and increase the number of individuals with chronic diseases such as diabetes. Furthermore, the English population is becoming increasingly sedentary and obese[225], risk factors for the development of and poorer outcomes from diabetes and cardiovascular disease. Projections indicate that, by 2030, there will be an additional 1.6 million individuals with diabetes compared to 2010; this increase not only represents a absolute increase in the number of cases, but also increased prevalence, with the English prevalence of diabetes rising from 7.4% in 2010 to 9.5% in 2030.[26]

The NHS will, without doubt, face increasing demand for the management of diabetes, and it is essential that services are configured in a manner that maximises the potential for good patient outcomes in conjunction with cost-effective care.

Some of the most consistent findings from the analyses contained in this thesis indicate that some of the most significant gains in patient outcomes could be realised through regular review of patients and improving accessibility of services.

Practice-level analyses indicated that those practices in the highest fifth of performance for the group of diabetes QOF indicators pertaining to processes of care (indicators DM02 – DM04, DM08 – DM11, DM13 – DM16, DM18, DM21 and DM22, depending on QOF year) experience age-sex adjusted admission rates that are up to 9.1% lower than practices in the lowest fifth of performance.

The importance of regular reviews and checks – even without specification of a particular treatment target – were further highlighted by the associations observed between the receipt of NDA care processes and outcomes.

Delivery of certain NDA care processes were associated with improved outcomes, with BMI checks, total cholesterol checks, foot checks and retinal screening conferring protection against emergency admissions, readmissions and death over all follow-up periods in fully adjusted patient-level models.

Furthermore, patients who received all nine care processes as described by the National Diabetes audit in 2005/06 were subject to an emergency admission rate that was 53.7% lower for the first year of follow-up and continued to provide significant benefits with respect to emergency admissions up to three years of follow-up, with a relative rate reduction of 16.4%.

Receipt of all 9 NDA care processes was also associated with marked reductions in readmission rates, with relative rate reductions of 71.4% in the first year of follow-up and 29.4% over five years of follow-up. Engagement with process measures also conferred reduced odds of death due to any cause, with individuals receiving all nine care processes in 2005/06 exhibiting reductions in the odds of death of 96.5% during the first year of follow-up and 40.3% over five years of follow-up.

It is conceivable that the total number of care processes received by a patient is a proxy marker of engagement with regular, scheduled diabetes care; patients who are able to attend frequent diabetes reviews – under the assumption that their practice is able to offer such reviews – are assumedly more likely to attain the highest number of care processes. Conversely, the groups of patients who have

received relatively few care processes are, for whatever reason, are less likely to be engaged with care. It is also likely that regular reviews provide prompts and opportunities for patient education and secondary and tertiary prevention, factors that are likely to be linked with reduced risk of the development of complications of diabetes and potentially avoidable unscheduled hospitalisations.

One of the key enablers of delivery of regular checks to patients is practice accessibility, metrics of which – PE07 (the ability to book an appointment within 2 working days) and PE08 (the ability to book an appointment more than 2 days in advance) – were indirectly measured through responses to the GP Patient Survey.

In practice-level analyses, associations between achievement of indicator PE08, the ability of patients to book appointments more than two days in advance, were observed – practices in the best performing fifth for this indicator had significantly reduced emergency admission rates in comparison to their peers in the worst performing fifth, with relative rate reductions of between 6.0% – 8.8%.

The benefits associated with the ability for patients with a chronic disease such as diabetes to book scheduled appointments to discuss and review their ongoing care, as opposed to requests for urgent short-term care, doubtless support the delivery of proactive, rather than reactive, care. The availability of such appointments may well enable patient engagement and preparedness of their primary care team, key components of effective care for chronic disease.[226]

Unfortunately, both PE07 and PE08, as of 2011/12[227], are no longer part of QOF, divorcing a proportion of practice remuneration from the ability of patients to book scheduled appointments. Although the GP Patient Survey continues to be distributed to a sample of the registered population in England, the lack of financial incentives to ensure availability of appointments to discuss non-urgent issues has the potential to negatively impact the outcomes for people with diabetes, as there may be an inferred prioritisation of urgent problems in the distribution of available appointments.

Whilst the associations observed between processes measures and outcomes are generally encouraging, the importance of attaining specific intermediate clinical targets should not be ignored.

Although associations between thematic groupings of QOF indicators and emergency admissions were largely non-significant in the fully adjusted models, some associations between individual attainment of certain QOF indicators and outcomes were observed. In patient-level analyses, achievement of DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol) conferred protection against emergency admissions and readmissions even after adjustment for other indicators of high-quality care; DM17 (TC ≤ 5.0 mmol/L) similarly conferred protection against readmissions.

The associations observed for increased odds of death due to any cause and attainment of the intermediate clinical outcomes in QOF were unexpected, but may arise from selection bias, where physicians may be more likely to check and aggressively manage individuals they view to be at high risk. An alternative explanation is that a number of individuals who have attained these targets have been treated to the degree where limited further benefit can be realised and, potentially, the risks of harm are greater.

The ability of practices to declare patients as exceptions to various QOF targets may have diluted any relationships between target-driven indicators and outcomes; although these patients will not have been counted insofar as QOF attainment is concerned, they will still have been present in the practice-level tallies of emergency admissions. Patients who have been declared as exceptions are likely to be those who either cannot access services, are unwilling or unable to comply with treatment recommendations, have already received maximal therapy or have been excepted from QOF on compassionate grounds.

When examining relationships between the level of patients a practice has declared as an exception and emergency admissions, practices who are in the highest fifth of exception reporting for the process group of QOF indicators experienced emergency admission rates that were 10% – 12% higher than those in the lowest fifth of exception reporting for three of the four QOF years where exception reporting data was available.

Unexpectedly, the fifth of practices with the highest levels of exception reporting for the intermediate cardiovascular outcomes QOF group were associated with lower emergency admission rates for three of the four QOF years where exception reporting data was available. Considering that the practice-level analyses only examined admissions occurring within a given QOF year, such a finding may relate to the short-term reduction in side-effects associated with anti-hypertensive and cholesterol-reducing therapy, whereas the deleterious effects of elevated blood pressure and hypercholesterolaemia may not be realised for a number of years.

Whilst it can be argued that practices should not be penalised for patients who are unwilling to engage with treatment or for whom aggressive treatment would not be appropriate, there is a danger of disenfranchising those who cannot engage with treatment due to social, environmental or mobility barriers. Exception reporting does not apply to NDA care processes and could, therefore, be argued to better reflect 'real world' outcomes of the delivery of high-quality diabetes care. Indeed, it was for this specific reason – ascertainment of the 'real world' impact of interventions as opposed to the effect on those who are able to engage and comply with treatment – that the decision was made not to account for exception reporting in the patient-level analyses reported in this thesis.

An interesting differentiation between the outcomes of receipt of care processes and achievement of intermediate clinical outcomes was observed in the analyses examining the odds of death due to a potentially diabetes-related cause. Attaining DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol) or DM12 (BP ≤ 145/85) in 2005/06 was associated with significantly reduced odds of death due to a diabetes-related cause – in other words, the individuals who achieved either of these QOF indicators were more likely to die of something unrelated to diabetes as opposed to a condition related to it. Such a finding may indicate that the benefits of care processes extend beyond the risks associated with diabetes, but that attainment of certain clinical targets act more specifically on the risks to life posed by diabetes.

Whilst these analyses have demonstrated that delivery of high-quality care can lead to improved outcomes, the wider socioeconomic environment may exert some of the strongest and most consistent effects with respect to changes in the rates and odds of favourable outcomes.

In practice-level analyses, practices located in the least deprived tenth of England were subject to emergency admission rates that were between 28% – 38% lower than those located in the most deprived tenth of England. Similar associations were also present in the patient-level analyses, with patients living in the most affluent fifth of England experiencing emergency admission and readmission rates 23% – 30% lower than those living in the most deprived fifth; for all-cause mortality, those living in the most affluent areas had odds of death that were approximately 22% – 34% lower than those living in the most deprived areas.

Deprivation is associated with a number of factors that can influence the quality of management in primary care and the likelihood of satisfactory outcomes of diabetes; high levels of deprivation are associated with poorer QOF achievement[142,147], patterns of health behaviours[228], emergency hospitalisations[13,141,200], prevalence of chronic disease[163] and multi-morbidity.[229] However, the presence of socioeconomic deprivation in and of itself is beyond the sphere of influence of primary care – even though it can have profound effects on the ability of patients to access services, maintain healthy lifestyles and adversely affect outcomes.

Such findings reinforce the notion that primary care – and, in a wider sense, healthcare as a whole – cannot be viewed as a closed system. External factors are important determinants of health outcomes that must be taken account of not only in the measurement of healthcare performance but also in the allocation of resources, thereby supporting equitable access to opportunities for individuals to maximise their own health.

Strengths and Limitations

The intention of this final chapter is to describe and discuss the general, overarching themes identified through the various analyses. As such, the major strengths and weaknesses of the analyses performed will be discussed here; specific issues pertaining to practice- and patient-level analyses are discussed in the relevant sections of preceding chapters (see pages 111-113 and 201-204).

One of the major strengths of all the analyses that have been undertaken for the purposes of this thesis is one of sample size. For the practice-level models, approximately 8,000 practices were included for all analyses; for patient-level analyses, over 67,000 people with diabetes were included in the models exploring relationships between quality of care received and outcomes. These sample sizes allowed for identification of relationships that may have been obscured in smaller analyses and granted sufficient power to allow adjustments such as clustering by PCT in the practice-level models.

Another major strength of the analyses performed was that a number of health and non-health predictors were included as predictors that were able to be included in the models of health outcomes. This allowed for assessment of how various factors may modulate health outcomes in a scenario that more closely resembles 'real world' clinical practice as opposed to the relatively rarefied environment of clinical trials and carefully managed prospective cohort studies. The 'full' models performed in both the practice- and patient-level analyses allowed for exploration of the effect of a particular quality marker when adjusted for the effect of other quality markers. As such, a more representative exploration of the benefits associated with a given indicator of quality was possible.

Despite the strengths of the approaches used in the various analyses contained in this thesis, there are certain limitations that merit discussion. In previous sections of this thesis, the representativeness of the population with diabetes provided for analysis in the CPRD-HES dataset has been discussed; although the CPRD dataset as a whole is considered to be representative of the registered population in England, whether the same holds true for sub-populations identified by the presence of a chronic disease is not known. Furthermore, the patient records supplied amount to a random sample of 125,000 individuals with diabetes – only 4% of the total registered population with diabetes in 2013.[230]

The potential lack of representativeness of the research population may explain the differences observed in the overall attainment of NDA care processes observed in the dataset compared to that observed nationally for 2005/06. Furthermore, the National Diabetes Audit for 2005/06 only sampled patients from 2,416 general practices in England and Wales, amounting to 35% of the registered population with diabetes for that year.[231]

It is, therefore, entirely possible that the groups of patients whose data was utilised for the patient-level analyses presented in this thesis and the National Diabetes Audit – both of which measure process attainment in 2005/06 – are mutually exclusive. This raises the possibility that sampling error may contribute to the marked discrepancies observed for process attainment between the individuals included in this study and reported attainment levels in the National Diabetes Audit, especially as identification of process attainment for these analyses was identified using the same Read codes as those employed by the National Diabetes Audit.

Despite the fact that a relatively low proportion of the total number of people in England with diabetes was used, the sample size remained large, lending considerable power to the analyses performed. Furthermore, differences in associations were modelled on the level of individual patients and were adjusted for age, sex, ethnicity, deprivation and co-morbidity, which may well improve the generalisability of these findings to the wider population with diabetes.

One of the strengths of the CPRD-HES dataset was its longitudinal nature, allowing for temporal delineation between healthcare events and outcomes. However, the maximum length of follow-up in the patient-level analyses was five years. The decision to commence observation at the start of the 2005/06 QOF year was made to allow for QOF to become established in practice workflows, as it was only introduced in 2004/05; data beyond the end of the 2009/10 QOF year (the fifth year of observation) was incomplete for a number of practices, introducing an upper limit on follow-up time. Whilst certain associations were observed over the available follow-up period, it is unknown whether these hold true – or, indeed, whether additional associations become apparent – over longer follow-up periods.

The receipt of aspects of care considered to be reflective of high quality were only measured for 2005/06 in the patient-level analysis. Whilst it is likely that a patient who achieved a certain quality indicator in one year is more likely to attain it again in future years, changes in the quality of care received by patients in subsequent years was not modelled. However, the consistent and biologically plausible associations observed for many of the quality indicators in 2005/06 likely indicate meaningful associations between markers of quality and outcomes.

Attention should also be drawn to the short follow-up period used for practice-level analyses; each QOF year was modelled in isolation, meaning that models only described events that occurred within that year. This approach makes the implicit assumption that the maximal effect of differences in quality on emergency admissions would be realised within 12 months; this might be appropriate for some acute illnesses, but is highly likely to be inadequate for changes in risk profiles for other precipitants of emergency admissions, such as cardiovascular disease.

The use of all-cause emergency admissions and readmissions, as opposed to diabetes-specific admissions, in the patient-level analyses was chosen so as to provide maximum comparability with the findings from the practice-level models. As such, the associations observed between markers of high-quality diabetes care and unscheduled hospital admissions may more closely reflect the overall impact that primary care quality can have on total unscheduled care utilisation. That being said, it is well-established that diabetes is an accepted risk factor for a wide range of diseases that affect a large number of organ systems; on these grounds, the lack of exclusion of admissions for certain diseases could be argued to be sound.

One of the intentions of the methodology employed for these analyses was to make them readily applicable to the activities of primary care in England; as such, use of markers of quality such as QOF and NDA were utilised. Use of these markers necessitated use of 'cut-offs' for variables such as blood pressure, HbA1c and total cholesterol. As alluded to in the discussion sections of previous chapters, it is likely that there is variation in the actual levels of these measurements in the population that has been identified as achieving a given 'cut off' value. Other studies have indicated a U-shaped relationship between many of these indicators and the occurrence of favourable outcomes.[100,·101] It is therefore conceivable that a number of individuals who have been deemed successful in achieving a given quality indicator may have measurements that would indicate an excess risk, which may introduce a bias favouring a null result for a given quality indicator.

Despite the considerable effort undertaken to adjust for a number of health and non-health predictors of outcomes, it is likely that a considerable degree of residual confounding remains in the various models. The variation in outcomes attributable to unclustered practice-level models was estimated to only amount to around 2% of the total variation, likely reflecting unmeasured differences in patient populations, local health interventions and socio-environmental factors. Patient-level models are likely to also contain a degree of residual confounding, partially due to the lack of practice identifiers that precluded linkage of additional datasets, but also through the absence of controlling for variables such as family history, total pack-years smoked, the burden of polypharmacy and housing circumstances amongst others.

Comparison to Existing Literature

Glycaemic Control

A number of previous studies, which have used routine data, longitudinal data and bespoke prospective cohorts, have examined the relationship between quality of care and outcomes for diabetes and other chronic diseases.

In these analyses, there was little evidence to indicate an association between glycaemic control and the occurrence of outcomes such as unplanned hospital admissions and death due to any cause. Studies such as the United Kingdom Prospective Diabetes Study (UKPDS), a prospective cohort study that followed over 5,000 individuals newly diagnosed with T2DM for a median follow-up period of 10 years, indicated that glycaemic control conferred protection against the complications of diabetes, with a 1% reduction in HbA1c reducing the risk of any diabetes end-point by 21%[33] and that intensive glucose control reduced the risk of any diabetes-related end-point by 9%.[31]

Conversely, the Action to Control Cardiovascular Risk in Diabetes (ACCORD) trial, a prospective multi-centre trial including over 10,000 American and Canadian individuals with established T2DM, observed that intensive management of HbA1c (with a target of ≤ 6.0% / 42.1 mmol/mol) was associated with an increased risk of cardiovascular death.[232]

More recently, a study based on a similar dataset CPRD-HES dataset to that used for this analysis, observed that reduction of HbA1c to levels below 6.25% (44.8 mmol/mol) was associated with an excess risk of death due to any cause, compatible with the findings of the ACCORD trial.[101] A similar finding was observed in a recent meta-analysis describing outcomes of individuals with diabetes across strata of glycaemic control.[76]

For the practice-level analyses presented in this thesis, some sporadic and statistically significant associations were observed between attainment of the strict glycaemic control QOF indicator group, comprising of HbA1c targets ranging between 7.0% (53.0 mmol/mol) and 7.4% (57.4 mmol/mol), and increased emergency admission rates. The vast majority of the associations which did not reach statistical significance also suggested an increase in emergency admission rates from practices with the highest levels of attainment of strict glycaemic control.

Patient-level analyses, utilising QOF indicator DM06 (HbA1c ≤ 7.4% / 57.4 mmol/mol) as a therapeutic target, indicated that attainment of this indicator was associated with decreased emergency admission rates (relative reductions of ~11%), readmission rates (relative reductions of ~16%) and reduced odds of dying from a diabetes-related cause (relative reductions of ~14%).

The associations observed in the patient-level analyses seem broadly compatible with previous findings, however the effect of extreme reductions in HbA1c were not modelled. The lack of associations in the practice-level models between glycaemic control and emergency hospital admissions likely result from differences in the classification of end-points and potential variations in the levels of glycaemic control achieved in each practice's population. It should also be noted that the population included in these studies is comprised of individuals with T1DM and T2DM with varying lengths of time with diabetes, meaning that the study findings from UKPDS may not be wholly generalisable to the study population described in this thesis.

Blood Pressure

The current body of evidence supports control, up to a certain limit, of blood pressure in order to minimise risks to health posed by vascular disease in individuals with diabetes.

Evidence from the UKPDS cohort indicated that reduction of blood pressure was associated with a reduced risk of the occurrence of any diabetes-related endpoint (relative reduction ~24%) but bore no association with all-cause mortality.[96, 97] However, the blood pressure target (150/85, mean actual achieved BP 144/82) for this particular arm of UKPDS could be considered to be sub-therapeutic by contemporary standards.

The ACCORD trial, which separated individuals with T2DM into intensive (SBP ≤ 120 mmHg) and conventional (SBP ≤ 140 mmHg) blood pressure treatment arms, did not observe any significant differences in the observed rates of fatal and non-fatal cardiovascular endpoints over a mean follow-up of 4.7 years.[233]

Two recent studies[100, 101] utilising a similar CPRD-HES dataset to that used for the patient-level analyses presented in this thesis noted a U-shaped relationship between the levels of blood pressure achieved and all-cause mortality, in a manner analogous to that observed for glycaemic control. Reducing blood pressure to below 130/80 mmHg was not associated with reductions in risk of all-cause mortality in newly diagnosed diabetics[100]; however, attainment of very low blood pressures (SBP < 110 – 115 and DBP < 72.5 – 75 mmHg) conferred an increased risk of all-cause mortality in people with a recent diagnosis of T2DM.[100, 101]

The findings from the presented analyses pertaining to patient-level models of the odds of death from a diabetes-related cause appear broadly compatible with that of UKPDS, insofar as a modest BP target of ≤ 145/85 mmHg conferring reduced odds of dying from a diabetes-related cause for follow-up periods lasting four to five years (relative reductions of ~10%).

However, in these analyses, patients that attained DM06 (BP ≤ 145/85 mmHg) exhibited an increased rate of emergency admissions and readmissions during the first two years of follow-up (relative increases of ~5% – 11% and ~10% – 19% respectively) and increased odds of all-cause mortality across all lengths of follow-up (relative increases of ~21% – 84%, with reducing magnitude of effect over longer follow-up periods).

These findings appear incompatible with associations described in the existing literature. No detailed analysis was performed on the actual levels of blood pressure attained by individuals; as such, it is unknown how aggressively blood pressure was managed in the individuals who died and whether it was controlled to a degree that introduced excess risk.

Another possibility is that the individuals identified as having a level of cardiovascular risk commensurate with a need for blood pressure control were identified as such, but failed to have their blood pressure controlled, on average, to a level that conferred a meaningful level of benefit. Should this be the case, the elevated odds of death observed may simply reflect the identification of a sub-population that is at elevated risk.

It should be noted that the patient-level analyses in this thesis do not account for QOF exceptions, so it is conceivable that individuals who are terminally ill and have concomitant low blood pressure resulting from cardiovascular dysfunction, could introduce a degree of bias that favours a result suggesting increased odds of death.

Furthermore, the associations described from the fully-adjusted models in these analyses take into account attainment of a number of other quality targets, which other studies may have not explicitly controlled for and may explain, to a degree, seemingly incompatible findings.

Regardless of the source of the stark differences noted between these studies and results published from previous studies, further exploration of this deviation from the existing body of evidence is warranted.

Cholesterol

In comparison to studies examining the effects of blood pressure reduction and normalisation of glycaemic load, relatively few studies exist that describe the relationship between control of lipids and outcomes in individuals with diabetes.[201] Recent interventional studies tend to focus on low-density lipoprotein (LDL) as opposed to total cholesterol, the lipid measure utilised for the analyses included in this thesis.

The Heart Protection Study (HPS)[234] and Collaborative Atorvastatin Diabetes Study (CARDS)[235] both examined the effects of statin therapy on cardiovascular endpoints in individuals with T2DM; the study group for HPS was restricted to individuals with high LDL cholesterol, whereas CARDS limited inclusion to individuals with normal levels of LDL cholesterol. Both HPS and CARDS demonstrated significant reductions in the occurrence of cardiovascular endpoints (relative reductions of 0.78 and 0.63 respectively; LDL concentrations in treatment *vs.* placebo groups were 2.3 mmol/L *vs.* 3.3 mmol/L and 1.8 mmol/L *vs.* 3.0 mmol/L respectively). There is also some evidence that the protection against the occurrence of cardiovascular endpoints associated with statin therapy is independent of LDL cholesterol levels, as the beneficial effects of statin therapy were observed to persist even once controlled for LDL levels in CARDS. CARDS also examined associations with all-cause mortality, but observed reductions were non-significant.

In a retrospective cohort study utilising a similar dataset to the one used in these analyses[101], a U-shaped association between total cholesterol levels and hazard of death due to any cause was observed. Total cholesterol levels in the range of ≥ 2.5 mmol/L to < 3.5 mmol/L and > 4.5 mmol/L and ≤ 5.5 mmol/L conferred protection against all-cause mortality compared to individuals with a total cholesterol level between 3.5 mmol/L and 4.5 mmol/L; total cholesterol levels below 2.5 mmol/L were associated with increased hazards of mortality (a relative increase of 40%).

In these analyses, achieving a total cholesterol of ≤ 5.0 mmol/L (DM17) was associated with reduced emergency admission rates for lengths of follow-up ranging between two and four years in fully-adjusted patient-level models (relative rate decreases of ~9%). Attaining a total cholesterol level of ≤ 5.0 was, however, associated with increased odds of death over one and two years of follow-up (relative increases of ~22% and ~9.9% respectively). No consistent associations were observed between attainment of a total cholesterol target of ≤ 5.0 mmol/L and odds of death due to a diabetes-related cause or readmissions.

The protection with respect to emergency admission rates associated with total cholesterol levels of ≤ 5.0 mmol/L seem appear broadly compatible with existing evidence. However, the findings regarding an association between achieving a total cholesterol of ≤ 5.0 mmol/L and increased odds of death could be argued to deviate from accepted findings.

As noted for the comparison of the findings related to blood pressure for these studies, the fully-adjusted patient-level models do not take account of QOF exception reporting, meaning that the presence of individuals at high risk of imminent death may have introduced an element of bias to the results reported in this thesis. It should also be noted that HPS and CARDS did not consider the diabetic population as a whole, excluding patients with or without pre-existing high levels of LDL cholesterol; furthermore, these studies described associations between LDL cholesterol as opposed to total cholesterol, which may limit the generalisability of their findings to the methodology utilised for these analyses. Additionally, the analyses performed for this thesis did not account for receipt of specific cholesterol lowering therapies, further limiting direct comparison with HPS and CARDS.

Another potential explanation for these findings is that the QOF total cholesterol target of ≤ 5.0 mmol/L is simply not stringent enough to confer benefits with respect to odds of death; the evidence-based recommendations from NICE currently stipulate a total cholesterol target of ≤ 4.0 mmol/L for individuals with T2DM.[70]

Conclusion

The analyses presented in this thesis lend considerable credence to the classification of diabetes mellitus as a primary care sensitive condition. Improving the quality of diabetes management in primary care stands to reduce unscheduled demand on hospital services, improve outcomes for patients and allow for rationalisation of expenditure across the health system in an era where demands upon it stand to increase considerably.

A number of significant determinants of emergency admissions, readmissions and mortality lie outside of the sphere of influence of primary care; inequities in outcomes by deprivation, which continue to exist even when receipt of high-quality care is taken into account, must be addressed and represent a major source of avoidable unscheduled hospital care utilisation and, potentially, avoidable deaths.

It is also clear from these analyses that patient and practitioner engagement with diabetes care is of central importance to maximising outcomes for patients and reducing the demand for unscheduled hospital care. Such engagement extends beyond mere achievement of targets; regular clinical review, measured in these analyses by practice-level performance in the process group of QOF indicators and receipt of NDA care processes by patients are strongly and consistently linked with improved outcomes. That is not to say that attainment of intermediate targets is unimportant – but explicit recognition that quality of diabetes care extends beyond such targets is important.

There is a clear opportunity for primary care to improve outcomes for individuals with diabetes and provide that care in an approachable, appropriate and cost-effective manner. However, realising this opportunity will require investment in improving accessibility of services and ensuring that general practices are adequately resourced, both in terms of the current burden of diabetes and that which is projected for the coming decades, to deliver comprehensive, high-quality care.

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Appendix

Full Regression Tables for Partially Adjusted Practice-Level Models

		2005/06		2006/07		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
Age	**0 - 4**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	5 - 14	1.015	0.139	1.010	0.368	1.012	0.249	1.017	0.125	1.002	0.828	0.986	0.158
	15 - 44	1.006	0.473	0.997	0.742	1.006	0.409	1.010	0.162	1.002	0.727	0.990	0.177
	45 - 64	1.000	0.953	0.994	0.390	1.004	0.608	1.003	0.641	0.997	0.651	0.989	0.103
	65 - 74	1.016	0.144	1.019	0.136	1.007	0.518	1.011	0.258	0.996	0.673	0.982	0.080
	≥ 75	0.991	0.391	0.985	0.143	0.993	0.526	0.996	0.682	0.991	0.339	0.977	**0.015**
Sex	**% Male**	1.003	0.496	1.009	**0.045**	1.005	0.432	1.003	0.632	1.006	0.187	1.004	0.470
Ethnicity	**White**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Non-White	0.997	**0.006**	0.999	0.360	0.997	0.060	0.998	0.081	0.996	**0.001**	0.997	**0.010**
	Unknown	0.999	0.418	0.998	0.276	0.999	0.715	0.996	0.109	0.998	0.264	0.999	0.607
List Size Quartile	**< 4,000**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	4,000 – 7,999	0.991	0.517	0.990	0.477	0.983	0.280	0.972	0.077	0.984	0.265	0.985	0.369
	≥ 8,000	0.966	0.056	0.955	**0.018**	0.959	**0.046**	0.952	**0.010**	0.959	**0.017**	0.968	0.092
GP FTEs per 1,000 patients		0.958	0.084	0.945	0.055	0.981	0.524	0.972	0.433	1.002	0.957	0.988	0.760
Diabetes Prevalence		0.957	**0.001**	0.917	**< 0.001**	0.960	**0.003**	0.974	**0.036**	0.976	**0.013**	0.971	**0.015**
IMD Decile (1 = Most Deprived)	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.832	**< 0.001**	0.834	**< 0.001**	0.850	**< 0.001**	0.860	**< 0.001**	0.864	**< 0.001**	0.887	**< 0.001**
	3	0.797	**< 0.001**	0.817	**< 0.001**	0.819	**< 0.001**	0.844	**< 0.001**	0.835	**< 0.001**	0.850	**< 0.001**
	4	0.743	**< 0.001**	0.757	**< 0.001**	0.781	**< 0.001**	0.809	**< 0.001**	0.800	**< 0.001**	0.821	**< 0.001**
	5	0.732	**< 0.001**	0.720	**< 0.001**	0.764	**< 0.001**	0.778	**< 0.001**	0.778	**< 0.001**	0.791	**< 0.001**
	6	0.717	**< 0.001**	0.714	**< 0.001**	0.726	**< 0.001**	0.772	**< 0.001**	0.767	**< 0.001**	0.762	**< 0.001**
	7	0.700	**< 0.001**	0.691	**< 0.001**	0.723	**< 0.001**	0.759	**< 0.001**	0.756	**< 0.001**	0.773	**< 0.001**
	8	0.679	**< 0.001**	0.673	**< 0.001**	0.707	**< 0.001**	0.739	**< 0.001**	0.734	**< 0.001**	0.731	**< 0.001**
	9	0.656	**< 0.001**	0.641	**< 0.001**	0.692	**< 0.001**	0.741	**< 0.001**	0.744	**< 0.001**	0.719	**< 0.001**
	10	0.660	**< 0.001**	0.618	**< 0.001**	0.657	**< 0.001**	0.704	**< 0.001**	0.729	**< 0.001**	0.704	**< 0.001**
Area Classification	**Rural**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Urban	0.920	**0.004**	0.914	**0.005**	0.881	**< 0.001**	0.896	**< 0.001**	0.889	**< 0.001**	0.914	**0.001**
QOF Process UA Fifth	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.976	0.217	0.938	**< 0.001**	0.965	**0.020**	0.966	**0.022**	0.939	**< 0.001**	0.964	**0.009**
	3	0.991	0.661	0.956	**0.017**	0.978	0.209	0.952	**0.010**	0.956	**0.007**	0.968	**0.040**
	4	0.983	0.436	0.947	**0.010**	0.952	**0.002**	0.941	**0.002**	0.929	**< 0.001**	0.966	**0.043**
	5	0.980	0.361	0.950	**0.009**	0.959	**0.039**	0.925	**< 0.001**	0.932	**< 0.001**	0.953	**0.010**

Table A1. Full results from multiple-variable negative binomial regression model of fifths of underlying achievement of QOF process indicators against emergency admissions.

		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p
Age	**0 - 4**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	5 - 14	1.013	0.236	1.018	0.106	1.005	0.645	0.988	0.247
	15 - 44	1.006	0.393	1.011	0.144	1.004	0.538	0.993	0.304
	45 - 64	1.004	0.586	1.004	0.600	0.999	0.861	0.991	0.187
	65 - 74	1.009	0.434	1.013	0.198	0.998	0.853	0.985	0.133
	≥ 75	0.993	0.533	0.996	0.719	0.992	0.434	0.979	**0.024**
Sex	**% Male**	1.005	0.382	1.003	0.579	1.007	0.178	1.004	0.475
Eth	**White**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Non-White	0.997	0.069	0.998	0.118	0.997	**0.002**	0.997	**0.017**
	Unknown	0.999	0.714	0.996	0.108	0.998	0.283	0.999	0.654
List Size Quartile	**< 4,000**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	4,000 – 7,999	0.983	0.285	0.975	0.102	0.984	0.257	0.985	0.355
	≥ 8,000	0.958	**0.036**	0.953	**0.011**	0.955	**0.007**	0.964	0.051
GP FTEs per 1,000 patients		0.978	0.473	0.967	0.369	0.996	0.907	0.983	0.645
Diabetes Prevalence		0.962	**0.006**	0.976	0.054	0.978	**0.021**	0.973	**0.023**
IMD Decile (1 = Most Deprived)	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.851	**< 0.001**	0.861	**< 0.001**	0.864	**< 0.001**	0.891	**< 0.001**
	3	0.819	**< 0.001**	0.847	**< 0.001**	0.839	**< 0.001**	0.853	**< 0.001**
	4	0.781	**< 0.001**	0.811	**< 0.001**	0.802	**< 0.001**	0.825	**< 0.001**
	5	0.765	**< 0.001**	0.780	**< 0.001**	0.780	**< 0.001**	0.793	**< 0.001**
	6	0.726	**< 0.001**	0.772	**< 0.001**	0.767	**< 0.001**	0.764	**< 0.001**
	7	0.723	**< 0.001**	0.760	**< 0.001**	0.757	**< 0.001**	0.775	**< 0.001**
	8	0.708	**< 0.001**	0.739	**< 0.001**	0.735	**< 0.001**	0.734	**< 0.001**
	9	0.693	**< 0.001**	0.743	**< 0.001**	0.746	**< 0.001**	0.722	**< 0.001**
	10	0.656	**< 0.001**	0.703	**< 0.001**	0.727	**< 0.001**	0.706	**< 0.001**
Area Classification	**Rural**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Urban	0.882	**< 0.001**	0.896	**< 0.001**	0.888	**< 0.001**	0.913	**0.001**
QOF Process ER Fifth	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.997	0.837	0.994	0.650	1.007	0.651	1.015	0.371
	3	1.000	0.996	1.034	0.066	1.015	0.334	1.031	0.059
	4	1.025	0.227	1.052	**0.006**	1.030	0.081	1.047	**0.010**
	5	1.057	**0.010**	1.067	**0.001**	1.078	**< 0.001**	1.076	**< 0.001**

Table A2. Full results from multiple-variable negative binomial regression model of fifths of exception reporting for QOF process indicators against emergency admissions.

		2005/06		2006/07		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
Age	**0 - 4**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	5 - 14	1.016	0.132	1.009	0.405	1.012	0.267	1.016	0.138	1.003	0.809	0.986	0.162
	15 - 44	1.006	0.460	0.997	0.690	1.005	0.438	1.010	0.191	1.003	0.715	0.991	0.182
	45 - 64	1.000	0.968	0.993	0.350	1.003	0.663	1.003	0.717	0.997	0.653	0.989	0.104
	65 - 74	1.016	0.141	1.019	0.150	1.007	0.549	1.010	0.288	0.995	0.659	0.982	0.076
	≥ 75	0.991	0.407	0.984	0.143	0.993	0.523	0.996	0.678	0.991	0.374	0.977	**0.016**
Sex	**% Male**	1.003	0.458	1.010	**0.033**	1.005	0.396	1.003	0.571	1.007	0.154	1.004	0.463
Eth	**White**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Non-White	0.997	**0.007**	0.999	0.391	0.997	0.060	0.998	0.091	0.996	**0.001**	0.997	**0.013**
	Unknown	0.999	0.418	0.998	0.277	0.999	0.712	0.996	0.113	0.998	0.281	0.999	0.635
List Size Quartile	**< 4,000**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	4,000 – 7,999	0.990	0.486	0.989	0.441	0.983	0.279	0.975	0.111	0.985	0.310	0.987	0.437
	≥ 8,000	0.965	**0.045**	0.953	**0.013**	0.960	**0.048**	0.957	**0.023**	0.961	**0.021**	0.970	0.111
GP FTEs per 1,000 patients		0.956	0.069	0.942	**0.042**	0.978	0.466	0.968	0.380	0.998	0.951	0.985	0.694
Diabetes Prevalence		0.957	**0.001**	0.917	**< 0.001**	0.960	**0.003**	0.974	**0.035**	0.976	**0.013**	0.971	**0.014**
(1 = Most Deprived)	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.833	**< 0.001**	0.834	**< 0.001**	0.850	**< 0.001**	0.860	**< 0.001**	0.864	**< 0.001**	0.888	**< 0.001**
	3	0.797	**< 0.001**	0.818	**< 0.001**	0.819	**< 0.001**	0.845	**< 0.001**	0.837	**< 0.001**	0.852	**< 0.001**
	4	0.743	**< 0.001**	0.757	**< 0.001**	0.780	**< 0.001**	0.809	**< 0.001**	0.801	**< 0.001**	0.822	**< 0.001**
IMD Decile	**5**	0.731	**< 0.001**	0.719	**< 0.001**	0.763	**< 0.001**	0.778	**< 0.001**	0.778	**< 0.001**	0.791	**< 0.001**
	6	0.717	**< 0.001**	0.713	**< 0.001**	0.724	**< 0.001**	0.768	**< 0.001**	0.765	**< 0.001**	0.761	**< 0.001**
	7	0.699	**< 0.001**	0.689	**< 0.001**	0.721	**< 0.001**	0.757	**< 0.001**	0.755	**< 0.001**	0.772	**< 0.001**
	8	0.679	**< 0.001**	0.672	**< 0.001**	0.706	**< 0.001**	0.736	**< 0.001**	0.732	**< 0.001**	0.731	**< 0.001**
	9	0.656	**< 0.001**	0.640	**< 0.001**	0.690	**< 0.001**	0.740	**< 0.001**	0.744	**< 0.001**	0.719	**< 0.001**
	10	0.659	**< 0.001**	0.617	**< 0.001**	0.655	**< 0.001**	0.702	**< 0.001**	0.728	**< 0.001**	0.703	**< 0.001**
Area Classification	**Rural**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Urban	0.919	**0.004**	0.913	**0.004**	0.881	**< 0.001**	0.895	**< 0.001**	0.886	**< 0.001**	0.913	**0.001**
	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.003	0.873	0.986	0.451	0.984	0.339	0.991	0.515	1.005	0.716	1.003	0.824
QOF CVS UA Fifth	**3**	1.017	0.401	0.993	0.693	0.997	0.866	1.008	0.632	0.993	0.643	0.993	0.614
	4	1.004	0.820	0.995	0.781	0.989	0.528	0.992	0.634	0.996	0.823	1.004	0.815
	5	1.008	0.727	0.986	0.515	0.989	0.605	1.002	0.906	1.017	0.396	1.009	0.651

Table A3. Full results from multiple-variable negative binomial regression model of fifths of underlying achievement of QOF cardiovascular indicators against emergency admissions.

		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p
Age	**0 - 4**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	5 - 14	1.011	0.299	1.017	0.130	1.004	0.720	0.987	0.217
	15 - 44	1.005	0.488	1.010	0.178	1.004	0.621	0.992	0.253
	45 - 64	1.003	0.711	1.003	0.697	0.998	0.756	0.990	0.152
	65 - 74	1.006	0.581	1.011	0.259	0.997	0.745	0.984	0.106
	≥ 75	0.993	0.498	0.995	0.668	0.992	0.399	0.978	**0.019**
Sex	**% Male**	1.005	0.389	1.003	0.575	1.007	0.188	1.004	0.462
Eth	**White**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Non-White	0.997	0.056	0.998	0.093	0.996	**0.002**	0.997	**0.013**
	Unknown	0.999	0.722	0.996	0.112	0.998	0.277	0.999	0.621
List Size Quartile	**< 4,000**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	4,000 – 7,999	0.985	0.349	0.975	0.105	0.985	0.295	0.985	0.329
	≥ 8,000	0.963	0.068	0.956	**0.018**	0.958	**0.012**	0.965	**0.050**
GP FTEs per 1,000 patients		0.978	0.472	0.967	0.369	0.996	0.907	0.982	0.628
Diabetes Prevalence		0.961	**0.004**	0.975	**0.045**	0.977	**0.018**	0.974	**0.024**
(1 = Most Deprived)	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.850	**< 0.001**	0.860	**< 0.001**	0.863	**< 0.001**	0.890	**< 0.001**
	3	0.818	**< 0.001**	0.845	**< 0.001**	0.837	**< 0.001**	0.852	**< 0.001**
	4	0.779	**< 0.001**	0.809	**< 0.001**	0.799	**< 0.001**	0.823	**< 0.001**
	5	0.762	**< 0.001**	0.778	**< 0.001**	0.778	**< 0.001**	0.792	**< 0.001**
IMD Decile	**6**	0.724	**< 0.001**	0.770	**< 0.001**	0.764	**< 0.001**	0.763	**< 0.001**
	7	0.721	**< 0.001**	0.757	**< 0.001**	0.755	**< 0.001**	0.773	**< 0.001**
	8	0.706	**< 0.001**	0.736	**< 0.001**	0.731	**< 0.001**	0.732	**< 0.001**
	9	0.691	**< 0.001**	0.740	**< 0.001**	0.743	**< 0.001**	0.720	**< 0.001**
	10	0.655	**< 0.001**	0.701	**< 0.001**	0.726	**< 0.001**	0.704	**< 0.001**
Area Classification	**Rural**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Urban	0.881	**< 0.001**	0.894	**< 0.001**	0.887	**< 0.001**	0.913	**0.001**
	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.969	**0.045**	1.009	0.543	0.986	0.359	1.018	0.238
QOF CVS ER Fifth	**3**	0.978	0.217	1.008	0.627	1.014	0.314	1.015	0.355
	4	0.968	0.079	1.003	0.861	0.989	0.532	1.040	**0.022**
	5	0.996	0.870	1.023	0.269	1.028	0.173	1.056	**0.010**

Table A4. Full results from multiple-variable negative binomial regression model of fifths of exception reporting for QOF cardiovascular indicators against emergency admissions.

		2005/06		2006/07		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
Age	**0 - 4**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	5 - 14	1.016	0.137	1.010	0.361	1.012	0.238	1.016	0.145	1.003	0.772	0.986	0.161
	15 - 44	1.006	0.465	0.997	0.701	1.005	0.460	1.010	0.192	1.003	0.677	0.990	0.163
	45 - 64	1.000	0.957	0.993	0.355	1.003	0.698	1.003	0.723	0.997	0.693	0.988	0.096
	65 - 74	1.016	0.142	1.019	0.144	1.007	0.542	1.010	0.291	0.996	0.669	0.982	0.073
	≥ 75	0.991	0.397	0.985	0.145	0.993	0.507	0.995	0.676	0.992	0.410	0.977	**0.014**
Sex	**% Male**	1.003	0.475	1.011	**0.023**	1.006	0.317	1.003	0.566	1.007	0.148	1.005	0.410
Eth	**White**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Non-White	0.997	**0.007**	0.999	0.491	0.998	0.106	0.998	0.086	0.996	**0.002**	0.997	**0.016**
	Unknown	0.999	0.409	0.998	0.290	0.999	0.773	0.996	0.114	0.998	0.290	0.999	0.651
List Size Quartile	**< 4,000**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	4,000 – 7,999	0.990	0.480	0.990	0.468	0.984	0.304	0.975	0.110	0.988	0.390	0.992	0.595
	≥ 8,000	0.964	**0.042**	0.956	**0.016**	0.963	0.062	0.958	**0.022**	0.965	**0.031**	0.976	0.176
GP FTEs per 1,000 patients		0.957	0.073	0.940	**0.037**	0.976	0.430	0.968	0.384	0.998	0.965	0.988	0.745
Diabetes Prevalence		0.958	**0.001**	0.916	**< 0.001**	0.957	**0.001**	0.974	**0.035**	0.976	**0.011**	0.969	**0.007**
(1 = Most Deprived)	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.833	**< 0.001**	0.835	**< 0.001**	0.852	**< 0.001**	0.861	**< 0.001**	0.865	**< 0.001**	0.889	**< 0.001**
	3	0.797	**< 0.001**	0.819	**< 0.001**	0.820	**< 0.001**	0.845	**< 0.001**	0.838	**< 0.001**	0.854	**< 0.001**
	4	0.742	**< 0.001**	0.759	**< 0.001**	0.781	**< 0.001**	0.810	**< 0.001**	0.802	**< 0.001**	0.823	**< 0.001**
IMD Decile	**5**	0.731	**< 0.001**	0.720	**< 0.001**	0.763	**< 0.001**	0.778	**< 0.001**	0.779	**< 0.001**	0.790	**< 0.001**
	6	0.717	**< 0.001**	0.712	**< 0.001**	0.723	**< 0.001**	0.768	**< 0.001**	0.766	**< 0.001**	0.762	**< 0.001**
	7	0.700	**< 0.001**	0.689	**< 0.001**	0.720	**< 0.001**	0.758	**< 0.001**	0.757	**< 0.001**	0.774	**< 0.001**
	8	0.679	**< 0.001**	0.671	**< 0.001**	0.704	**< 0.001**	0.736	**< 0.001**	0.733	**< 0.001**	0.730	**< 0.001**
	9	0.656	**< 0.001**	0.640	**< 0.001**	0.689	**< 0.001**	0.740	**< 0.001**	0.744	**< 0.001**	0.718	**< 0.001**
	10	0.660	**< 0.001**	0.617	**< 0.001**	0.652	**< 0.001**	0.702	**< 0.001**	0.729	**< 0.001**	0.702	**< 0.001**
Area Classification	**Rural**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Urban	0.919	**0.003**	0.914	**0.004**	0.884	**< 0.001**	0.894	**< 0.001**	0.888	**< 0.001**	0.914	**0.001**
	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.002	0.925	0.990	0.640	1.035	0.135	1.000	0.987	0.969	0.079	0.980	0.157
QOF Strict Glycaemic Control UA Fifth	**3**	1.002	0.929	1.015	0.546	1.029	0.271	0.976	0.218	0.958	0.053	0.980	0.186
	4	1.002	0.950	1.037	0.249	1.037	0.267	0.995	0.827	0.983	0.524	1.010	0.626
	5	0.994	0.840	1.034	0.348	1.092	**0.017**	1.000	0.995	1.015	0.666	1.034	0.248

Table A5. Full results from multiple-variable negative binomial regression model of fifths of underlying achievement of QOF strict glycaemic control indicators against emergency admissions.

		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p
Age	**0 - 4**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	5 - 14	1.011	0.275	1.017	0.115	1.004	0.711	0.987	0.202
	15 - 44	1.005	0.452	1.010	0.167	1.004	0.601	0.992	0.247
	45 - 64	1.003	0.654	1.004	0.634	0.998	0.810	0.990	0.156
	65 - 74	1.007	0.536	1.012	0.242	0.997	0.752	0.983	0.103
	≥ 75	0.993	0.515	0.996	0.699	0.992	0.413	0.978	**0.019**
Sex	**% Male**	1.005	0.381	1.003	0.574	1.007	0.180	1.004	0.513
Eth	**White**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Non-White	0.997	0.055	0.998	0.081	0.996	**0.001**	0.997	**0.008**
	Unknown	0.999	0.715	0.996	0.111	0.998	0.272	0.999	0.640
List Size Quartile	**< 4,000**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	4,000 – 7,999	0.985	0.337	0.976	0.121	0.986	0.304	0.986	0.373
	≥ 8,000	0.961	0.054	0.957	**0.019**	0.958	**0.012**	0.967	0.063
GP FTEs per 1,000 patients		0.977	0.464	0.967	0.363	0.993	0.842	0.980	0.597
Diabetes Prevalence		0.962	**0.005**	0.976	0.057	0.979	**0.025**	0.974	**0.028**
(1 = Most Deprived)	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.849	**< 0.001**	0.860	**< 0.001**	0.862	**< 0.001**	0.890	**< 0.001**
	3	0.818	**< 0.001**	0.846	**< 0.001**	0.838	**< 0.001**	0.852	**< 0.001**
	4	0.779	**< 0.001**	0.810	**< 0.001**	0.801	**< 0.001**	0.823	**< 0.001**
IMD Decile	**5**	0.762	**< 0.001**	0.779	**< 0.001**	0.779	**< 0.001**	0.792	**< 0.001**
	6	0.725	**< 0.001**	0.772	**< 0.001**	0.764	**< 0.001**	0.763	**< 0.001**
	7	0.722	**< 0.001**	0.760	**< 0.001**	0.756	**< 0.001**	0.773	**< 0.001**
	8	0.706	**< 0.001**	0.737	**< 0.001**	0.734	**< 0.001**	0.734	**< 0.001**
	9	0.691	**< 0.001**	0.742	**< 0.001**	0.746	**< 0.001**	0.722	**< 0.001**
	10	0.655	**< 0.001**	0.702	**< 0.001**	0.728	**< 0.001**	0.706	**< 0.001**
Area Classification	**Rural**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Urban	0.880	**< 0.001**	0.895	**< 0.001**	0.886	**< 0.001**	0.912	**0.001**
	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.991	0.528	1.012	0.418	0.987	0.315	1.010	0.552
QOF Strict Glycaemic Control ER Fifth	**3**	0.983	0.347	1.020	0.225	0.998	0.915	1.023	0.129
	4	1.001	0.955	1.023	0.171	1.024	0.185	1.024	0.202
	5	1.025	0.326	1.055	**0.012**	1.059	**0.015**	1.079	**0.002**

Table A6. Full results from multiple-variable negative binomial regression model of fifths of exception reporting for QOF strict glycaemic control indicators against emergency admissions.

		2009/10		2010/11	
		IRR	p	IRR	p
Age	**0 - 4**	*Reference Group*		*Reference Group*	
	5 - 14	1.002	0.861	0.985	0.137
	15 - 44	1.002	0.750	0.990	0.150
	45 - 64	0.996	0.618	0.988	0.087
	65 - 74	0.995	0.635	0.981	0.061
	≥ 75	0.991	0.360	0.976	**0.012**
Sex	**% Male**	1.007	0.169	1.004	0.471
Eth	**White**	*Reference Group*		*Reference Group*	
	Non-White	0.996	**0.001**	0.997	**0.010**
	Unknown	0.998	0.269	0.999	0.622
List Size Quartile	**< 4,000**	*Reference Group*		*Reference Group*	
	4,000 – 7,999	0.987	0.377	0.990	0.554
	≥ 8,000	0.964	**0.034**	0.974	0.161
GP FTEs per 1,000 patients		0.999	0.976	0.987	0.735
Diabetes Prevalence		0.976	**0.015**	0.972	**0.014**
(1 = Most Deprived)	**1**	*Reference Group*		*Reference Group*	
	2	0.865	**< 0.001**	0.888	**< 0.001**
	3	0.838	**< 0.001**	0.852	**< 0.001**
	4	0.801	**< 0.001**	0.823	**< 0.001**
IMD Decile	**5**	0.779	**< 0.001**	0.790	**< 0.001**
	6	0.767	**< 0.001**	0.761	**< 0.001**
	7	0.757	**< 0.001**	0.772	**< 0.001**
	8	0.733	**< 0.001**	0.731	**< 0.001**
	9	0.744	**< 0.001**	0.719	**< 0.001**
	10	0.729	**< 0.001**	0.702	**< 0.001**
Area Classification	**Rural**	*Reference Group*		*Reference Group*	
	Urban	0.888	**< 0.001**	0.914	**0.001**
	1	*Reference Group*		*Reference Group*	
	2	0.966	**0.027**	0.958	**0.003**
QOF Intermediate Glycaemic Control UA Fifth	**3**	0.955	**0.010**	0.991	0.594
	4	0.971	0.126	0.970	0.098
	5	0.992	0.720	1.014	0.538

Table A7. Full results from multiple-variable negative binomial regression model of fifths of underlying achievement of QOF intermediate glycaemic control indicators against emergency admissions.

		2009/10		2010/11	
		IRR	p	IRR	p
Age	**0 - 4**	*Reference Group*		*Reference Group*	
	5 - 14	1.004	0.689	0.987	0.200
	15 - 44	1.004	0.587	0.992	0.242
	45 - 64	0.999	0.838	0.990	0.159
	65 - 74	0.997	0.778	0.984	0.109
	≥ 75	0.992	0.427	0.978	**0.019**
Sex	**% Male**	1.007	0.173	1.004	0.512
Eth	**White**	*Reference Group*		*Reference Group*	
	Non-White	0.996	**0.001**	0.997	**0.009**
	Unknown	0.998	0.268	0.999	0.636
List Size Quartile	**< 4,000**	*Reference Group*		*Reference Group*	
	4,000 – 7,999	0.986	0.316	0.986	0.385
	≥ 8,000	0.958	**0.013**	0.966	0.062
GP FTEs per 1,000 patients		0.994	0.865	0.981	0.617
Diabetes Prevalence		0.978	**0.023**	0.974	**0.030**
(1 = Most Deprived)	**1**	*Reference Group*		*Reference Group*	
	2	0.862	**< 0.001**	0.890	**< 0.001**
	3	0.837	**< 0.001**	0.852	**< 0.001**
	4	0.800	**< 0.001**	0.823	**< 0.001**
IMD Decile	**5**	0.779	**< 0.001**	0.794	**< 0.001**
	6	0.765	**< 0.001**	0.764	**< 0.001**
	7	0.757	**< 0.001**	0.775	**< 0.001**
	8	0.734	**< 0.001**	0.737	**< 0.001**
	9	0.745	**< 0.001**	0.724	**< 0.001**
	10	0.728	**< 0.001**	0.707	**< 0.001**
Area Classification	**Rural**	*Reference Group*		*Reference Group*	
	Urban	0.887	**< 0.001**	0.912	**0.001**
QOF Intermediate Glycaemic Control ER Fifth	**1**	*Reference Group*		*Reference Group*	
	2	1.001	0.965	1.012	0.408
	3	1.008	0.602	1.038	**0.014**
	4	1.032	0.086	1.027	0.149
	5	1.066	**0.006**	1.093	**< 0.001**

Table A8. Full results from multiple-variable negative binomial regression model of fifths of exception reporting for QOF intermediate glycaemic control indicators against emergency admissions.

		2005/06		2006/07		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
Age	**0 - 4**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	5 - 14	1.016	0.133	1.009	0.435	1.011	0.299	1.016	0.146	1.002	0.858	0.985	0.153
	15 - 44	1.006	0.453	0.996	0.673	1.005	0.495	1.010	0.190	1.002	0.731	0.990	0.167
	45 - 64	1.000	0.996	0.993	0.346	1.002	0.717	1.003	0.703	0.997	0.643	0.988	0.096
	65 - 74	1.017	0.136	1.019	0.153	1.005	0.617	1.011	0.262	0.996	0.674	0.981	0.063
	≥ 75	0.991	0.417	0.984	0.142	0.993	0.501	0.995	0.672	0.991	0.361	0.977	**0.014**
Sex	**% Male**	1.003	0.526	1.010	**0.039**	1.005	0.382	1.003	0.621	1.007	0.186	1.004	0.450
Eth	**White**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Non-White	0.997	**0.006**	0.999	0.359	0.997	0.060	0.998	0.081	0.996	**0.001**	0.997	**0.009**
	Unknown	0.999	0.394	0.998	0.266	0.999	0.722	0.996	0.108	0.998	0.261	0.999	0.620
List Size Quartile	**< 4,000**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	4,000 – 7,999	0.990	0.496	0.990	0.493	0.985	0.348	0.975	0.114	0.985	0.307	0.991	0.592
	≥ 8,000	0.964	**0.041**	0.955	**0.017**	0.965	0.082	0.958	**0.025**	0.961	**0.022**	0.977	0.205
GP FTEs per 1,000 patients		0.959	0.091	0.942	**0.044**	0.977	0.452	0.971	0.427	1.000	0.992	0.986	0.713
Diabetes Prevalence		0.957	**0.001**	0.917	**< 0.001**	0.960	**0.003**	0.974	**0.036**	0.976	**0.013**	0.972	**0.017**
(1 = Most Deprived)	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.832	**< 0.001**	0.833	**< 0.001**	0.851	**< 0.001**	0.859	**< 0.001**	0.864	**< 0.001**	0.889	**< 0.001**
	3	0.797	**< 0.001**	0.818	**< 0.001**	0.818	**< 0.001**	0.845	**< 0.001**	0.838	**< 0.001**	0.853	**< 0.001**
	4	0.742	**< 0.001**	0.759	**< 0.001**	0.780	**< 0.001**	0.809	**< 0.001**	0.800	**< 0.001**	0.822	**< 0.001**
IMD Decile	**5**	0.732	**< 0.001**	0.719	**< 0.001**	0.762	**< 0.001**	0.779	**< 0.001**	0.778	**< 0.001**	0.791	**< 0.001**
	6	0.718	**< 0.001**	0.713	**< 0.001**	0.723	**< 0.001**	0.770	**< 0.001**	0.766	**< 0.001**	0.761	**< 0.001**
	7	0.702	**< 0.001**	0.691	**< 0.001**	0.720	**< 0.001**	0.758	**< 0.001**	0.756	**< 0.001**	0.772	**< 0.001**
	8	0.680	**< 0.001**	0.673	**< 0.001**	0.705	**< 0.001**	0.738	**< 0.001**	0.734	**< 0.001**	0.731	**< 0.001**
	9	0.658	**< 0.001**	0.641	**< 0.001**	0.690	**< 0.001**	0.742	**< 0.001**	0.745	**< 0.001**	0.720	**< 0.001**
	10	0.661	**< 0.001**	0.619	**< 0.001**	0.653	**< 0.001**	0.704	**< 0.001**	0.730	**< 0.001**	0.703	**< 0.001**
Area Classification	**Rural**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Urban	0.921	**0.005**	0.913	**0.004**	0.880	**< 0.001**	0.896	**< 0.001**	0.888	**< 0.001**	0.912	**0.001**
	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.003	0.889	1.001	0.953	0.986	0.443	0.991	0.505	0.988	0.487	0.955	**0.004**
QOF Moderate Glycaemic Control UA Fifth	**3**	1.006	0.794	0.949	**0.012**	0.992	0.707	0.971	0.109	0.962	**0.029**	0.970	0.107
	4	0.971	0.193	0.990	0.667	0.974	0.313	0.976	0.179	0.980	0.318	0.982	0.366
	5	0.980	0.448	0.980	0.442	1.024	0.366	0.969	0.150	0.977	0.250	1.008	0.687

Table A9. Full results from multiple-variable negative binomial regression model of fifths of underlying achievement of QOF moderate glycaemic control indicators against emergency admissions.

		2007/08		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p	IRR	p
Age	**0 - 4**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	5 - 14	1.011	0.285	1.017	0.115	1.005	0.658	0.987	0.210
	15 - 44	1.005	0.475	1.010	0.167	1.004	0.549	0.992	0.258
	45 - 64	1.003	0.677	1.004	0.630	0.999	0.876	0.990	0.172
	65 - 74	1.007	0.543	1.012	0.223	0.998	0.833	0.984	0.119
	≥ 75	0.993	0.503	0.996	0.686	0.993	0.453	0.978	**0.021**
Sex	**% Male**	1.006	0.366	1.003	0.587	1.007	0.172	1.004	0.510
Eth	**White**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Non-White	0.997	0.055	0.998	0.089	0.996	**0.001**	0.997	**0.011**
	Unknown	0.999	0.718	0.996	0.108	0.998	0.268	0.999	0.632
List Size Quartile	**< 4,000**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	4,000 – 7,999	0.987	0.400	0.977	0.137	0.986	0.326	0.984	0.327
	≥ 8,000	0.964	0.077	0.957	**0.021**	0.958	**0.013**	0.965	**0.050**
GP FTEs per 1,000 patients		0.978	0.466	0.968	0.387	0.994	0.881	0.981	0.621
Diabetes Prevalence		0.962	**0.005**	0.976	0.052	0.978	**0.021**	0.973	**0.024**
(1 = Most Deprived)	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.849	**< 0.001**	0.859	**< 0.001**	0.863	**< 0.001**	0.890	**< 0.001**
	3	0.818	**< 0.001**	0.846	**< 0.001**	0.838	**< 0.001**	0.852	**< 0.001**
	4	0.780	**< 0.001**	0.809	**< 0.001**	0.800	**< 0.001**	0.823	**< 0.001**
IMD Decile	**5**	0.763	**< 0.001**	0.780	**< 0.001**	0.780	**< 0.001**	0.793	**< 0.001**
	6	0.726	**< 0.001**	0.771	**< 0.001**	0.766	**< 0.001**	0.764	**< 0.001**
	7	0.722	**< 0.001**	0.760	**< 0.001**	0.757	**< 0.001**	0.774	**< 0.001**
	8	0.707	**< 0.001**	0.738	**< 0.001**	0.734	**< 0.001**	0.735	**< 0.001**
	9	0.692	**< 0.001**	0.741	**< 0.001**	0.746	**< 0.001**	0.723	**< 0.001**
	10	0.656	**< 0.001**	0.702	**< 0.001**	0.728	**< 0.001**	0.706	**< 0.001**
Area Classification	**Rural**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Urban	0.880	**< 0.001**	0.895	**< 0.001**	0.887	**< 0.001**	0.913	**0.001**
	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.971	0.080	0.997	0.829	0.989	0.412	1.023	0.116
QOF Moderate Glycaemic Control ER Fifth	**3**	0.975	0.121	1.003	0.865	1.017	0.236	1.046	**0.002**
	4	0.975	0.222	1.016	0.332	1.027	0.169	1.043	**0.045**
	5	1.021	0.400	1.054	**0.017**	1.064	**0.004**	1.087	**< 0.001**

Table A10. Full results from multiple-variable negative binomial regression model of fifths of exception reporting for QOF moderate glycaemic control indicators against emergency admissions.

		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p
Age	**0 - 4**	*Reference Group*		*Reference Group*		*Reference Group*	
	5 - 14	1.019	0.081	1.005	0.610	0.989	0.302
	15 - 44	1.011	0.127	1.004	0.532	0.993	0.319
	45 - 64	1.005	0.539	0.999	0.864	0.991	0.208
	65 - 74	1.012	0.241	0.997	0.784	0.984	0.114
	≥ 75	0.998	0.862	0.994	0.524	0.981	**0.045**
Sex	**% Male**	1.004	0.468	1.008	0.118	1.006	0.336
Eth	**White**	*Reference Group*		*Reference Group*		*Reference Group*	
	Non-White	0.997	0.064	0.996	**0.001**	0.997	**0.007**
	Unknown	0.996	0.112	0.998	0.272	0.999	0.614
List Size Quartile	**< 4,000**	*Reference Group*		*Reference Group*		*Reference Group*	
	4,000 – 7,999	0.969	0.054	0.978	0.120	0.977	0.164
	≥ 8,000	0.950	**0.009**	0.948	**0.003**	0.952	**0.014**
GP FTEs per 1,000 patients		0.974	0.482	1.004	0.912	0.995	0.896
Diabetes Prevalence		0.973	**0.026**	0.974	**0.007**	0.969	**0.007**
(1 = Most Deprived)	**1**	*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.861	**< 0.001**	0.865	**< 0.001**	0.889	**< 0.001**
	3	0.845	**< 0.001**	0.838	**< 0.001**	0.854	**< 0.001**
	4	0.812	**< 0.001**	0.803	**< 0.001**	0.825	**< 0.001**
IMD Decile	**5**	0.781	**< 0.001**	0.782	**< 0.001**	0.793	**< 0.001**
	6	0.772	**< 0.001**	0.769	**< 0.001**	0.765	**< 0.001**
	7	0.761	**< 0.001**	0.757	**< 0.001**	0.776	**< 0.001**
	8	0.739	**< 0.001**	0.736	**< 0.001**	0.734	**< 0.001**
	9	0.744	**< 0.001**	0.748	**< 0.001**	0.722	**< 0.001**
	10	0.707	**< 0.001**	0.732	**< 0.001**	0.708	**< 0.001**
Area Classification	**Rural**	*Reference Group*		*Reference Group*		*Reference Group*	
	Urban	0.898	**< 0.001**	0.890	**< 0.001**	0.918	**0.001**
QOF PE07 UA	**1**	*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.981	0.244	0.958	**0.008**	0.962	0.060
	3	0.957	**0.019**	0.963	0.079	0.964	0.084
	4	0.941	**0.002**	0.946	**0.007**	0.937	**0.006**
	5	0.945	**0.008**	0.928	**0.001**	0.903	**< 0.001**

Table A11. Full results from multiple-variable negative binomial regression model of fifths of underlying achievement of QOF indicator PE07 against emergency admissions.

		2008/09		2009/10		2010/11	
		IRR	p	IRR	p	IRR	p
Age	0 - 4	*Reference Group*		*Reference Group*		*Reference Group*	
	5 - 14	1.018	0.090	1.004	0.697	0.987	0.192
	15 - 44	1.012	0.100	1.004	0.530	0.992	0.262
	45 - 64	1.005	0.476	0.999	0.847	0.991	0.177
	65 - 74	1.012	0.211	0.997	0.756	0.983	0.093
	≥ 75	0.998	0.878	0.993	0.506	0.980	**0.028**
Sex	% Male	1.004	0.462	1.008	0.115	1.005	0.363
Eth	White	*Reference Group*		*Reference Group*		*Reference Group*	
	Non-White	0.998	0.077	0.996	**0.001**	0.997	**0.010**
	Unknown	0.996	0.099	0.998	0.253	0.999	0.593
List Size Quartile	< 4,000	*Reference Group*		*Reference Group*		*Reference Group*	
	4,000 – 7,999	0.959	**0.013**	0.972	0.056	0.971	0.088
	≥ 8,000	0.932	**< 0.001**	0.938	**0.001**	0.943	**0.003**
GP FTEs per 1,000 patients		0.974	0.465	1.004	0.921	0.993	0.843
Diabetes Prevalence		0.969	**0.010**	0.973	**0.006**	0.966	**0.005**
(1 = Most Deprived) IMD Decile	1	*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.864	**< 0.001**	0.866	**< 0.001**	0.889	**< 0.001**
	3	0.848	**< 0.001**	0.839	**< 0.001**	0.854	**< 0.001**
	4	0.813	**< 0.001**	0.803	**< 0.001**	0.825	**< 0.001**
	5	0.781	**< 0.001**	0.781	**< 0.001**	0.794	**< 0.001**
	6	0.774	**< 0.001**	0.769	**< 0.001**	0.765	**< 0.001**
	7	0.762	**< 0.001**	0.759	**< 0.001**	0.777	**< 0.001**
	8	0.742	**< 0.001**	0.738	**< 0.001**	0.735	**< 0.001**
	9	0.748	**< 0.001**	0.750	**< 0.001**	0.723	**< 0.001**
	10	0.712	**< 0.001**	0.737	**< 0.001**	0.710	**< 0.001**
Area Classification	Rural	*Reference Group*		*Reference Group*		*Reference Group*	
	Urban	0.901	**< 0.001**	0.891	**< 0.001**	0.919	**0.002**
QOF PE08 UA	1	*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.948	**0.002**	0.995	0.770	0.981	0.322
	3	0.937	**0.001**	0.971	0.112	0.954	**0.021**
	4	0.905	**< 0.001**	0.937	**0.001**	0.938	**0.005**
	5	0.897	**< 0.001**	0.937	**0.005**	0.909	**< 0.001**

Table A12. Full results from multiple-variable negative binomial regression model of fifths of underlying achievement of QOF indicator PE08 against emergency admissions.

List of Fields Provided in CPRD Tables

Field name	Description	Type	Format
patid	Encrypted unique identifier given to a patient in GPRD	INTEGER	20
vmid	Old VM id for the patient when the practice was using the VAMP system	INTEGER	20
gender	Patient's gender	INTEGER	1
yob	Patient's year of birth	INTEGER	4
mob	Patient's month of birth (for those aged under 16). 0 indicates no month set	INTEGER	2
marital	Patient's current martial status	INTEGER	3
famnum	Family ID number	INTEGER	20
chsreg	Value to indicate whether the patient is registered with Child Health Surveillance	INTEGER	1
chsdate	Date of registration with Child Health Surveillance	DATE	dd/mm/yyyy
prescr	Type of prescribing exemption the patient has currently (e.g. medical or maternity)	INTEGER	3
capsup	Level of capitation supplement the patient has currently (e.g. low, medium, or high)	INTEGER	3
ses	Patient's socio-economic status. Currently 0; to be populated in future builds	INTEGER	1
frd	Date the patient first registered with the practice. If patient only has 'temporary' records, the date is the first encounter with the practice; if patient has 'permanent' records it is the date of the first 'permanent' record (excluding preceding temporary records)	DATE	dd/mm/yyyy
crd	Date the patient's current period of registration with the practice began (date of the first 'permanent' record after the latest transferred out period). If there are no 'transferred out periods', the date is equal to 'frd'	DATE	dd/mm/yyyy
regstat	Status of registration detailing gaps and temporary patients	INTEGER	2
reggap	Number of days missing in the patients registration details	INTEGER	5
internal	Number of internal transfer out periods, in the patient's registration details	INTEGER	2
tod	Date the patient transferred out of the practice, if relevant. Empty for patients who have not transferred out	DATE	dd/mm/yyyy
toreason	Reason the patient transferred out of the practice. Includes 'Death' as an option	INTEGER	3
deathdate	Date of death of patient – derived using a GPRD algorithm	DATE	dd/mm/yyyy
accept	Flag to indicate whether the patient has met certain quality standards: 1 = acceptable, 0 = unacceptable	INTEGER	1

Table A13. Data fields in patient table of CPRD data.

Field name	Description	Type	Format
pracid	Encrypted unique identifier given to a specific practice in GPRD	INTEGER	3
region	Value to indicate where in the UK the practice is based. The region denotes the Strategic Health Authority for practices within England, and the country i.e. Wales, Scotland, or Northern Ireland for the rest	INTEGER	3
lcd	Date of the last collection for the practice	DATE	dd/mm/yyyy
uts	Date at which the practice data is deemed to be of research quality. Derived using a GPRD algorithm that primarily looks at practice death recording and gaps in the data	DATE	dd/mm/yyyy

Table A14. Data fields in practice table of CPRD data.

Field name	Description	Type	Format
staffid	Encrypted unique identifier given to the practice staff member entering the data	INTEGER	20
gender	Staff's gender	INTEGER	1
role	Role of the member of staff who created the event	INTEGER	3

Table A15. Data fields in staff table of CPRD data.

Field name	Description	Type	Format
patid	Encrypted unique identifier given to a patient in GPRD	INTEGER	20
eventdate	Date associated with the event, as entered by the GP	DATE	dd/mm/yyyy
sysdate	Date the event was entered into Vision	DATE	dd/mm/yyyy
constype	Type of consultation (e.g. Surgery Consultation, Night Visit, Emergency etc)	INTEGER	3
consid	The consultation identifier linking events at the same consultation, when used in combination with pracid	INTEGER	20
staffid	The identifier of the practice staff member entering the data. A value of 0 indicates that the staffid is unknown	INTEGER	20
duration	The length of time (minutes) between the opening, and closing of the consultation record	INTEGER	10

Table A16. Data fields in consultation table of CPRD data.

Field name	Description	Type	Format
patid	Encrypted unique identifier given to a patient in GPRD	INTEGER	20
eventdate	Date associated with the event, as entered by the GP	DATE	dd/mm/yyyy
sysdate	Date the event was entered into Vision	DATE	dd/mm/yyyy
constype	Code for the category of event recorded within the GP system (e.g. diagnosis or symptom)	INTEGER	3
consid	Identifier that allows information about the consultation to be retrieved, when used in combination with pracid	INTEGER	20
medcode	GPRD unique code for the medical term selected by the GP	INTEGER	20
staffid	Identifier of the practice staff member entering the data. A value of 0 indicates that the staffid is unknown	INTEGER	20
textid	Identifier that allows freetext information on the event to be retrieved, when used in combination with pracid and event type 'Clinical'. A value of 0 indicates that there is no freetext information for this event	INTEGER	20
episode	Episode type for a specific clinical event	INTEGER	3
enttype	Identifier that represents the structured data area in Vision where the data was entered	INTEGER	5
adid	Identifier that allows additional information to be retrieved for this event, when used in combination with pracid. A value of 0 signifies that there is no additional information associated with the event.	INTEGER	20

Table A17. Data fields in clinical table of CPRD data.

Field name	Description	Type	Format
patid	Encrypted unique identifier given to a patient in GPRD	INTEGER	20
enttype	Identifier that represents the structured data area in Vision where the data was entered	INTEGER	5
adid	Identifier that allows information about the original clinical event to be retrieved, when used in combination with pracid	INTEGER	20
data1	Depends on Entity Type	NUMERIC	15.3
data2	Depends on Entity Type	NUMERIC	15.3
data3	Depends on Entity Type	NUMERIC	15.3
data4	Depends on Entity Type	INTEGER	12
data5	Depends on Entity Type	INTEGER	12
data6	Depends on Entity Type	INTEGER	12
data7	Depends on Entity Type	INTEGER	4

Table A18. Data fields in additional clinical details table of CPRD data.

Field name	Description	Type	Format
patid	Encrypted unique identifier given to a patient in GPRD	INTEGER	20
eventdate	Date associated with the event, as entered by the GP	DATE	dd/mm/yyyy
sysdate	Date the event was entered into Vision	DATE	dd/mm/yyyy
constype	Code for the category of event recorded within the GP system (e.g. management or administration)	INTEGER	3
consid	Identifier that allows information about the consultation to be retrieved, when used in combination with pracid	INTEGER	20
medcode	GPRD unique code for the medical term selected by the GP	INTEGER	20
staffid	Identifier of the practice staff member entering the data. A value of 0 indicates that the staffid is unknown	INTEGER	20
textid	Identifier that allows freetext information on the event to be retrieved, when used in combination with pracid and event type 'Referral'. A value of 0 indicates that there is no freetext information for this event	INTEGER	20
source	Classification of the source of the referral e.g. GP, Self	INTEGER	2
nhsspec	Referral speciality according to the National Health Service (NHS) classification	INTEGER	3
fhsaspec	Referral speciality according to the Family Health Services Authority (FHSA) classification	INTEGER	3
inpatient	Classification of the type of referral, e.g. Day case, In patient	INTEGER	2
attendance	Category describing whether the referral event is the first visit, a follow-up etc	INTEGER	2
urgency	Classification of the urgency of the referral e.g. Routine, Urgent	INTEGER	2

Table A19. Data fields in referral table of CPRD data.

Field name	Description	Type	Format
patid	Encrypted unique identifier given to a patient in GPRD	INTEGER	20
eventdate	Date associated with the event, as entered by the GP	DATE	dd/mm/yyyy
sysdate	Date the event was entered into Vision	DATE	dd/mm/yyyy
constype	Code for the category of event recorded within the GP system (e.g. intervention)	INTEGER	3
consid	Identifier that allows information about the consultation to be retrieved, when used in combination with pracid	INTEGER	20
medcode	GPRD unique code for the medical term selected by the GP	INTEGER	20
staffid	Identifier of the practice staff member entering the data. A value of 0 indicates that the staffid is unknown	INTEGER	20
textid	Identifier that allows freetext information on the event to be retrieved, when used in combination with pracid and event type 'Immunisation'. A value of 0 indicates that there is no freetext information for this event	INTEGER	20
immstype	Individual components of an immunisation, e.g. Mumps, Rubella, Measles	INTEGER	4
stage	Stage of the immunisation given, e.g. 1, 2, B2	INTEGER	2
status	Status of the immunisation e.g. Advised, Given, Refusal	INTEGER	3
compound	Immunisation compound administered – may be a single or multi-component preparation, e.g. MMR	INTEGER	4
source	Location where the immunisation was administered, e.g. In this practice	INTEGER	3
reason	Reason for administering the immunisation, e.g. Routine measure	INTEGER	3
method	Route of administration for the immunisation, e.g. Oral, Intramuscular	INTEGER	3

Table A20. Data fields in immunisation table of CPRD data.

Field name	Description	Type	Format
patid	Encrypted unique identifier given to a patient in GPRD	INTEGER	20
eventdate	Date associated with the event, as entered by the GP	DATE	dd/mm/yyyy
sysdate	Date the event was entered into Vision	DATE	dd/mm/yyyy
constype	Code for the category of event recorded within the GP system (e.g. examination)	INTEGER	3
consid	Identifier that allows information about the consultation to be retrieved, when used in combination with pracid	INTEGER	20
medcode	GPRD unique code for the medical term selected by the GP	INTEGER	20
staffid	Identifier of the practice staff member entering the data. A value of 0 indicates that the staffid is unknown	INTEGER	20
textid	Identifier that allows freetext information on the event to be retrieved, when used in combination with pracid and event type 'Test'. A value of 0 indicates that there is no freetext information for this event	INTEGER	20
enttype	Identifier that represents the structured data area in Vision where the data was entered	INTEGER	5
	For Entity Types with 4 Data Fields		
data1	Qualifier	INTEGER	3
data2	Normal range from	NUMERIC	16.3
data3	Normal range to	NUMERIC	16.3
data4	Normal range basis	NUMERIC	16.3
	For Entity Types with 7 Data Fields		
data1	Operator	INTEGER	3
data2	Value	NUMERIC	16.3
data3	Unit of measure	INTEGER	4
data4	Qualifier	INTEGER	3
data5	Normal range from	NUMERIC	16.3
data6	Normal range to	NUMERIC	16.3
data7	Normal range basis (or peak flow device for entity type 311)	INTEGER	2
	For Entity Types with 8 Data Fields		
data1	Operator	INTEGER	3
data2	Value	NUMERIC	16.3
data3	Unit of measure	INTEGER	4
data4	Qualifier	INTEGER	3
data5	Normal range from	NUMERIC	16.3
data6	Normal range to	NUMERIC	16.3
data7	Normal range basis	INTEGER	2
data8	Expected delivery date	INTEGER	10

Table A21. Data fields in test table of CPRD data.

Field name	Description	Type	Format
patid	Encrypted unique identifier given to a patient in GPRD	INTEGER	20
eventdate	Date associated with the event, as entered by the GP	DATE	dd/mm/yyyy
sysdate	Date the event was entered into Vision	DATE	dd/mm/yyyy
consid	Identifier that allows information about the consultation to be retrieved, when used in combination with pracid	INTEGER	20
prodcode	GPRD unique code for the treatment selected by the GP	INTEGER	20
staffid	Identifier of the practice staff member entering the data. A value of 0 indicates that the staffid is unknown	INTEGER	20
textid	Identifier that allows freetext information (dosage) on the event to be retrieved, when used in combination with pracid and event type 'Therapy'. A value of 0 indicates that there is no freetext information for the event. Use the Common Dosages Lookup (constituting ~ 95% of dosage strings in data) to interpret values < 100,000	INTEGER	20
bnfcode	Code representing the chapter & section from the British National Formulary for the product selected by GP	INTEGER	5
qty	Total quantity entered by the GP for the prescribed product	INTEGER	20
ndd	Numeric daily dose prescribed for the event. Derived using a GPRD algorithm on common dosage strings (represented by textid < 100,000). Value is set to 0 for all dosage strings represented by textid > 100,000	NUMERIC	10.3
numdays	Number of treatment days prescribed for a specific therapy event	INTEGER	20
numpacks	Number of individual product packs prescribed for a specific therapy event	INTEGER	8
packtype	Pack size or type of the prescribed product	INTEGER	10
issueseq	Number to indicate whether the event is associated with a repeat schedule. Value of 0 implies the event is not part of a repeat prescription. A value ≥ 1 denotes the issue number for the prescription within a repeat schedule	INTEGER	20

Table A22. Data fields in therapy table of CPRD data.

List of Fields Provided in HES Tables

Field name	Description	Type	Format
patid	The encrypted unique identifier given to patient in GPRD GOLD	INTEGER	20
HESid	A unique identifier given to a patient in the HES data. An individual that has contributed to more than one GPRD practice at different times has the same HESid	INTEGER	10
HESstart	Start of valid HES data collection for patient: max (01/04/1997, patient's current registration date (crd), practice UTS date)	DATE	DD/MM/YYYY
HESend	End of valid HES data collection for patient: min (31/12/2010, patient's transfer out date, practice last collection date (lcd), practice linkage date)	DATE	DD/MM/YYYY
match	Flag indicating strength of matching: 0 = No match (never hospitalised) 1 = Hospitalised (Linked using NHS, DOB, & gender)	INTEGER	1

Table A23. Data fields in source table of HES data.

Field name	Description	Type	Format
patid	The encrypted unique identifier given to patient in GPRD GOLD	INTEGER	20
pracid	The encrypted unique identifier given to a specific practice in GPRD GOLD	INTEGER	3
birthyear	Patient's year of birth according to GPRD records	INTEGER	4
gender	Patient's gender according to GPRD records	INTEGER	1
ethnos	Patient's ethnicity derived from HES records in years 1997 – 2010	CHAR	10
HESstart	Start of valid HES data collection for patient: max (01/04/1997, patient's current registration date (crd), practice UTS date)	DATE	DD/MM/YYYY
HESend	End of valid HES data collection for patient: min (31/12/2010, patient's transfer out date, practice last collection date (lcd), practice linkage date)	DATE	DD/MM/YYYY

Table A24. Data fields in patient table of HES data.

Field name	Description	Type	Format
patid	The encrypted unique identifier given to patient in GPRD GOLD	INTEGER	20
spno	Spell number uniquely identifying a hospitalisation	INTEGER	20
admidate	Date of admission	DATE	DD/MM/YYYY
discharged	Date of discharge	DATE	DD/MM/YYYY
admimeth	Method of admission	INTEGER	2
admisorc	Source of admission	INTEGER	2
disdest	Destination on discharge	INTEGER	2
dismeth	Method of discharge	INTEGER	1
duration	Duration of hospitalisation spell in days	INTEGER	5
elecdate	Date of decision to admit patient	DATE	DD/MM/YYYY
elecdur	Waiting time (difference in days between elecdate and admidate)	INTEGER	5

Table A25. Data fields in hospitalisation table of HES data.

Field name	Description	Type	Format
patid	The encrypted unique identifier given to patient in GPRD GOLD	INTEGER	20
spno	Spell number uniquely identifying a hospitalisation	INTEGER	20
epikey	Episode key uniquely identifying an episode of care	INTEGER	20
admidate	Date of admission	DATE	DD/MM/YYYY
epistart	Date of start of episode	DATE	DD/MM/YYYY
epiend	Date of end of episode	DATE	DD/MM/YYYY
discharged	Date of discharge	DATE	DD/MM/YYYY
eorder	Order of episode within spell	INTEGER	3
epidur	Duration of episode in days	INTEGER	5
epitype	Type of episode (general, delivery, birth, psychiatric etc.)	INTEGER	1
admimeth	Method of admission	INTEGER	2
admisorc	Source of admission	INTEGER	2
disdest	Destination on discharge	INTEGER	2
dismeth	Method of discharge	INTEGER	1
mainspef	Speciality under which consultant is contracted	CHAR	3
tretspef	Speciality under which consultant is working in period of care	CHAR	3
pconsult	Consultant code (pseudonymised)	CHAR	16
intmanig	Intended management	INTEGER	1
classpat	Patient Classification: (Actual Management) 1=Ordinary admission; 2=Day case admission; 3=Regular day attendee; 4=Regular night attendee; 5=Mothers and babies using only delivery facilities; 8=Not applicable (other maternity event)	INTEGER	1
firstreg	First regular day or night admission?	CHAR	2

Table A26. Data fields in episodes table of HES data.

Field name	Description	Type	Format
patid	The encrypted unique identifier given to patient in GPRD GOLD	INTEGER	20
spno	Number uniquely identifying a hospitalisation	INTEGER	20
epikey	Episode key uniquely identifying an episode of care	INTEGER	20
epistart	Start date of episode of care	DATE	DD/MM/YYYY
epiend	Date of end of episode	DATE	DD/MM/YYYY
ICD	An ICD10 diagnosis code in XXX or XXX.X format	CHAR	5
ICDx	5th/6th characters of the ICD code (if available)	CHAR	2
primary	1 if code is primary diagnosis code in episode, 0 if not	INTEGER	1

Table A27. Data fields in diagnoses by episode table of HES data.

Field name	Description	Type	Format
patid	The encrypted unique identifier given to patient in GPRD GOLD	INTEGER	20
spno	Spell number uniquely identifying a hospitalisation	INTEGER	20
admidate	Date of admission	DATE	DD/MM/YYYY
discharged	Date of discharge	DATE	DD/MM/YYYY
ICD	An ICD10 diagnosis code in XXX or XXX.X format	CHAR	5
ICDx	5th/6th characters of the ICD code (if available)	CHAR	2

Table A28. Data fields in diagnoses by hospitalisation table of HES data.

Field name	Description	Type	Format
patid	The encrypted unique identifier given to patient in GPRD GOLD	INTEGER	20
spno	Spell number uniquely identifying a hospitalisation	INTEGER	20
admidate	Date of admission	DATE	DD/MM/YYYY
discharged	Date of discharge	DATE	DD/MM/YYYY
ICD_PRIMARY	Primary ICD10 diagnosis code in XXX or XXX.X format	CHAR	5
ICDx	5th/6th characters of the ICD code (if available)	CHAR	2

Table A29. Data fields in primary diagnoses across hospitalisation table of HES data.

Field name	Description	Type	Format
patid	The encrypted unique identifier given to patient in GPRD GOLD	INTEGER	20
spno	Spell number uniquely identifying a hospitalisation	INTEGER	20
admidate	Date of admission	DATE	DD/MM/YYYY
discharged	Date of discharge	DATE	DD/MM/YYYY
ICD_PRIMARY	Primary ICD10 diagnosis code in XXX or XXX.X format	CHAR	5
ICDx	5th/6th characters of the ICD code (if available)	CHAR	2

Table A30. Data fields in procedures table of HES data.

Field name	Description	Type	Format
patid	The encrypted unique identifier given to patient in GPRD GOLD	INTEGER	20
spno	Spell number uniquely identifying a hospitalisation	INTEGER	20
epikey	Episode key uniquely identifying an episode of care	INTEGER	20
epistart	Date of start of episode	DATE	DD/MM/YYYY
epiend	Date of end of episode	DATE	DD/MM/YYYY
eorder	Order of episode within spell	INTEGER	3
epidur	Duration of episode in days	INTEGER	5
numacp	Number of augmented care periods within episode	INTEGER	2
acpn	Order of an augmented care episode within a sequence of episodes that make up a period of augmented care	INTEGER	2
acpstar	Start date of a period of augmented care	DATE	DD/MM/YYYY
acpend	End date of a period of augmented care	DATE	DD/MM/YYYY
acpdur	Duration of augmented care period in days	INTEGER	8
intdays	Number of days of intensive care in a period of augmented care	INTEGER	5
depdays	Number of days of high dependency care in a period of augmented care	INTEGER	5
acploc	Location of a patient during a period of augmented care	INTEGER	2
acpsour	Location of patient immediately before the period of augmented care	INTEGER	2
acpdisp	Destination of a discharged patient after a period of augmented care	INTEGER	2
acpout	Augmented care period outcome indicator	INTEGER	2
acpplan	Flag for whether ACP was planned in advance of admission to ACP location	CHAR	1
acpspef	Code for main specialty of consultant clinically managing the ACP	CHAR	3
orgsup	Number of organ support systems used (up to five) during an ACP	INTEGER	2
acpdqind	Currently no Information on variable	CHAR	1

Table A31. Data fields in augmented care periods table of HES data.

Field name	Description	Type	Format
patid	The encrypted unique identifier given to patient in GPRD GOLD	INTEGER	20
spno	Spell number uniquely identifying a hospitalisation	INTEGER	20
epikey	Episode key uniquely identifying an episode of care	INTEGER	20
admidate	Date of admission	DATE	DD/MM/YYYY
discharged	Date of discharge	DATE	DD/MM/YYYY
epistart	Date of start of episode	DATE	DD/MM/YYYY
epiend	Date of end of episode	DATE	DD/MM/YYYY
eorder	Order of episode within spell	INTEGER	3
ccstartdate	Date on which the critical care period started	DATE	DD/MM/YYYY
ccstarttime	Time at which the critical care period started	CHAR	8
ccdisrdydate	Critical care discharge ready date	DATE	DD/MM/YYYY
ccdisrdytime	Critical care discharge ready time	CHAR	8
ccdisdate	Critical care discharge date	DATE	DD/MM/YYYY
ccdistime	Critical care discharge time	CHAR	8
ccadmitype	Critical care admission type	INTEGER	2
ccadmisorc	Critical care admission source	INTEGER	2
ccsorcloc	Specific location in the admission source	INTEGER	2
ccdisstat	Patient's status at time of discharge	INTEGER	2
ccdisdest	Critical care discharge destination	INTEGER	2
ccdisloc	Principle location the patient is being discharged to for further care	INTEGER	2
cclev2days	Total calendar days during which level 2 care alone was provided during the period	INTEGER	5
cclev3days	Total calendar days during which level 3 care was provided during the period	INTEGER	5
bcardsupdays	Number of days of basic cardiovascular support	INTEGER	5
acardsupdays	Number of days of advanced cardiovascular support	INTEGER	5
bressupdays	Number of days of basic respiratory support	INTEGER	5
aressupdays	Number of days of advanced respiratory support	INTEGER	5
gisupdays	Number of days of gastrointestinal support	INTEGER	5
liversupdays	Number of days of liver support	INTEGER	5
neurosupdays	Number of days of neurological support	INTEGER	5
rensupdays	Number of days of renal support	INTEGER	5
dermsupdays	Number of days of dermatological support	INTEGER	5
orgsupmax	Maximum number of organ systems supported at any one time, at any point in the critical care period	INTEGER	2
ccunitfun	Critical care unit function	INTEGER	2
unitbedconfig	Critical care unit bed configuration	INTEGER	2
bestmatch	Flag stating whether the row represents the best match between the critical care & episode start & end dates for this critical care period	INTEGER	2
ccaprel	Comparision of dates of the critical care period and the associated inpatient episode. Used in derivation of the 'bestmatch' field	INTEGER	2

Table A32. Data fields in critical care table of HES data.

Field name	Description	Type	Format
patid	The encrypted unique identifier given to patient in GPRD GOLD	INTEGER	20
spno	Spell number uniquely identifying a hospitalisation	INTEGER	20
epikey	Episode key uniquely identifying an episode of care	INTEGER	20
epistart	Date of start of episode	DATE	DD/MM/YYYY
epiend	Date of end of episode	DATE	DD/MM/YYYY
eorder	Order of episode within spell	INTEGER	3
epidur	Duration of episode in days	INTEGER	5
numbaby	Number of babies delivered at the end of a single pregnancy. Both live and stillborn babies are counted	CHAR	1
numtailb	Number of baby tails	INTEGER	1
matordr	Order of birth	INTEGER	1
neocare	Neonatal level of care	INTEGER	1
wellbaby	Well baby check flag - indicates whether the episode relates to a well baby (a neonate receiving normal levels of care, usually given by a mother or mother substitute)	CHAR	1
anasdate	First antenatal assessment date	DATE	DD/MM/YYYY
birordr	The position in the sequence of births	CHAR	1
birstat	Indicates whether the baby was born alive or dead (still birth).	INTEGER	1
biresus	Identifies resuscitation method used to get the baby breathing	INTEGER	1
sexbaby	Sex of baby	CHAR	1
birweit	Weight of the baby in grams immediately after birth	INTEGER	4
delmeth	Method used to deliver a baby that is a registrable birth	CHAR	1
delonset	Method used to induce (initiate) labour, rather than to accelerate it	INTEGER	1
delinten	Intended type of delivery place	INTEGER	1
delplac	Actual type of delivery place	INTEGER	1
delchang	Reason for changing the delivery place type	INTEGER	1
delprean	Anaesthetic or analgesic administered before and during labour and delivery	INTEGER	1
delposan	Anaesthetic or analgesic administered after delivery	INTEGER	1
delstat	Status of the person conducting the delivery	INTEGER	1
anagest	Gestation period in weeks at the date of the first antenatal assessment (calculated from anadate, gestat and the dobbaby)	INTEGER	2
gestat	Length of gestation - number of completed weeks of gestation	INTEGER	2
numpreg	Number of previous pregnancies that resulted in a registrable birth (live or still born)	INTEGER	2
matage	Mother's age at delivery	INTEGER	3
neodur	Baby's age in days	INTEGER	3
antedur	Antenatal days of stay	INTEGER	3
postdur	Postnatal days of stay	INTEGER	3

Table A33. Data fields in maternity table of HES data.

Log-Log Plots of Survival Function for QOF Indicators and NDA Processes

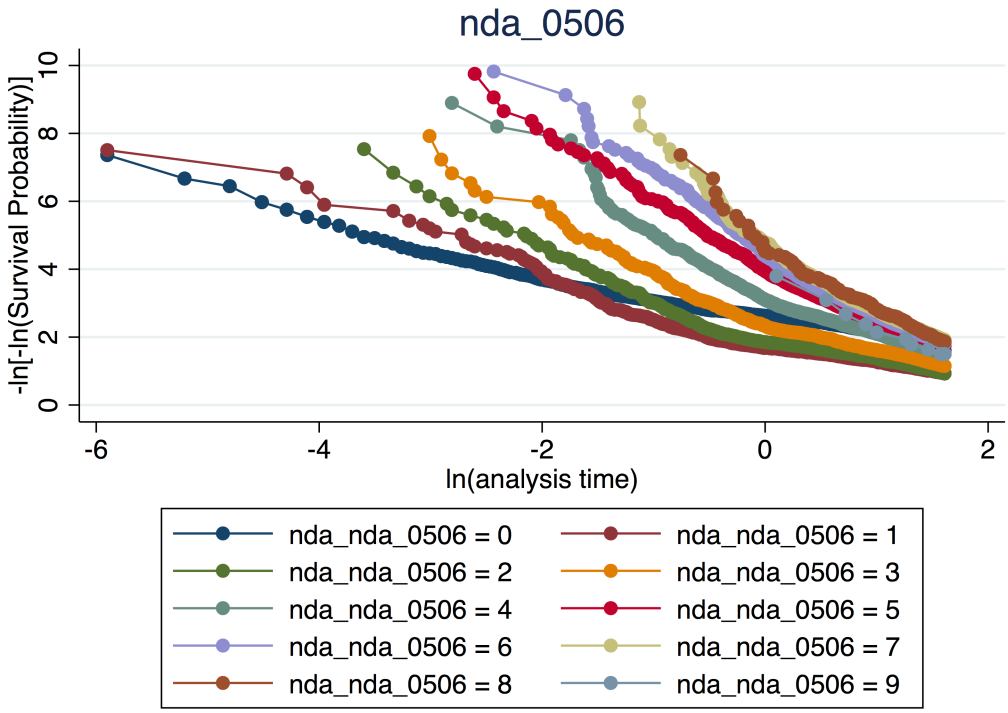


Figure A1. Log-log plot of survival function for strata of the number of NDA processes achieved in 2005/06.

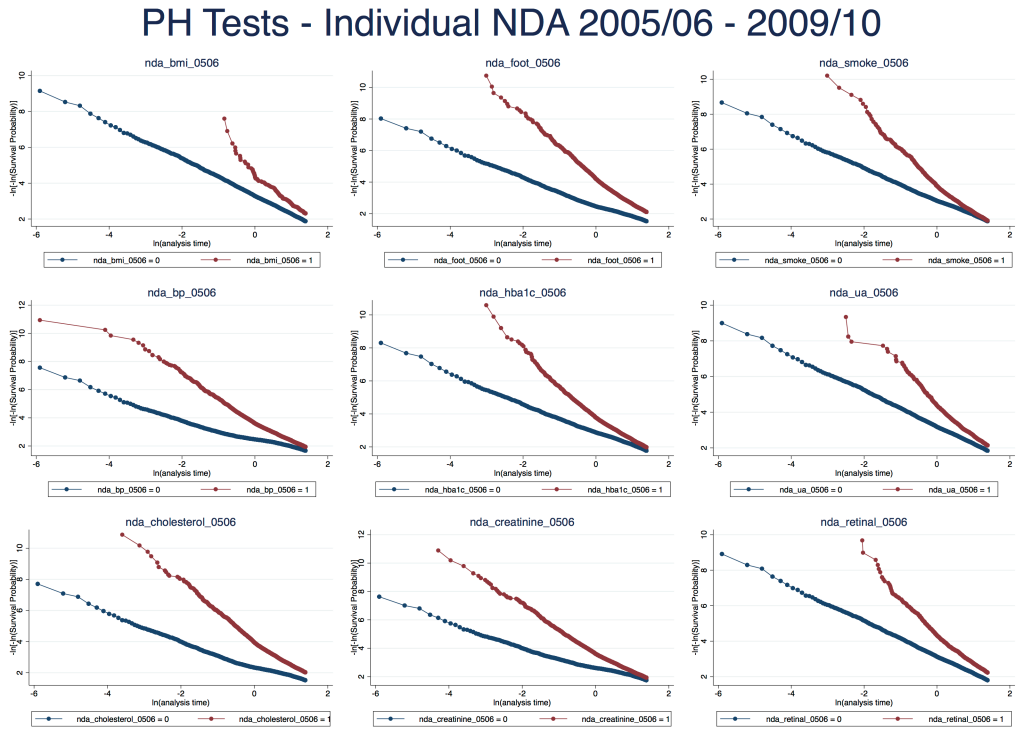


Figure A2. Log-log plot of survival functions for receipt of individual NDA processes achieved in 2005/06.

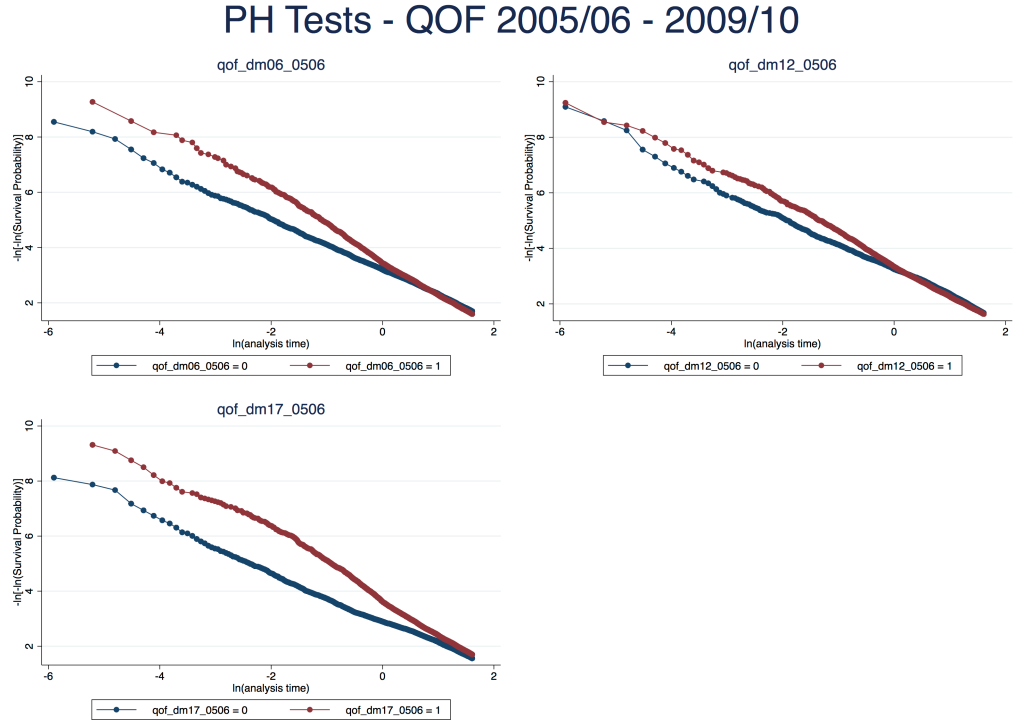


Figure A3. Log-log plot of survival functions for receipt of individual QOF indicators achieved in 2005/06.

Full Regression Tables for Partially Adjusted Patient-Level Models

Emergency Admissions and QOF Attainment

Convergence not achieved

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.864	**0.013**	0.804	**< 0.001**	0.810	**< 0.001**	0.828	**< 0.001**	0.844	**< 0.001**
Years With DM		1.004	0.076	1.004	**0.004**	1.005	**< 0.001**	1.004	**< 0.001**	1.004	**< 0.001**
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	1.011	0.730	1.051	**0.022**	1.050	**0.007**	1.041	**0.011**	1.040	**0.007**
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.163	0.370	1.050	0.679	1.080	0.426	1.050	0.561	0.988	0.880
	45 – 64y	1.048	0.776	0.987	0.908	0.989	0.906	0.973	0.746	0.945	0.457
	65 – 74y	1.210	0.254	1.125	0.316	1.113	0.268	1.093	0.296	1.057	0.469
	≥ 75y	1.371	0.058	1.307	**0.022**	1.347	**0.002**	1.368	**< 0.001**	1.344	**< 0.001**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.825	**< 0.001**	0.810	**< 0.001**	0.814	**< 0.001**	0.834	**< 0.001**	0.834	**< 0.001**
	3	0.797	**< 0.001**	0.751	**< 0.001**	0.753	**< 0.001**	0.764	**< 0.001**	0.783	**< 0.001**
	4	0.792	**< 0.001**	0.737	**< 0.001**	0.735	**< 0.001**	0.749	**< 0.001**	0.757	**< 0.001**
	5	0.753	**< 0.001**	0.703	**< 0.001**	0.693	**< 0.001**	0.697	**< 0.001**	0.702	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.226	**< 0.001**	1.310	**< 0.001**	1.331	**< 0.001**	1.317	**< 0.001**	1.316	**< 0.001**
	CCI = 2	1.440	**< 0.001**	1.496	**< 0.001**	1.514	**< 0.001**	1.471	**< 0.001**	1.418	**< 0.001**
	CCI = 3	1.706	**< 0.001**	1.869	**< 0.001**	1.804	**< 0.001**	1.731	**< 0.001**	1.666	**< 0.001**
	CCI ≥ 4	2.070	**< 0.001**	2.128	**< 0.001**	2.066	**< 0.001**	1.935	**< 0.001**	1.793	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.042	0.257	1.107	**< 0.001**	1.120	**< 0.001**	1.119	**< 0.001**	1.100	**< 0.001**
	Current Smoker	1.135	**0.011**	1.232	**< 0.001**	1.235	**< 0.001**	1.242	**< 0.001**	1.248	**< 0.001**
	Unknown	1.187	**0.003**	1.335	**< 0.001**	1.403	**< 0.001**	1.437	**< 0.001**	1.417	**< 0.001**
DM06		0.826	**< 0.001**	0.830	**< 0.001**	0.845	**< 0.001**	0.847	**< 0.001**	0.849	**< 0.001**

Table A34. Full results from multiple-variable zero-inflated negative binomial regression model of attainment of DM06 in 2005/06 against emergency admissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.830	**0.002**	0.777	**< 0.001**	0.785	**< 0.001**	0.803	**< 0.001**	0.820	**< 0.001**
Years With DM		1.005	**0.015**	1.006	**< 0.001**	1.006	**< 0.001**	1.005	**< 0.001**	1.005	**< 0.001**
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	1.015	0.632	1.054	**0.016**	1.051	**0.006**	1.041	**0.011**	1.039	**0.009**
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.151	0.404	1.056	0.640	1.086	0.394	1.054	0.538	0.987	0.867
	45 – 64y	1.034	0.842	0.984	0.890	0.988	0.896	0.969	0.709	0.937	0.393
	65 – 74y	1.167	0.355	1.097	0.429	1.090	0.374	1.068	0.440	1.030	0.703
	≥ 75y	1.322	0.094	1.269	**0.041**	1.310	**0.005**	1.326	**0.001**	1.297	**0.001**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.823	**< 0.001**	0.809	**< 0.001**	0.814	**< 0.001**	0.836	**< 0.001**	0.836	**< 0.001**
	3	0.797	**< 0.001**	0.752	**< 0.001**	0.754	**< 0.001**	0.765	**< 0.001**	0.784	**< 0.001**
	4	0.789	**< 0.001**	0.735	**< 0.001**	0.734	**< 0.001**	0.749	**< 0.001**	0.757	**< 0.001**
	5	0.750	**< 0.001**	0.704	**< 0.001**	0.693	**< 0.001**	0.697	**< 0.001**	0.702	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.238	**< 0.001**	1.318	**< 0.001**	1.341	**< 0.001**	1.329	**< 0.001**	1.327	**< 0.001**
	CCI = 2	1.449	**< 0.001**	1.496	**< 0.001**	1.518	**< 0.001**	1.475	**< 0.001**	1.421	**< 0.001**
	CCI = 3	1.733	**< 0.001**	1.888	**< 0.001**	1.827	**< 0.001**	1.758	**< 0.001**	1.691	**< 0.001**
	CCI ≥ 4	2.089	**< 0.001**	2.137	**< 0.001**	2.083	**< 0.001**	1.956	**< 0.001**	1.810	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.037	0.323	1.103	**< 0.001**	1.116	**< 0.001**	1.115	**< 0.001**	1.096	**< 0.001**
	Current Smoker	1.138	**0.009**	1.234	**< 0.001**	1.239	**< 0.001**	1.246	**< 0.001**	1.252	**< 0.001**
	Unknown	1.238	**< 0.001**	1.394	**< 0.001**	1.460	**< 0.001**	1.478	**< 0.001**	1.454	**< 0.001**
DM12		0.981	0.430	0.976	0.185	0.968	**0.044**	0.942	**< 0.001**	0.939	**< 0.001**

Table A35. Full results from multiple-variable zero-inflated negative binomial regression model of attainment of DM12 in 2005/06 against emergency admissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.836	**0.002**	0.784	**< 0.001**	0.792	**< 0.001**	0.810	**< 0.001**	0.826	**< 0.001**
Years With DM		1.005	**0.015**	1.006	**< 0.001**	1.006	**< 0.001**	1.005	**< 0.001**	1.005	**< 0.001**
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	0.992	0.808	1.035	0.117	1.035	0.057	1.028	0.083	1.028	0.057
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.161	0.376	1.063	0.602	1.084	0.400	1.056	0.519	0.989	0.881
	45 – 64y	1.084	0.628	1.019	0.874	1.011	0.905	0.993	0.933	0.956	0.555
	65 – 74y	1.258	0.171	1.164	0.196	1.139	0.179	1.114	0.207	1.065	0.413
	≥ 75y	1.396	**0.046**	1.329	**0.015**	1.357	**0.002**	1.372	**< 0.001**	1.333	**< 0.001**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.825	**< 0.001**	0.809	**< 0.001**	0.813	**< 0.001**	0.834	**< 0.001**	0.834	**< 0.001**
	3	0.799	**< 0.001**	0.753	**< 0.001**	0.754	**< 0.001**	0.766	**< 0.001**	0.785	**< 0.001**
	4	0.787	**< 0.001**	0.734	**< 0.001**	0.734	**< 0.001**	0.749	**< 0.001**	0.757	**< 0.001**
	5	0.753	**< 0.001**	0.706	**< 0.001**	0.695	**< 0.001**	0.698	**< 0.001**	0.703	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.247	**< 0.001**	1.325	**< 0.001**	1.343	**< 0.001**	1.330	**< 0.001**	1.327	**< 0.001**
	CCI = 2	1.440	**< 0.001**	1.496	**< 0.001**	1.515	**< 0.001**	1.472	**< 0.001**	1.420	**< 0.001**
	CCI = 3	1.741	**< 0.001**	1.898	**< 0.001**	1.828	**< 0.001**	1.757	**< 0.001**	1.690	**< 0.001**
	CCI ≥ 4	2.110	**< 0.001**	2.149	**< 0.001**	2.084	**< 0.001**	1.953	**< 0.001**	1.807	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.050	0.175	1.112	**< 0.001**	1.122	**< 0.001**	1.120	**< 0.001**	1.101	**< 0.001**
	Current Smoker	1.140	**0.008**	1.232	**< 0.001**	1.235	**< 0.001**	1.240	**< 0.001**	1.246	**< 0.001**
	Unknown	1.129	**0.038**	1.294	**< 0.001**	1.367	**< 0.001**	1.404	**< 0.001**	1.395	**< 0.001**
DM17		0.761	**< 0.001**	0.817	**< 0.001**	0.840	**< 0.001**	0.850	**< 0.001**	0.869	**< 0.001**

Table A36. Full results from multiple-variable zero-inflated negative binomial regression model of attainment of DM17 in 2005/06 against emergency admissions.

Readmissions and QOF Attainment

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.863	0.296	0.786	**0.017**	0.733	**< 0.001**	0.754	**< 0.001**	0.807	**0.002**
Years With DM		1.000	0.995	1.002	0.469	1.003	0.261	1.002	0.443	1.002	0.269
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	0.936	0.388	1.026	0.630	1.050	0.260	0.998	0.952	1.004	0.900
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	0.955	0.922	1.042	0.898	1.179	0.532	1.185	0.452	1.103	0.628
	45 – 64y	0.625	0.321	0.699	0.259	0.812	0.425	0.791	0.296	0.737	0.126
	65 – 74y	0.553	0.212	0.654	0.185	0.725	0.221	0.700	0.113	0.666	**0.043**
	≥ 75y	0.553	0.210	0.596	0.105	0.708	0.186	0.714	0.135	0.664	**0.041**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.922	0.454	0.888	0.125	0.838	**0.005**	0.847	**0.002**	0.827	**< 0.001**
	3	0.808	0.058	0.704	**< 0.001**	0.707	**< 0.001**	0.733	**< 0.001**	0.736	**< 0.001**
	4	0.902	0.382	0.785	**0.002**	0.721	**< 0.001**	0.736	**< 0.001**	0.756	**< 0.001**
	5	0.717	**0.006**	0.711	**< 0.001**	0.689	**< 0.001**	0.692	**< 0.001**	0.704	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.050	0.622	1.218	**0.003**	1.211	**< 0.001**	1.269	**< 0.001**	1.266	**< 0.001**
	CCI = 2	1.078	0.495	1.233	**0.008**	1.247	**0.001**	1.316	**< 0.001**	1.309	**< 0.001**
	CCI = 3	1.283	0.062	1.427	**< 0.001**	1.469	**< 0.001**	1.517	**< 0.001**	1.566	**< 0.001**
	CCI ≥ 4	1.622	**0.001**	1.790	**< 0.001**	1.822	**< 0.001**	1.787	**< 0.001**	1.761	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.052	0.563	1.176	**0.008**	1.166	**0.002**	1.144	**0.001**	1.133	**0.001**
	Current Smoker	0.891	0.326	1.058	0.491	1.034	0.620	1.018	0.752	1.103	0.053
	Unknown	1.230	0.142	1.436	**< 0.001**	1.518	**< 0.001**	1.540	**< 0.001**	1.587	**< 0.001**
DM06		0.752	**< 0.001**	0.753	**< 0.001**	0.791	**< 0.001**	0.795	**< 0.001**	0.811	**< 0.001**

Table A37. Full results from multiple-variable zero-inflated negative binomial regression model of attainment of DM06 in 2005/06 against readmissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.825	0.171	0.756	**0.005**	0.705	**< 0.001**	0.727	**< 0.001**	0.776	**< 0.001**
Years With DM		1.001	0.722	1.004	0.164	1.005	0.079	1.003	0.164	1.004	0.083
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	0.948	0.484	1.040	0.460	1.056	0.203	1.003	0.933	1.007	0.836
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	0.972	0.952	1.058	0.861	1.195	0.499	1.193	0.435	1.102	0.632
	45 – 64y	0.650	0.360	0.706	0.274	0.823	0.455	0.794	0.302	0.732	0.118
	65 – 74y	0.555	0.213	0.640	0.163	0.717	0.205	0.687	0.096	0.649	**0.031**
	≥ 75y	0.551	0.205	0.576	0.083	0.693	0.160	0.693	0.103	0.640	**0.026**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.902	0.345	0.884	0.110	0.839	**0.005**	0.851	**0.003**	0.832	**< 0.001**
	3	0.808	0.061	0.709	**< 0.001**	0.709	**< 0.001**	0.737	**< 0.001**	0.739	**< 0.001**
	4	0.895	0.351	0.776	**0.002**	0.717	**< 0.001**	0.735	**< 0.001**	0.757	**< 0.001**
	5	0.705	**0.004**	0.709	**< 0.001**	0.686	**< 0.001**	0.694	**< 0.001**	0.705	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.084	0.412	1.253	**0.001**	1.237	**< 0.001**	1.294	**< 0.001**	1.287	**< 0.001**
	CCI = 2	1.110	0.343	1.256	**0.004**	1.257	**< 0.001**	1.322	**< 0.001**	1.312	**< 0.001**
	CCI = 3	1.312	**0.042**	1.461	**< 0.001**	1.496	**< 0.001**	1.557	**< 0.001**	1.603	**< 0.001**
	CCI ≥ 4	1.663	**0.001**	1.826	**< 0.001**	1.856	**< 0.001**	1.818	**< 0.001**	1.787	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.039	0.666	1.167	**0.011**	1.159	**0.003**	1.134	**0.003**	1.125	**0.001**
	Current Smoker	0.898	0.363	1.059	0.483	1.036	0.596	1.019	0.740	1.101	0.058
	Unknown	1.299	0.063	1.535	**< 0.001**	1.595	**< 0.001**	1.590	**< 0.001**	1.635	**< 0.001**
DM12		0.976	0.640	0.981	0.631	0.950	0.125	0.916	**0.003**	0.922	**0.003**

Table A38. Full results from multiple-variable zero-inflated negative binomial regression model of attainment of DM12 in 2005/06 against readmissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.830	0.184	0.769	**0.009**	0.719	**< 0.001**	0.738	**< 0.001**	0.785	**< 0.001**
Years With DM		1.001	0.783	1.004	0.178	1.005	0.077	1.003	0.160	1.004	0.083
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	0.931	0.345	1.023	0.669	1.042	0.337	0.991	0.796	0.996	0.912
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	0.921	0.864	1.039	0.905	1.172	0.546	1.179	0.467	1.100	0.636
	45 – 64y	0.637	0.342	0.711	0.284	0.826	0.464	0.802	0.326	0.746	0.142
	65 – 74y	0.581	0.253	0.670	0.210	0.740	0.251	0.713	0.133	0.673	**0.049**
	≥ 75y	0.554	0.211	0.596	0.105	0.708	0.187	0.712	0.131	0.658	**0.037**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.931	0.511	0.890	0.130	0.838	**0.005**	0.848	**0.002**	0.828	**< 0.001**
	3	0.825	0.087	0.712	**< 0.001**	0.711	**< 0.001**	0.738	**< 0.001**	0.742	**< 0.001**
	4	0.904	0.391	0.776	**0.002**	0.718	**< 0.001**	0.735	**< 0.001**	0.757	**< 0.001**
	5	0.720	**0.007**	0.716	**< 0.001**	0.692	**< 0.001**	0.694	**< 0.001**	0.706	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.114	0.274	1.266	**< 0.001**	1.245	**< 0.001**	1.302	**< 0.001**	1.292	**< 0.001**
	CCI = 2	1.091	0.428	1.251	**0.005**	1.253	**< 0.001**	1.322	**< 0.001**	1.313	**< 0.001**
	CCI = 3	1.340	**0.028**	1.479	**< 0.001**	1.509	**< 0.001**	1.564	**< 0.001**	1.607	**< 0.001**
	CCI ≥ 4	1.708	**< 0.001**	1.838	**< 0.001**	1.869	**< 0.001**	1.823	**< 0.001**	1.791	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.065	0.473	1.179	**0.007**	1.162	**0.002**	1.137	**0.002**	1.129	**0.001**
	Current Smoker	0.897	0.353	1.054	0.521	1.029	0.671	1.012	0.841	1.096	0.071
	Unknown	1.170	0.267	1.410	**0.001**	1.482	**< 0.001**	1.499	**< 0.001**	1.558	**< 0.001**
DM17		0.703	**< 0.001**	0.804	**< 0.001**	0.826	**< 0.001**	0.826	**< 0.001**	0.851	**< 0.001**

Table A39. Full results from multiple-variable zero-inflated negative binomial regression model of attainment of DM17 in 2005/06 against readmissions.

Odds of Death (all-cause) and QOF Attainment

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.642	**< 0.001**	0.681	**< 0.001**	0.782	**< 0.001**	0.863	**0.019**	0.855	**0.007**
Years With DM		1.003	0.393	1.002	0.443	1.006	**0.004**	1.008	**< 0.001**	1.011	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.826	**< 0.001**	0.856	**< 0.001**	0.859	**< 0.001**	0.845	**< 0.001**	0.840	**< 0.001**
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		2.111	0.210	1.295	0.516	1.528	0.251	1.683	0.115
	45 – 64y	4.419	**< 0.001**	6.533	**0.001**	3.918	**< 0.001**	4.554	**< 0.001**	4.933	**< 0.001**
	65 – 74y	14.278	**< 0.001**	18.979	**< 0.001**	11.703	**< 0.001**	13.007	**< 0.001**	14.390	**< 0.001**
	≥ 75y	43.897	**< 0.001**	62.828	**< 0.001**	40.128	**< 0.001**	48.707	**< 0.001**	57.083	**< 0.001**
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.950	0.462	0.844	**0.001**	0.826	**< 0.001**	0.844	**< 0.001**	0.843	**< 0.001**
	3	0.968	0.638	0.795	**< 0.001**	0.786	**< 0.001**	0.778	**< 0.001**	0.782	**< 0.001**
	4	0.836	**0.010**	0.753	**< 0.001**	0.770	**< 0.001**	0.781	**< 0.001**	0.778	**< 0.001**
	5	0.753	**< 0.001**	0.668	**< 0.001**	0.662	**< 0.001**	0.654	**< 0.001**	0.663	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.264	**< 0.001**	1.234	**< 0.001**	1.311	**< 0.001**	1.313	**< 0.001**	1.339	**< 0.001**
	CCI = 2	2.585	**< 0.001**	2.376	**< 0.001**	2.495	**< 0.001**	2.528	**< 0.001**	2.521	**< 0.001**
	CCI = 3	3.024	**< 0.001**	3.275	**< 0.001**	3.428	**< 0.001**	3.531	**< 0.001**	3.575	**< 0.001**
	CCI ≥ 4	4.976	**< 0.001**	4.867	**< 0.001**	5.096	**< 0.001**	5.554	**< 0.001**	5.871	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.002	0.972	1.076	**0.046**	1.123	**< 0.001**	1.148	**< 0.001**	1.162	**< 0.001**
	Current Smoker	1.403	**< 0.001**	1.590	**< 0.001**	1.738	**< 0.001**	1.757	**< 0.001**	1.877	**< 0.001**
	Unknown	0.321	**< 0.001**	0.443	**< 0.001**	0.659	**< 0.001**	0.835	**0.001**	1.028	0.565
DM06		0.550	**< 0.001**	0.678	**< 0.001**	0.742	**< 0.001**	0.772	**< 0.001**	0.804	**< 0.001**

Table A40. Full results from logistic regression model of attainment of DM06 in 2005/06 against death (all cause).

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.577	**< 0.001**	0.635	**< 0.001**	0.743	**< 0.001**	0.826	**0.002**	0.825	**0.001**
Years With DM		1.006	**0.030**	1.005	**0.045**	1.008	**< 0.001**	1.010	**< 0.001**	1.012	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.821	**< 0.001**	0.857	**< 0.001**	0.859	**< 0.001**	0.845	**< 0.001**	0.839	**< 0.001**
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		2.095	0.214	1.290	0.521	1.524	0.254	1.677	0.117
	45 – 64y	4.288	**< 0.001**	6.334	**0.002**	3.833	**0.001**	4.470	**< 0.001**	4.853	**< 0.001**
	65 – 74y	13.092	**< 0.001**	17.657	**< 0.001**	11.082	**< 0.001**	12.412	**< 0.001**	13.832	**< 0.001**
	≥ 75y	38.844	**< 0.001**	57.215	**< 0.001**	37.395	**< 0.001**	45.828	**< 0.001**	54.224	**< 0.001**
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.955	0.508	0.849	**0.001**	0.830	**< 0.001**	0.847	**< 0.001**	0.846	**< 0.001**
	3	0.969	0.652	0.797	**< 0.001**	0.788	**< 0.001**	0.780	**< 0.001**	0.783	**< 0.001**
	4	0.834	**0.009**	0.753	**< 0.001**	0.770	**< 0.001**	0.781	**< 0.001**	0.778	**< 0.001**
	5	0.757	**< 0.001**	0.670	**< 0.001**	0.663	**< 0.001**	0.656	**< 0.001**	0.663	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.299	**< 0.001**	1.253	**< 0.001**	1.326	**< 0.001**	1.326	**< 0.001**	1.350	**< 0.001**
	CCI = 2	2.642	**< 0.001**	2.401	**< 0.001**	2.513	**< 0.001**	2.544	**< 0.001**	2.535	**< 0.001**
	CCI = 3	3.162	**< 0.001**	3.353	**< 0.001**	3.488	**< 0.001**	3.586	**< 0.001**	3.624	**< 0.001**
	CCI ≥ 4	5.219	**< 0.001**	4.995	**< 0.001**	5.196	**< 0.001**	5.649	**< 0.001**	5.961	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.998	0.961	1.069	0.067	1.117	**< 0.001**	1.143	**< 0.001**	1.158	**< 0.001**
	Current Smoker	1.432	**< 0.001**	1.611	**< 0.001**	1.756	**< 0.001**	1.773	**< 0.001**	1.893	**< 0.001**
	Unknown	0.357	**< 0.001**	0.500	**< 0.001**	0.727	**< 0.001**	0.907	0.068	1.093	0.064
DM12		0.777	**< 0.001**	0.961	0.228	0.984	0.569	0.977	0.362	0.963	0.113

Table A41. Full results from logistic regression model of attainment of DM12 in 2005/06 against death (all cause).

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.604	**< 0.001**	0.654	**< 0.001**	0.760	**< 0.001**	0.843	**0.007**	0.840	**0.003**
Years With DM		1.006	**0.032**	1.004	0.056	1.008	**< 0.001**	1.010	**< 0.001**	1.012	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.729	**< 0.001**	0.800	**< 0.001**	0.815	**< 0.001**	0.808	**< 0.001**	0.808	**< 0.001**
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		2.140	0.202	1.307	0.501	1.538	0.244	1.691	0.112
	45 – 64y	4.994	**< 0.001**	7.104	**0.001**	4.176	**< 0.001**	4.801	**< 0.001**	5.164	**< 0.001**
	65 – 74y	16.926	**< 0.001**	21.062	**< 0.001**	12.671	**< 0.001**	13.893	**< 0.001**	15.255	**< 0.001**
	≥ 75y	47.581	**< 0.001**	66.106	**< 0.001**	41.741	**< 0.001**	50.296	**< 0.001**	58.810	**< 0.001**
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.936	0.348	0.837	**< 0.001**	0.821	**< 0.001**	0.840	**< 0.001**	0.840	**< 0.001**
	3	0.956	0.518	0.789	**< 0.001**	0.782	**< 0.001**	0.775	**< 0.001**	0.780	**< 0.001**
	4	0.836	**0.011**	0.752	**< 0.001**	0.769	**< 0.001**	0.780	**< 0.001**	0.777	**< 0.001**
	5	0.768	**< 0.001**	0.675	**< 0.001**	0.667	**< 0.001**	0.659	**< 0.001**	0.667	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.311	**< 0.001**	1.262	**< 0.001**	1.334	**< 0.001**	1.333	**< 0.001**	1.356	**< 0.001**
	CCI = 2	2.611	**< 0.001**	2.391	**< 0.001**	2.510	**< 0.001**	2.543	**< 0.001**	2.534	**< 0.001**
	CCI = 3	3.122	**< 0.001**	3.350	**< 0.001**	3.492	**< 0.001**	3.592	**< 0.001**	3.629	**< 0.001**
	CCI ≥ 4	5.133	**< 0.001**	4.957	**< 0.001**	5.169	**< 0.001**	5.626	**< 0.001**	5.936	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.033	0.505	1.096	**0.013**	1.140	**< 0.001**	1.164	**< 0.001**	1.176	**< 0.001**
	Current Smoker	1.391	**< 0.001**	1.585	**< 0.001**	1.734	**< 0.001**	1.752	**< 0.001**	1.872	**< 0.001**
	Unknown	0.244	**< 0.001**	0.376	**< 0.001**	0.573	**< 0.001**	0.739	**< 0.001**	0.917	0.073
DM17		0.343	**< 0.001**	0.525	**< 0.001**	0.597	**< 0.001**	0.638	**< 0.001**	0.670	**< 0.001**

Table A42. Full results from logistic regression model of attainment of DM17 in 2005/06 against death (all cause).

Odds of Death Due to Diabetes-Related Causes and QOF Attainment

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	**T1DM**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.729	0.085	0.742	**0.028**	0.689	**0.001**	0.753	**0.006**	0.740	**0.001**
Years With DM		1.019	**0.001**	1.013	**0.002**	1.013	**< 0.001**	1.013	**< 0.001**	1.013	**< 0.001**
Gender	**Male**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	1.040	0.655	1.019	0.758	1.029	0.570	1.029	0.515	1.014	0.713
Age Group	**< 25y**	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		1.426	0.779	0.990	0.990	1.237	0.780	0.941	0.927
	45 – 64y	1.883	0.230	2.037	0.566	1.421	0.651	1.714	0.467	1.008	0.991
	65 – 74y	2.047	0.169	2.070	0.557	1.364	0.689	1.615	0.518	0.968	0.960
	≥ 75y	2.256	0.116	2.278	0.506	1.601	0.544	1.902	0.385	1.177	0.799
IMD	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.030	0.822	1.042	0.655	0.993	0.930	0.990	0.874	0.966	0.566
	3	1.039	0.772	1.020	0.833	0.998	0.982	1.006	0.929	0.991	0.876
	4	0.892	0.391	0.904	0.272	0.927	0.315	0.901	0.113	0.880	**0.030**
	5	0.814	0.151	0.803	**0.027**	0.807	**0.009**	0.854	**0.026**	0.843	**0.007**
CCI Group	**CCI = 0**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	0.719	**0.005**	0.890	0.152	0.913	0.165	0.941	0.276	0.963	0.447
	CCI = 2	0.692	**0.001**	0.782	**0.002**	0.844	**0.010**	0.890	**0.041**	0.916	0.088
	CCI = 3	0.888	0.389	1.058	0.564	1.117	0.174	1.136	0.077	1.184	**0.010**
	CCI ≥ 4	0.613	**0.001**	0.789	**0.029**	0.811	**0.023**	0.858	0.063	0.877	0.083
Smoking Status	**Non-Smoker**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.939	0.504	0.871	**0.043**	0.910	0.091	0.915	0.069	0.941	0.163
	Current Smoker	0.803	0.117	0.753	**0.004**	0.746	**< 0.001**	0.766	**< 0.001**	0.785	**< 0.001**
	Unknown	1.096	0.719	0.829	0.244	0.947	0.635	0.963	0.680	0.933	0.377
DM06		0.924	0.347	0.911	0.117	0.869	**0.004**	0.882	**0.003**	0.881	**0.001**

Table A43. Full results from logistic regression model of attainment of DM06 in 2005/06 against death due to a potentially diabetes-related cause.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	**T1DM**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.719	0.071	0.732	**0.021**	0.671	**0.001**	0.734	**0.003**	0.723	**< 0.001**
Years With DM		1.019	**0.001**	1.014	**0.001**	1.014	**< 0.001**	1.014	**< 0.001**	1.014	**< 0.001**
Gender	**Male**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	1.041	0.643	1.020	0.751	1.027	0.599	1.026	0.563	1.010	0.802
Age Group	**< 25y**	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		1.404	0.789	1.003	0.997	1.252	0.768	0.948	0.935
	45 – 64y	1.883	0.230	1.996	0.577	1.431	0.645	1.724	0.463	1.009	0.989
	65 – 74y	2.036	0.172	2.010	0.573	1.361	0.692	1.610	0.520	0.960	0.950
	≥ 75y	2.242	0.118	2.202	0.524	1.583	0.554	1.883	0.393	1.159	0.818
IMD	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.032	0.811	1.042	0.659	0.994	0.937	0.990	0.878	0.966	0.567
	3	1.038	0.776	1.020	0.830	1.002	0.983	1.009	0.895	0.993	0.904
	4	0.890	0.384	0.901	0.260	0.927	0.310	0.902	0.116	0.881	**0.031**
	5	0.815	0.153	0.803	**0.027**	0.807	**0.009**	0.854	**0.026**	0.843	**0.007**
CCI Group	**CCI = 0**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	0.719	**0.005**	0.891	0.157	0.917	0.183	0.946	0.322	0.968	0.520
	CCI = 2	0.693	**0.001**	0.783	**0.002**	0.847	**0.011**	0.895	0.053	0.921	0.111
	CCI = 3	0.890	0.400	1.063	0.531	1.124	0.149	1.147	0.057	1.198	**0.006**
	CCI ≥ 4	0.615	**0.001**	0.795	**0.034**	0.821	**0.033**	0.870	0.090	0.888	0.120
Smoking Status	**Non-Smoker**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.936	0.485	0.869	**0.039**	0.910	0.090	0.917	0.076	0.942	0.172
	Current Smoker	0.805	0.122	0.751	**0.003**	0.744	**< 0.001**	0.768	**< 0.001**	0.787	**< 0.001**
	Unknown	1.101	0.703	0.836	0.268	0.961	0.727	0.969	0.731	0.938	0.417
DM12		1.014	0.865	0.978	0.710	0.935	0.172	0.911	**0.032**	0.904	**0.009**

Table A44. Full results from logistic regression model of attainment of DM12 in 2005/06 against death due to a potentially diabetes-related cause.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	**T1DM**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.720	0.073	0.730	**0.020**	0.669	**0.001**	0.734	**0.003**	0.723	**< 0.001**
Years With DM		1.019	**0.001**	1.014	**0.001**	1.014	**< 0.001**	1.014	**< 0.001**	1.014	**< 0.001**
Gender	**Male**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	1.049	0.583	1.030	0.638	1.033	0.523	1.030	0.503	1.012	0.753
Age Group	**< 25y**	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		1.395	0.792	0.983	0.983	1.237	0.780	0.945	0.931
	45 – 64y	1.862	0.239	1.932	0.595	1.388	0.673	1.688	0.480	1.002	0.997
	65 – 74y	2.024	0.176	1.944	0.591	1.318	0.722	1.576	0.539	0.953	0.941
	≥ 75y	2.241	0.119	2.144	0.537	1.539	0.578	1.846	0.408	1.152	0.826
IMD	**1**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.034	0.804	1.044	0.641	0.995	0.945	0.991	0.890	0.967	0.570
	3	1.043	0.749	1.025	0.788	1.004	0.962	1.009	0.889	0.992	0.898
	4	0.892	0.391	0.903	0.272	0.927	0.312	0.902	0.117	0.881	**0.031**
	5	0.813	0.146	0.803	**0.028**	0.810	**0.009**	0.857	**0.029**	0.845	**0.008**
CCI Group	**CCI = 0**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	0.717	**0.005**	0.887	0.143	0.914	0.171	0.944	0.303	0.968	0.510
	CCI = 2	0.694	**0.001**	0.784	**0.002**	0.846	**0.011**	0.891	**0.044**	0.917	0.095
	CCI = 3	0.891	0.402	1.060	0.551	1.121	0.161	1.141	0.066	1.192	**0.007**
	CCI ≥ 4	0.617	**0.001**	0.795	**0.034**	0.819	**0.030**	0.866	0.079	0.884	0.104
Smoking Status	**Non-Smoker**	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.933	0.464	0.864	**0.031**	0.904	0.071	0.911	0.057	0.938	0.142
	Current Smoker	0.806	0.123	0.749	**0.003**	0.743	**< 0.001**	0.766	**< 0.001**	0.785	**< 0.001**
	Unknown	1.112	0.677	0.848	0.308	0.979	0.853	0.991	0.918	0.957	0.582
DM17		1.112	0.200	1.093	0.137	1.030	0.558	1.001	0.986	0.979	0.597

Table A45. Full results from logistic regression model of attainment of DM17 in 2005/06 against death due to a potentially diabetes-related cause.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	T1DM	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.852	**0.006**	0.798	**< 0.001**	0.802	**< 0.001**	0.818	**< 0.001**	0.832	**< 0.001**
Years With DM		1.005	**0.015**	1.005	**0.001**	1.005	**< 0.001**	1.005	**< 0.001**	1.005	**< 0.001**
Gender	Male	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	0.990	0.737	1.032	0.137	1.035	0.056	1.031	0.055	1.033	**0.026**
Age Group	< 25y	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.211	0.259	1.088	0.470	1.109	0.280	1.075	0.396	1.006	0.939
	45 – 64y	1.154	0.395	1.054	0.649	1.039	0.687	1.015	0.861	0.973	0.722
	65 – 74y	1.246	0.193	1.169	0.183	1.148	0.154	1.121	0.181	1.072	0.367
	≥ 75y	1.282	0.140	1.289	**0.030**	1.350	**0.002**	1.375	**< 0.001**	1.339	**< 0.001**
IMD	1	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.830	**< 0.001**	0.813	**< 0.001**	0.818	**< 0.001**	0.837	**< 0.001**	0.836	**< 0.001**
	3	0.809	**< 0.001**	0.759	**< 0.001**	0.760	**< 0.001**	0.770	**< 0.001**	0.787	**< 0.001**
	4	0.790	**< 0.001**	0.740	**< 0.001**	0.742	**< 0.001**	0.754	**< 0.001**	0.760	**< 0.001**
	5	0.755	**< 0.001**	0.708	**< 0.001**	0.700	**< 0.001**	0.700	**< 0.001**	0.704	**< 0.001**
CCI Group	CCI = 0	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.250	**< 0.001**	1.334	**< 0.001**	1.345	**< 0.001**	1.335	**< 0.001**	1.332	**< 0.001**
	CCI = 2	1.447	**< 0.001**	1.498	**< 0.001**	1.500	**< 0.001**	1.464	**< 0.001**	1.413	**< 0.001**
	CCI = 3	1.753	**< 0.001**	1.907	**< 0.001**	1.807	**< 0.001**	1.744	**< 0.001**	1.682	**< 0.001**
	CCI ≥ 4	2.009	**< 0.001**	2.098	**< 0.001**	2.013	**< 0.001**	1.908	**< 0.001**	1.777	**< 0.001**
Smoking Status	Non-Smoker	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.158	**< 0.001**	1.196	**< 0.001**	1.179	**< 0.001**	1.163	**< 0.001**	1.130	**< 0.001**
	Current Smoker	1.294	**< 0.001**	1.347	**< 0.001**	1.305	**< 0.001**	1.294	**< 0.001**	1.284	**< 0.001**
	Unknown	1.121	**0.047**	1.324	**< 0.001**	1.399	**< 0.001**	1.434	**< 0.001**	1.423	**< 0.001**
NDA Processess Met	0	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	1	1.484	**< 0.001**	1.286	**< 0.001**	1.164	**0.003**	1.055	0.264	1.011	0.810
	2	1.745	**< 0.001**	1.449	**< 0.001**	1.284	**< 0.001**	1.178	**0.001**	1.115	**0.015**
	3	1.447	**< 0.001**	1.330	**< 0.001**	1.194	**< 0.001**	1.106	**0.019**	1.068	0.099
	4	1.351	**< 0.001**	1.317	**< 0.001**	1.217	**< 0.001**	1.135	**0.001**	1.115	**0.002**
	5	0.926	0.099	1.013	0.720	0.996	0.891	0.972	0.348	0.970	0.279
	6	0.707	**< 0.001**	0.838	**< 0.001**	0.873	**< 0.001**	0.883	**< 0.001**	0.897	**< 0.001**
	7	0.604	**< 0.001**	0.743	**< 0.001**	0.813	**< 0.001**	0.834	**< 0.001**	0.866	**< 0.001**
	8	0.574	**< 0.001**	0.713	**< 0.001**	0.769	**< 0.001**	0.803	**< 0.001**	0.847	**< 0.001**
	9	0.458	**< 0.001**	0.631	**< 0.001**	0.741	**< 0.001**	0.784	**< 0.001**	0.829	**< 0.001**

Table A46. Full results from multiple-variable zero-inflated negative binomial regression model of the number of NDA care processes received in 2005/06 against emergency admissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	T1DM	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.847	**0.005**	0.790	**< 0.001**	0.794	**< 0.001**	0.813	**< 0.001**	0.828	**< 0.001**
Years With DM		1.005	**0.012**	1.005	**< 0.001**	1.006	**< 0.001**	1.005	**< 0.001**	1.005	**< 0.001**
Gender	Male	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	0.996	0.886	1.038	0.081	1.039	**0.032**	1.034	**0.036**	1.034	**0.022**
Age Group	< 25y	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.224	0.232	1.072	0.551	1.097	0.336	1.063	0.472	0.990	0.895
	45 – 64y	1.119	0.501	1.010	0.931	1.015	0.878	0.992	0.925	0.952	0.524
	65 – 74y	1.240	0.201	1.129	0.301	1.123	0.229	1.096	0.279	1.048	0.543
	≥ 75y	1.300	0.119	1.246	0.060	1.317	**0.004**	1.338	**0.001**	1.304	**0.001**
IMD	1	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.822	**< 0.001**	0.812	**< 0.001**	0.815	**< 0.001**	0.835	**< 0.001**	0.835	**< 0.001**
	3	0.800	**< 0.001**	0.755	**< 0.001**	0.756	**< 0.001**	0.766	**< 0.001**	0.784	**< 0.001**
	4	0.793	**< 0.001**	0.739	**< 0.001**	0.739	**< 0.001**	0.752	**< 0.001**	0.759	**< 0.001**
	5	0.751	**< 0.001**	0.707	**< 0.001**	0.697	**< 0.001**	0.699	**< 0.001**	0.704	**< 0.001**
CCI Group	CCI = 0	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.230	**< 0.001**	1.325	**< 0.001**	1.343	**< 0.001**	1.334	**< 0.001**	1.332	**< 0.001**
	CCI = 2	1.400	**< 0.001**	1.474	**< 0.001**	1.492	**< 0.001**	1.458	**< 0.001**	1.409	**< 0.001**
	CCI = 3	1.740	**< 0.001**	1.905	**< 0.001**	1.819	**< 0.001**	1.751	**< 0.001**	1.686	**< 0.001**
	CCI ≥ 4	1.978	**< 0.001**	2.094	**< 0.001**	2.024	**< 0.001**	1.913	**< 0.001**	1.778	**< 0.001**
Smoking Status	Non-Smoker	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.069	0.056	1.124	**< 0.001**	1.129	**< 0.001**	1.125	**< 0.001**	1.104	**< 0.001**
	Current Smoker	1.138	**0.008**	1.226	**< 0.001**	1.227	**< 0.001**	1.234	**< 0.001**	1.241	**< 0.001**
	Unknown	1.018	0.759	1.192	**< 0.001**	1.286	**< 0.001**	1.343	**< 0.001**	1.348	**< 0.001**
NDA BMI Process		0.548	**< 0.001**	0.666	**< 0.001**	0.739	**< 0.001**	0.782	**< 0.001**	0.819	**< 0.001**

Table A47. Full results from multiple-variable zero-inflated negative binomial regression model of receipt of the NDA BMI care process in 2005/06 against emergency admissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.838	**0.003**	0.782	**< 0.001**	0.788	**< 0.001**	0.807	**< 0.001**	0.823	**< 0.001**
Years With DM		1.005	**0.013**	1.006	**< 0.001**	1.006	**< 0.001**	1.005	**< 0.001**	1.005	**< 0.001**
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	1.015	0.628	1.054	**0.016**	1.052	**0.005**	1.043	**0.008**	1.041	**0.006**
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.191	0.299	1.073	0.547	1.095	0.346	1.063	0.473	0.995	0.951
	45 – 64y	1.091	0.603	1.009	0.940	1.004	0.970	0.983	0.839	0.948	0.487
	65 – 74y	1.241	0.198	1.132	0.291	1.111	0.277	1.084	0.342	1.042	0.594
	≥ 75y	1.389	**0.049**	1.301	**0.024**	1.331	**0.003**	1.344	**< 0.001**	1.311	**< 0.001**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.824	**< 0.001**	0.811	**< 0.001**	0.815	**< 0.001**	0.836	**< 0.001**	0.836	**< 0.001**
	3	0.799	**< 0.001**	0.754	**< 0.001**	0.755	**< 0.001**	0.766	**< 0.001**	0.785	**< 0.001**
	4	0.793	**< 0.001**	0.737	**< 0.001**	0.736	**< 0.001**	0.751	**< 0.001**	0.758	**< 0.001**
	5	0.752	**< 0.001**	0.705	**< 0.001**	0.694	**< 0.001**	0.697	**< 0.001**	0.702	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.246	**< 0.001**	1.322	**< 0.001**	1.344	**< 0.001**	1.331	**< 0.001**	1.328	**< 0.001**
	CCI = 2	1.436	**< 0.001**	1.492	**< 0.001**	1.515	**< 0.001**	1.472	**< 0.001**	1.419	**< 0.001**
	CCI = 3	1.739	**< 0.001**	1.889	**< 0.001**	1.826	**< 0.001**	1.756	**< 0.001**	1.688	**< 0.001**
	CCI ≥ 4	2.077	**< 0.001**	2.130	**< 0.001**	2.077	**< 0.001**	1.948	**< 0.001**	1.804	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.049	0.184	1.107	**< 0.001**	1.118	**< 0.001**	1.115	**< 0.001**	1.095	**< 0.001**
	Current Smoker	1.143	**0.007**	1.232	**< 0.001**	1.237	**< 0.001**	1.243	**< 0.001**	1.249	**< 0.001**
	Unknown	1.118	0.059	1.311	**< 0.001**	1.399	**< 0.001**	1.441	**< 0.001**	1.434	**< 0.001**
NDA BP Process		0.762	**< 0.001**	0.864	**< 0.001**	0.902	**< 0.001**	0.917	**< 0.001**	0.934	**< 0.001**

Table A48. Full results from multiple-variable zero-inflated negative binomial regression model of receipt of the NDA BP care process in 2005/06 against emergency admissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.838	**0.003**	0.786	**< 0.001**	0.792	**< 0.001**	0.810	**< 0.001**	0.825	**< 0.001**
Years With DM		1.005	**0.010**	1.005	**< 0.001**	1.006	**< 0.001**	1.005	**< 0.001**	1.005	**< 0.001**
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	1.014	0.643	1.051	**0.022**	1.050	**0.007**	1.042	**0.010**	1.040	**0.007**
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.219	0.241	1.086	0.484	1.097	0.337	1.065	0.459	0.997	0.965
	45 – 64y	1.172	0.344	1.049	0.679	1.026	0.786	1.002	0.982	0.962	0.617
	65 – 74y	1.313	0.106	1.179	0.161	1.140	0.177	1.108	0.227	1.060	0.448
	≥ 75y	1.412	**0.040**	1.330	**0.015**	1.354	**0.002**	1.366	**< 0.001**	1.329	**< 0.001**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.825	**< 0.001**	0.810	**< 0.001**	0.814	**< 0.001**	0.834	**< 0.001**	0.834	**< 0.001**
	3	0.805	**< 0.001**	0.756	**< 0.001**	0.757	**< 0.001**	0.767	**< 0.001**	0.785	**< 0.001**
	4	0.786	**< 0.001**	0.736	**< 0.001**	0.737	**< 0.001**	0.751	**< 0.001**	0.758	**< 0.001**
	5	0.758	**< 0.001**	0.706	**< 0.001**	0.695	**< 0.001**	0.698	**< 0.001**	0.703	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.253	**< 0.001**	1.332	**< 0.001**	1.348	**< 0.001**	1.334	**< 0.001**	1.331	**< 0.001**
	CCI = 2	1.406	**< 0.001**	1.481	**< 0.001**	1.503	**< 0.001**	1.465	**< 0.001**	1.414	**< 0.001**
	CCI = 3	1.761	**< 0.001**	1.906	**< 0.001**	1.825	**< 0.001**	1.754	**< 0.001**	1.688	**< 0.001**
	CCI ≥ 4	2.079	**< 0.001**	2.134	**< 0.001**	2.063	**< 0.001**	1.938	**< 0.001**	1.796	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.063	0.085	1.116	**< 0.001**	1.123	**< 0.001**	1.120	**< 0.001**	1.099	**< 0.001**
	Current Smoker	1.146	**0.005**	1.235	**< 0.001**	1.236	**< 0.001**	1.242	**< 0.001**	1.247	**< 0.001**
	Unknown	1.021	0.719	1.219	**< 0.001**	1.322	**< 0.001**	1.380	**< 0.001**	1.385	**< 0.001**
NDA Cholesterol Process		0.592	**< 0.001**	0.734	**< 0.001**	0.805	**< 0.001**	0.843	**< 0.001**	0.875	**< 0.001**

Table A49. Full results from multiple-variable zero-inflated negative binomial regression model of receipt of the NDA cholesterol care process in 2005/06 against emergency admissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.827	**0.001**	0.778	**< 0.001**	0.786	**< 0.001**	0.805	**< 0.001**	0.822	**< 0.001**
Years With DM		1.005	**0.014**	1.005	**< 0.001**	1.006	**< 0.001**	1.005	**< 0.001**	1.005	**< 0.001**
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	1.014	0.655	1.054	**0.016**	1.052	**0.005**	1.043	**0.008**	1.041	**0.006**
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.199	0.283	1.079	0.518	1.096	0.342	1.064	0.463	0.997	0.968
	45 – 64y	1.109	0.535	1.018	0.876	1.006	0.947	0.986	0.867	0.951	0.508
	65 – 74y	1.270	0.154	1.146	0.245	1.116	0.258	1.089	0.318	1.045	0.566
	≥ 75y	1.408	**0.041**	1.315	**0.019**	1.337	**0.003**	1.350	**< 0.001**	1.316	**< 0.001**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.826	**< 0.001**	0.811	**< 0.001**	0.815	**< 0.001**	0.836	**< 0.001**	0.836	**< 0.001**
	3	0.807	**< 0.001**	0.757	**< 0.001**	0.757	**< 0.001**	0.767	**< 0.001**	0.786	**< 0.001**
	4	0.792	**< 0.001**	0.738	**< 0.001**	0.736	**< 0.001**	0.751	**< 0.001**	0.758	**< 0.001**
	5	0.760	**< 0.001**	0.708	**< 0.001**	0.695	**< 0.001**	0.698	**< 0.001**	0.703	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.249	**< 0.001**	1.325	**< 0.001**	1.345	**< 0.001**	1.332	**< 0.001**	1.329	**< 0.001**
	CCI = 2	1.439	**< 0.001**	1.495	**< 0.001**	1.516	**< 0.001**	1.473	**< 0.001**	1.419	**< 0.001**
	CCI = 3	1.767	**< 0.001**	1.905	**< 0.001**	1.832	**< 0.001**	1.759	**< 0.001**	1.691	**< 0.001**
	CCI ≥ 4	2.110	**< 0.001**	2.146	**< 0.001**	2.082	**< 0.001**	1.952	**< 0.001**	1.806	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.050	0.172	1.108	**< 0.001**	1.118	**< 0.001**	1.115	**< 0.001**	1.096	**< 0.001**
	Current Smoker	1.143	**0.007**	1.233	**< 0.001**	1.237	**< 0.001**	1.243	**< 0.001**	1.249	**< 0.001**
	Unknown	1.101	0.102	1.302	**< 0.001**	1.400	**< 0.001**	1.445	**< 0.001**	1.439	**< 0.001**
NDA Creatinine Process		0.747	**< 0.001**	0.857	**< 0.001**	0.905	**< 0.001**	0.922	**< 0.001**	0.941	**0.001**

Table A50. Full results from multiple-variable zero-inflated negative binomial regression model of receipt of the NDA creatinine care process in 2005/06 against emergency admissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.834	**0.002**	0.785	**< 0.001**	0.792	**< 0.001**	0.811	**< 0.001**	0.827	**< 0.001**
Years With DM		1.005	**0.012**	1.005	**< 0.001**	1.006	**< 0.001**	1.005	**< 0.001**	1.005	**< 0.001**
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	1.012	0.690	1.047	**0.034**	1.045	**0.015**	1.037	**0.020**	1.037	**0.013**
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.230	0.222	1.089	0.468	1.106	0.295	1.070	0.426	1.001	0.992
	45 – 64y	1.148	0.409	1.036	0.759	1.031	0.750	1.003	0.968	0.965	0.640
	65 – 74y	1.287	0.134	1.166	0.190	1.144	0.163	1.110	0.221	1.063	0.426
	≥ 75y	1.359	0.068	1.304	**0.023**	1.356	**0.002**	1.366	**< 0.001**	1.332	**< 0.001**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.827	**< 0.001**	0.813	**< 0.001**	0.816	**< 0.001**	0.836	**< 0.001**	0.836	**< 0.001**
	3	0.800	**< 0.001**	0.755	**< 0.001**	0.756	**< 0.001**	0.767	**< 0.001**	0.785	**< 0.001**
	4	0.802	**< 0.001**	0.743	**< 0.001**	0.741	**< 0.001**	0.754	**< 0.001**	0.760	**< 0.001**
	5	0.761	**< 0.001**	0.712	**< 0.001**	0.700	**< 0.001**	0.702	**< 0.001**	0.705	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.246	**< 0.001**	1.330	**< 0.001**	1.344	**< 0.001**	1.333	**< 0.001**	1.332	**< 0.001**
	CCI = 2	1.443	**< 0.001**	1.492	**< 0.001**	1.505	**< 0.001**	1.466	**< 0.001**	1.416	**< 0.001**
	CCI = 3	1.744	**< 0.001**	1.893	**< 0.001**	1.814	**< 0.001**	1.746	**< 0.001**	1.682	**< 0.001**
	CCI ≥ 4	2.048	**< 0.001**	2.097	**< 0.001**	2.035	**< 0.001**	1.919	**< 0.001**	1.784	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.063	0.083	1.119	**< 0.001**	1.124	**< 0.001**	1.121	**< 0.001**	1.100	**< 0.001**
	Current Smoker	1.152	**0.004**	1.229	**< 0.001**	1.230	**< 0.001**	1.237	**< 0.001**	1.244	**< 0.001**
	Unknown	1.009	0.875	1.195	**< 0.001**	1.299	**< 0.001**	1.360	**< 0.001**	1.366	**< 0.001**
NDA Foot Check Process		0.557	**< 0.001**	0.688	**< 0.001**	0.763	**< 0.001**	0.806	**< 0.001**	0.843	**< 0.001**

Table A51. Full results from multiple-variable zero-inflated negative binomial regression model of receipt of the NDA foot check care process in 2005/06 against emergency admissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.836	**0.002**	0.782	**< 0.001**	0.788	**< 0.001**	0.807	**< 0.001**	0.823	**< 0.001**
Years With DM		1.005	**0.020**	1.005	**< 0.001**	1.006	**< 0.001**	1.005	**< 0.001**	1.005	**< 0.001**
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	1.015	0.649	1.055	**0.014**	1.052	**0.005**	1.043	**0.008**	1.041	**0.006**
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.161	0.377	1.065	0.592	1.092	0.363	1.060	0.494	0.994	0.934
	45 – 64y	1.064	0.710	1.005	0.968	1.003	0.978	0.982	0.831	0.948	0.485
	65 – 74y	1.203	0.271	1.122	0.326	1.108	0.288	1.082	0.358	1.040	0.609
	≥ 75y	1.347	0.075	1.291	**0.029**	1.329	**0.003**	1.343	**0.001**	1.311	**< 0.001**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.825	**< 0.001**	0.810	**< 0.001**	0.815	**< 0.001**	0.836	**< 0.001**	0.835	**< 0.001**
	3	0.801	**< 0.001**	0.755	**< 0.001**	0.757	**< 0.001**	0.768	**< 0.001**	0.786	**< 0.001**
	4	0.782	**< 0.001**	0.732	**< 0.001**	0.733	**< 0.001**	0.748	**< 0.001**	0.756	**< 0.001**
	5	0.745	**< 0.001**	0.698	**< 0.001**	0.689	**< 0.001**	0.692	**< 0.001**	0.698	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.249	**< 0.001**	1.325	**< 0.001**	1.345	**< 0.001**	1.332	**< 0.001**	1.328	**< 0.001**
	CCI = 2	1.444	**< 0.001**	1.496	**< 0.001**	1.514	**< 0.001**	1.471	**< 0.001**	1.418	**< 0.001**
	CCI = 3	1.729	**< 0.001**	1.891	**< 0.001**	1.822	**< 0.001**	1.752	**< 0.001**	1.686	**< 0.001**
	CCI ≥ 4	2.070	**< 0.001**	2.135	**< 0.001**	2.073	**< 0.001**	1.946	**< 0.001**	1.803	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.046	0.216	1.108	**< 0.001**	1.119	**< 0.001**	1.116	**< 0.001**	1.097	**< 0.001**
	Current Smoker	1.148	**0.005**	1.238	**< 0.001**	1.241	**< 0.001**	1.246	**< 0.001**	1.251	**< 0.001**
	Unknown	1.159	**0.011**	1.335	**< 0.001**	1.414	**< 0.001**	1.456	**< 0.001**	1.447	**< 0.001**
NDA HbA1c Process		0.784	**< 0.001**	0.859	**< 0.001**	0.891	**< 0.001**	0.909	**< 0.001**	0.929	**< 0.001**

Table A52. Full results from multiple-variable zero-inflated negative binomial regression model of receipt of the NDA HbA1c care process in 2005/06 against emergency admissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.840	**0.003**	0.785	**< 0.001**	0.790	**< 0.001**	0.808	**< 0.001**	0.824	**< 0.001**
Years With DM		1.005	**0.022**	1.005	**< 0.001**	1.006	**< 0.001**	1.005	**< 0.001**	1.005	**< 0.001**
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	1.012	0.714	1.052	**0.019**	1.050	**0.006**	1.041	**0.011**	1.039	**0.008**
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.119	0.505	1.041	0.732	1.073	0.467	1.048	0.582	0.989	0.882
	45 – 64y	1.021	0.903	0.972	0.805	0.977	0.805	0.964	0.664	0.938	0.401
	65 – 74y	1.144	0.424	1.085	0.487	1.078	0.440	1.062	0.481	1.030	0.703
	≥ 75y	1.285	0.133	1.242	0.064	1.290	**0.008**	1.315	**0.001**	1.295	**0.001**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.840	**< 0.001**	0.825	**< 0.001**	0.826	**< 0.001**	0.845	**< 0.001**	0.843	**< 0.001**
	3	0.807	**< 0.001**	0.762	**< 0.001**	0.761	**< 0.001**	0.771	**< 0.001**	0.790	**< 0.001**
	4	0.801	**< 0.001**	0.746	**< 0.001**	0.743	**< 0.001**	0.756	**< 0.001**	0.763	**< 0.001**
	5	0.778	**< 0.001**	0.726	**< 0.001**	0.709	**< 0.001**	0.709	**< 0.001**	0.712	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.244	**< 0.001**	1.322	**< 0.001**	1.341	**< 0.001**	1.330	**< 0.001**	1.328	**< 0.001**
	CCI = 2	1.448	**< 0.001**	1.501	**< 0.001**	1.515	**< 0.001**	1.473	**< 0.001**	1.419	**< 0.001**
	CCI = 3	1.711	**< 0.001**	1.883	**< 0.001**	1.812	**< 0.001**	1.746	**< 0.001**	1.681	**< 0.001**
	CCI ≥ 4	2.054	**< 0.001**	2.121	**< 0.001**	2.063	**< 0.001**	1.937	**< 0.001**	1.795	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.047	0.203	1.112	**< 0.001**	1.122	**< 0.001**	1.119	**< 0.001**	1.099	**< 0.001**
	Current Smoker	1.168	**0.002**	1.252	**< 0.001**	1.246	**< 0.001**	1.249	**< 0.001**	1.253	**< 0.001**
	Unknown	1.195	**0.002**	1.359	**< 0.001**	1.437	**< 0.001**	1.478	**< 0.001**	1.462	**< 0.001**
NDA Retinal Screening Process		0.683	**< 0.001**	0.760	**< 0.001**	0.819	**< 0.001**	0.852	**< 0.001**	0.874	**< 0.001**

Table A53. Full results from multiple-variable zero-inflated negative binomial regression model of receipt of the NDA retinal screening care process in 2005/06 against emergency admissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.833	**0.002**	0.780	**< 0.001**	0.786	**< 0.001**	0.805	**< 0.001**	0.821	**< 0.001**
Years With DM		1.005	**0.017**	1.006	**< 0.001**	1.006	**< 0.001**	1.005	**< 0.001**	1.005	**< 0.001**
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	1.007	0.836	1.051	**0.023**	1.051	**0.006**	1.043	**0.008**	1.043	**0.004**
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.154	0.396	1.057	0.638	1.088	0.381	1.059	0.497	0.995	0.946
	45 – 64y	1.050	0.772	0.988	0.916	0.990	0.914	0.972	0.733	0.940	0.417
	65 – 74y	1.186	0.309	1.102	0.407	1.091	0.369	1.067	0.446	1.028	0.719
	≥ 75y	1.325	0.092	1.270	**0.041**	1.310	**0.005**	1.326	**0.001**	1.298	**0.001**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.824	**< 0.001**	0.810	**< 0.001**	0.815	**< 0.001**	0.836	**< 0.001**	0.836	**< 0.001**
	3	0.800	**< 0.001**	0.753	**< 0.001**	0.755	**< 0.001**	0.766	**< 0.001**	0.785	**< 0.001**
	4	0.787	**< 0.001**	0.735	**< 0.001**	0.735	**< 0.001**	0.750	**< 0.001**	0.758	**< 0.001**
	5	0.750	**< 0.001**	0.704	**< 0.001**	0.693	**< 0.001**	0.697	**< 0.001**	0.702	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.245	**< 0.001**	1.320	**< 0.001**	1.342	**< 0.001**	1.329	**< 0.001**	1.326	**< 0.001**
	CCI = 2	1.445	**< 0.001**	1.496	**< 0.001**	1.517	**< 0.001**	1.473	**< 0.001**	1.419	**< 0.001**
	CCI = 3	1.730	**< 0.001**	1.887	**< 0.001**	1.825	**< 0.001**	1.754	**< 0.001**	1.687	**< 0.001**
	CCI ≥ 4	2.075	**< 0.001**	2.132	**< 0.001**	2.079	**< 0.001**	1.951	**< 0.001**	1.807	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.140	**0.001**	1.142	**< 0.001**	1.129	**< 0.001**	1.113	**< 0.001**	1.078	**< 0.001**
	Current Smoker	1.281	**< 0.001**	1.287	**< 0.001**	1.257	**< 0.001**	1.245	**< 0.001**	1.230	**< 0.001**
	Unknown	1.266	**< 0.001**	1.414	**< 0.001**	1.481	**< 0.001**	1.513	**< 0.001**	1.490	**< 0.001**
NDA Smoking Status Process		0.824	**< 0.001**	0.936	**0.003**	0.977	0.236	1.000	0.989	1.024	0.142

Table A54. Full results from multiple-variable zero-inflated negative binomial regression model of receipt of the NDA smoking status care process in 2005/06 against emergency admissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.839	**0.003**	0.781	**< 0.001**	0.788	**< 0.001**	0.806	**< 0.001**	0.821	**< 0.001**
Years With DM		1.005	**0.014**	1.005	**< 0.001**	1.006	**< 0.001**	1.005	**< 0.001**	1.005	**< 0.001**
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	1.011	0.724	1.052	**0.020**	1.051	**0.006**	1.043	**0.008**	1.041	**0.005**
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.139	0.439	1.051	0.673	1.086	0.391	1.059	0.501	0.994	0.939
	45 – 64y	1.029	0.862	0.981	0.871	0.988	0.900	0.972	0.738	0.941	0.429
	65 – 74y	1.159	0.378	1.095	0.437	1.089	0.376	1.069	0.436	1.031	0.692
	≥ 75y	1.306	0.110	1.266	**0.044**	1.310	**0.005**	1.328	**0.001**	1.300	**0.001**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.819	**< 0.001**	0.807	**< 0.001**	0.813	**< 0.001**	0.835	**< 0.001**	0.836	**< 0.001**
	3	0.795	**< 0.001**	0.752	**< 0.001**	0.754	**< 0.001**	0.766	**< 0.001**	0.785	**< 0.001**
	4	0.791	**< 0.001**	0.737	**< 0.001**	0.736	**< 0.001**	0.750	**< 0.001**	0.758	**< 0.001**
	5	0.750	**< 0.001**	0.704	**< 0.001**	0.693	**< 0.001**	0.696	**< 0.001**	0.702	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.233	**< 0.001**	1.316	**< 0.001**	1.340	**< 0.001**	1.329	**< 0.001**	1.327	**< 0.001**
	CCI = 2	1.439	**< 0.001**	1.490	**< 0.001**	1.514	**< 0.001**	1.472	**< 0.001**	1.419	**< 0.001**
	CCI = 3	1.730	**< 0.001**	1.884	**< 0.001**	1.824	**< 0.001**	1.755	**< 0.001**	1.688	**< 0.001**
	CCI ≥ 4	2.071	**< 0.001**	2.132	**< 0.001**	2.078	**< 0.001**	1.950	**< 0.001**	1.806	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.036	0.323	1.101	**< 0.001**	1.114	**< 0.001**	1.112	**< 0.001**	1.093	**< 0.001**
	Current Smoker	1.140	**0.008**	1.234	**< 0.001**	1.238	**< 0.001**	1.245	**< 0.001**	1.250	**< 0.001**
	Unknown	1.210	**0.001**	1.385	**< 0.001**	1.465	**< 0.001**	1.506	**< 0.001**	1.490	**< 0.001**
NDA Urinary Albumin Process		0.782	**< 0.001**	0.886	**< 0.001**	0.934	**0.001**	0.965	0.061	0.991	0.585

Table A55. Full results from multiple-variable zero-inflated negative binomial regression model of receipt of the NDA urinary albumin care process in 2005/06 against emergency admissions.

Readmissions and NDA Attainment

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	T1DM	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.835	0.199	0.772	**0.010**	0.726	**< 0.001**	0.747	**< 0.001**	0.795	**0.001**
Years With DM		1.000	0.945	1.003	0.294	1.003	0.198	1.002	0.308	1.003	0.152
Gender	Male	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	0.896	0.140	0.989	0.835	1.020	0.652	0.980	0.585	0.993	0.838
Age Group	< 25y	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	0.898	0.824	1.061	0.855	1.202	0.484	1.183	0.457	1.112	0.600
	45 – 64y	0.609	0.299	0.727	0.317	0.844	0.515	0.811	0.349	0.757	0.163
	65 – 74y	0.533	0.190	0.684	0.237	0.756	0.287	0.715	0.137	0.681	0.056
	≥ 75y	0.466	0.110	0.575	0.084	0.702	0.177	0.704	0.119	0.660	**0.038**
IMD	1	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.935	0.526	0.885	0.108	0.836	**0.004**	0.851	**0.003**	0.829	**< 0.001**
	3	0.849	0.136	0.717	**< 0.001**	0.718	**< 0.001**	0.745	**< 0.001**	0.745	**< 0.001**
	4	0.932	0.539	0.789	**0.003**	0.727	**< 0.001**	0.746	**< 0.001**	0.763	**< 0.001**
	5	0.744	**0.013**	0.735	**< 0.001**	0.701	**< 0.001**	0.699	**< 0.001**	0.708	**< 0.001**
CCI Group	CCI = 0	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.095	0.349	1.272	**< 0.001**	1.245	**< 0.001**	1.305	**< 0.001**	1.296	**< 0.001**
	CCI = 2	1.126	0.272	1.270	**0.002**	1.252	**< 0.001**	1.316	**< 0.001**	1.304	**< 0.001**
	CCI = 3	1.370	**0.017**	1.515	**< 0.001**	1.506	**< 0.001**	1.551	**< 0.001**	1.601	**< 0.001**
	CCI ≥ 4	1.611	**0.001**	1.760	**< 0.001**	1.774	**< 0.001**	1.749	**< 0.001**	1.732	**< 0.001**
Smoking Status	Non-Smoker	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.209	**0.029**	1.308	**< 0.001**	1.254	**< 0.001**	1.204	**< 0.001**	1.176	**< 0.001**
	Current Smoker	1.079	0.514	1.229	**0.012**	1.136	0.060	1.080	0.184	1.146	**0.009**
	Unknown	1.139	0.350	1.416	**< 0.001**	1.470	**< 0.001**	1.471	**< 0.001**	1.519	**< 0.001**
NDA Processess Met	0	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	1	1.374	**0.036**	1.156	0.237	1.054	0.620	0.915	0.349	0.879	0.146
	2	1.501	**0.007**	1.262	0.055	1.055	0.620	0.926	0.422	0.896	0.221
	3	1.420	**0.011**	1.358	**0.005**	1.202	0.054	1.106	0.238	1.095	0.248
	4	1.496	**0.001**	1.427	**< 0.001**	1.272	**0.004**	1.138	0.080	1.086	0.231
	5	0.782	**0.016**	0.930	0.357	0.920	0.222	0.900	0.079	0.886	**0.031**
	6	0.590	**< 0.001**	0.767	**< 0.001**	0.785	**< 0.001**	0.780	**< 0.001**	0.797	**< 0.001**
	7	0.464	**< 0.001**	0.638	**< 0.001**	0.721	**< 0.001**	0.746	**< 0.001**	0.796	**< 0.001**
	8	0.354	**< 0.001**	0.506	**< 0.001**	0.594	**< 0.001**	0.635	**< 0.001**	0.688	**< 0.001**
	9	0.291	**< 0.001**	0.446	**< 0.001**	0.526	**< 0.001**	0.551	**< 0.001**	0.603	**< 0.001**

Table A56. Full results from multiple-variable zero-inflated negative binomial regression model of the number of NDA care processes received in 2005/06 against readmissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	T1DM	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.809	0.132	0.762	**0.007**	0.713	**< 0.001**	0.738	**< 0.001**	0.788	**< 0.001**
Years With DM		1.002	0.656	1.005	0.144	1.004	0.126	1.003	0.207	1.003	0.102
Gender	Male	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	0.936	0.379	1.015	0.771	1.035	0.414	0.990	0.777	0.996	0.897
Age Group	< 25y	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.171	0.739	1.150	0.663	1.254	0.389	1.205	0.409	1.091	0.667
	45 – 64y	0.786	0.608	0.766	0.399	0.874	0.605	0.815	0.362	0.741	0.134
	65 – 74y	0.703	0.455	0.717	0.297	0.776	0.332	0.714	0.135	0.661	**0.039**
	≥ 75y	0.616	0.301	0.600	0.108	0.722	0.212	0.704	0.119	0.642	**0.027**
IMD	1	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.933	0.512	0.887	0.116	0.836	**0.004**	0.846	**0.002**	0.826	**< 0.001**
	3	0.840	0.115	0.713	**< 0.001**	0.713	**< 0.001**	0.740	**< 0.001**	0.741	**< 0.001**
	4	0.963	0.749	0.796	**0.004**	0.731	**< 0.001**	0.744	**< 0.001**	0.762	**< 0.001**
	5	0.744	**0.014**	0.722	**< 0.001**	0.694	**< 0.001**	0.694	**< 0.001**	0.704	**< 0.001**
CCI Group	CCI = 0	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.034	0.730	1.242	**0.001**	1.231	**< 0.001**	1.301	**< 0.001**	1.293	**< 0.001**
	CCI = 2	1.035	0.752	1.234	**0.008**	1.232	**0.001**	1.305	**< 0.001**	1.299	**< 0.001**
	CCI = 3	1.385	**0.014**	1.522	**< 0.001**	1.532	**< 0.001**	1.578	**< 0.001**	1.614	**< 0.001**
	CCI ≥ 4	1.579	**0.002**	1.788	**< 0.001**	1.801	**< 0.001**	1.775	**< 0.001**	1.751	**< 0.001**
Smoking Status	Non-Smoker	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.084	0.345	1.202	**0.002**	1.175	**0.001**	1.142	**0.001**	1.134	**0.001**
	Current Smoker	0.908	0.403	1.062	0.456	1.028	0.679	1.004	0.941	1.089	0.094
	Unknown	1.093	0.535	1.277	**0.013**	1.359	**< 0.001**	1.395	**< 0.001**	1.469	**< 0.001**
NDA BMI Process		0.429	**< 0.001**	0.571	**< 0.001**	0.652	**< 0.001**	0.705	**< 0.001**	0.753	**< 0.001**

Table A57. Full results from multiple-variable zero-inflated negative binomial regression model of receipt of the NDA BMI care process in 2005/06 against readmissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.834	0.195	0.770	**0.009**	0.716	**< 0.001**	0.736	**< 0.001**	0.785	**< 0.001**
Years With DM		1.001	0.736	1.004	0.162	1.005	0.079	1.003	0.149	1.004	0.072
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	0.953	0.523	1.038	0.484	1.057	0.198	1.006	0.869	1.009	0.771
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.108	0.828	1.118	0.729	1.220	0.448	1.205	0.409	1.107	0.613
	45 – 64y	0.753	0.545	0.753	0.370	0.852	0.539	0.813	0.356	0.745	0.140
	65 – 74y	0.674	0.402	0.697	0.258	0.751	0.273	0.708	0.125	0.664	**0.041**
	≥ 75y	0.642	0.344	0.617	0.129	0.719	0.206	0.710	0.128	0.651	**0.032**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.914	0.409	0.889	0.126	0.839	**0.005**	0.850	**0.002**	0.829	**< 0.001**
	3	0.827	0.093	0.715	**< 0.001**	0.715	**< 0.001**	0.741	**< 0.001**	0.742	**< 0.001**
	4	0.926	0.516	0.785	**0.002**	0.724	**< 0.001**	0.742	**< 0.001**	0.761	**< 0.001**
	5	0.722	**0.008**	0.714	**< 0.001**	0.690	**< 0.001**	0.694	**< 0.001**	0.705	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.083	0.417	1.252	**0.001**	1.240	**< 0.001**	1.300	**< 0.001**	1.292	**< 0.001**
	CCI = 2	1.063	0.581	1.245	**0.006**	1.250	**0.001**	1.318	**< 0.001**	1.309	**< 0.001**
	CCI = 3	1.322	**0.036**	1.469	**< 0.001**	1.501	**< 0.001**	1.560	**< 0.001**	1.602	**< 0.001**
	CCI ≥ 4	1.590	**0.002**	1.798	**< 0.001**	1.842	**< 0.001**	1.805	**< 0.001**	1.775	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.069	0.441	1.176	**0.008**	1.161	**0.003**	1.133	**0.003**	1.125	**0.001**
	Current Smoker	0.901	0.372	1.057	0.500	1.032	0.638	1.015	0.797	1.099	0.064
	Unknown	1.166	0.282	1.394	**0.001**	1.462	**< 0.001**	1.488	**< 0.001**	1.540	**< 0.001**
NDA BP Process		0.639	**< 0.001**	0.781	**< 0.001**	0.816	**< 0.001**	0.836	**< 0.001**	0.854	**< 0.001**

Table A58. Full results from multiple-variable zero-inflated negative binomial regression model of receipt of the NDA BP care process in 2005/06 against readmissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.823	0.163	0.765	**0.008**	0.715	**< 0.001**	0.734	**< 0.001**	0.783	**< 0.001**
Years With DM		1.001	0.801	1.004	0.187	1.004	0.109	1.003	0.198	1.004	0.096
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	0.953	0.522	1.037	0.487	1.055	0.214	1.004	0.923	1.008	0.806
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	0.967	0.945	1.094	0.781	1.189	0.512	1.188	0.446	1.101	0.633
	45 – 64y	0.699	0.451	0.768	0.406	0.854	0.546	0.823	0.385	0.758	0.165
	65 – 74y	0.617	0.311	0.711	0.287	0.754	0.281	0.716	0.140	0.675	**0.050**
	≥ 75y	0.579	0.250	0.623	0.138	0.717	0.203	0.716	0.137	0.660	**0.039**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.963	0.726	0.894	0.144	0.839	**0.005**	0.848	**0.002**	0.828	**< 0.001**
	3	0.869	0.208	0.722	**< 0.001**	0.721	**< 0.001**	0.745	**< 0.001**	0.745	**< 0.001**
	4	0.912	0.427	0.782	**0.002**	0.724	**< 0.001**	0.741	**< 0.001**	0.761	**< 0.001**
	5	0.767	**0.028**	0.726	**< 0.001**	0.695	**< 0.001**	0.697	**< 0.001**	0.706	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.122	0.242	1.270	**< 0.001**	1.252	**< 0.001**	1.307	**< 0.001**	1.296	**< 0.001**
	CCI = 2	1.005	0.964	1.228	**0.010**	1.238	**0.001**	1.311	**< 0.001**	1.304	**< 0.001**
	CCI = 3	1.333	**0.030**	1.487	**< 0.001**	1.506	**< 0.001**	1.561	**< 0.001**	1.605	**< 0.001**
	CCI ≥ 4	1.612	**0.001**	1.793	**< 0.001**	1.830	**< 0.001**	1.793	**< 0.001**	1.766	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.102	0.257	1.192	**0.004**	1.171	**0.001**	1.141	**0.002**	1.131	**0.001**
	Current Smoker	0.914	0.434	1.064	0.449	1.037	0.591	1.016	0.783	1.101	0.059
	Unknown	1.104	0.487	1.321	**0.005**	1.406	**< 0.001**	1.443	**< 0.001**	1.514	**< 0.001**
NDA Cholesterol Process		0.500	**< 0.001**	0.682	**< 0.001**	0.750	**< 0.001**	0.784	**< 0.001**	0.823	**< 0.001**

Table A59. Full results from multiple-variable zero-inflated negative binomial regression model of receipt of the NDA cholesterol care process in 2005/06 against readmissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.819	0.155	0.760	**0.006**	0.710	**< 0.001**	0.731	**< 0.001**	0.780	**< 0.001**
Years With DM		1.001	0.741	1.004	0.175	1.005	0.089	1.003	0.167	1.004	0.079
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	0.946	0.465	1.041	0.444	1.060	0.176	1.007	0.838	1.011	0.738
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.003	0.994	1.090	0.790	1.200	0.488	1.198	0.424	1.114	0.594
	45 – 64y	0.693	0.439	0.741	0.345	0.840	0.503	0.810	0.347	0.749	0.148
	65 – 74y	0.623	0.319	0.686	0.238	0.739	0.250	0.704	0.120	0.666	**0.043**
	≥ 75y	0.596	0.272	0.609	0.120	0.709	0.189	0.707	0.124	0.654	**0.034**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.945	0.603	0.898	0.162	0.843	**0.007**	0.853	**0.003**	0.831	**< 0.001**
	3	0.855	0.165	0.725	**< 0.001**	0.719	**< 0.001**	0.744	**< 0.001**	0.744	**< 0.001**
	4	0.917	0.457	0.787	**0.003**	0.724	**< 0.001**	0.741	**< 0.001**	0.760	**< 0.001**
	5	0.749	**0.018**	0.727	**< 0.001**	0.696	**< 0.001**	0.698	**< 0.001**	0.707	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.099	0.339	1.257	**0.001**	1.243	**< 0.001**	1.301	**< 0.001**	1.293	**< 0.001**
	CCI = 2	1.079	0.486	1.254	**0.004**	1.255	**< 0.001**	1.321	**< 0.001**	1.312	**< 0.001**
	CCI = 3	1.358	**0.021**	1.489	**< 0.001**	1.513	**< 0.001**	1.569	**< 0.001**	1.610	**< 0.001**
	CCI ≥ 4	1.683	**< 0.001**	1.828	**< 0.001**	1.857	**< 0.001**	1.815	**< 0.001**	1.785	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.077	0.395	1.184	**0.006**	1.165	**0.002**	1.137	**0.002**	1.127	**0.001**
	Current Smoker	0.905	0.394	1.062	0.463	1.034	0.623	1.015	0.791	1.100	0.062
	Unknown	1.160	0.296	1.397	**0.001**	1.487	**< 0.001**	1.512	**< 0.001**	1.578	**< 0.001**
NDA Creatinine Process		0.658	**< 0.001**	0.798	**< 0.001**	0.845	**< 0.001**	0.860	**< 0.001**	0.890	**0.001**

Table A60. Full results from multiple-variable zero-inflated negative binomial regression model of receipt of the NDA creatinine care process in 2005/06 against readmissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.797	0.106	0.745	**0.003**	0.703	**< 0.001**	0.727	**< 0.001**	0.781	**< 0.001**
Years With DM		1.001	0.771	1.004	0.157	1.004	0.102	1.003	0.182	1.004	0.092
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	0.953	0.522	1.032	0.549	1.048	0.276	0.998	0.964	1.003	0.916
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.084	0.866	1.181	0.605	1.274	0.358	1.237	0.347	1.130	0.546
	45 – 64y	0.739	0.523	0.783	0.439	0.886	0.642	0.836	0.424	0.763	0.175
	65 – 74y	0.651	0.367	0.732	0.329	0.785	0.357	0.729	0.161	0.681	0.056
	≥ 75y	0.587	0.261	0.631	0.148	0.745	0.260	0.728	0.158	0.666	**0.043**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.925	0.461	0.875	0.081	0.830	**0.003**	0.846	**0.002**	0.825	**< 0.001**
	3	0.824	0.080	0.707	**< 0.001**	0.710	**< 0.001**	0.739	**< 0.001**	0.741	**< 0.001**
	4	0.951	0.663	0.793	**0.003**	0.729	**< 0.001**	0.745	**< 0.001**	0.762	**< 0.001**
	5	0.732	**0.009**	0.722	**< 0.001**	0.695	**< 0.001**	0.697	**< 0.001**	0.706	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.055	0.578	1.243	**0.001**	1.228	**< 0.001**	1.293	**< 0.001**	1.291	**< 0.001**
	CCI = 2	1.104	0.362	1.252	**0.004**	1.246	**0.001**	1.312	**< 0.001**	1.307	**< 0.001**
	CCI = 3	1.375	**0.016**	1.490	**< 0.001**	1.514	**< 0.001**	1.558	**< 0.001**	1.605	**< 0.001**
	CCI ≥ 4	1.609	**0.001**	1.744	**< 0.001**	1.798	**< 0.001**	1.767	**< 0.001**	1.750	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.089	0.321	1.191	**0.004**	1.159	**0.003**	1.131	**0.003**	1.124	**0.002**
	Current Smoker	0.938	0.583	1.063	0.449	1.027	0.687	1.008	0.889	1.092	0.083
	Unknown	1.058	0.688	1.270	**0.015**	1.363	**< 0.001**	1.411	**< 0.001**	1.478	**< 0.001**
NDA Foot Check Process		0.453	**< 0.001**	0.607	**< 0.001**	0.692	**< 0.001**	0.742	**< 0.001**	0.778	**< 0.001**

Table A61. Full results from multiple-variable zero-inflated negative binomial regression model of receipt of the NDA foot check care process in 2005/06 against readmissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.838	0.207	0.771	**0.009**	0.719	**< 0.001**	0.737	**< 0.001**	0.784	**< 0.001**
Years With DM		1.001	0.890	1.004	0.203	1.005	0.089	1.003	0.171	1.004	0.088
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	0.932	0.355	1.035	0.510	1.053	0.228	1.002	0.953	1.008	0.793
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.082	0.867	1.108	0.750	1.227	0.435	1.209	0.400	1.120	0.575
	45 – 64y	0.725	0.492	0.746	0.356	0.849	0.528	0.811	0.349	0.749	0.147
	65 – 74y	0.632	0.329	0.687	0.238	0.746	0.262	0.703	0.118	0.664	**0.041**
	≥ 75y	0.608	0.285	0.607	0.116	0.713	0.195	0.706	0.120	0.652	**0.033**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.908	0.373	0.888	0.123	0.840	**0.006**	0.851	**0.003**	0.829	**< 0.001**
	3	0.822	0.082	0.717	**< 0.001**	0.716	**< 0.001**	0.743	**< 0.001**	0.743	**< 0.001**
	4	0.890	0.322	0.771	**0.001**	0.715	**< 0.001**	0.733	**< 0.001**	0.754	**< 0.001**
	5	0.699	**0.003**	0.704	**< 0.001**	0.681	**< 0.001**	0.685	**< 0.001**	0.697	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.085	0.410	1.255	**0.001**	1.239	**< 0.001**	1.300	**< 0.001**	1.292	**< 0.001**
	CCI = 2	1.095	0.408	1.256	**0.004**	1.256	**< 0.001**	1.325	**< 0.001**	1.314	**< 0.001**
	CCI = 3	1.304	**0.046**	1.473	**< 0.001**	1.493	**< 0.001**	1.553	**< 0.001**	1.595	**< 0.001**
	CCI ≥ 4	1.583	**0.002**	1.806	**< 0.001**	1.835	**< 0.001**	1.799	**< 0.001**	1.772	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.054	0.548	1.176	**0.008**	1.162	**0.002**	1.137	**0.002**	1.127	**0.001**
	Current Smoker	0.893	0.334	1.062	0.460	1.038	0.577	1.017	0.764	1.101	0.058
	Unknown	1.214	0.170	1.438	**< 0.001**	1.521	**< 0.001**	1.543	**< 0.001**	1.608	**< 0.001**
NDA HbA1c Process		0.697	**< 0.001**	0.792	**< 0.001**	0.838	**< 0.001**	0.847	**< 0.001**	0.884	**< 0.001**

Table A62. Full results from multiple-variable zero-inflated negative binomial regression model of receipt of the NDA HbA1c care process in 2005/06 against readmissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.827	0.177	0.761	**0.007**	0.714	**< 0.001**	0.735	**< 0.001**	0.783	**< 0.001**
Years With DM		1.002	0.709	1.004	0.176	1.004	0.096	1.003	0.194	1.003	0.106
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	0.944	0.448	1.037	0.494	1.057	0.196	1.004	0.909	1.008	0.794
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	0.852	0.741	0.994	0.984	1.156	0.581	1.172	0.482	1.100	0.636
	45 – 64y	0.583	0.260	0.667	0.205	0.799	0.389	0.779	0.264	0.729	0.114
	65 – 74y	0.499	0.147	0.618	0.134	0.701	0.176	0.675	0.081	0.646	**0.030**
	≥ 75y	0.494	0.140	0.548	0.061	0.670	0.127	0.674	0.079	0.632	**0.022**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.931	0.513	0.908	0.212	0.853	**0.012**	0.863	**0.006**	0.842	**< 0.001**
	3	0.824	0.086	0.727	**< 0.001**	0.720	**< 0.001**	0.746	**< 0.001**	0.747	**< 0.001**
	4	0.905	0.397	0.784	**0.002**	0.725	**< 0.001**	0.743	**< 0.001**	0.764	**< 0.001**
	5	0.753	**0.021**	0.756	**0.001**	0.713	**< 0.001**	0.712	**< 0.001**	0.719	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.094	0.361	1.266	**< 0.001**	1.244	**< 0.001**	1.300	**< 0.001**	1.293	**< 0.001**
	CCI = 2	1.129	0.270	1.280	**0.002**	1.268	**< 0.001**	1.332	**< 0.001**	1.321	**< 0.001**
	CCI = 3	1.293	0.053	1.453	**< 0.001**	1.479	**< 0.001**	1.546	**< 0.001**	1.595	**< 0.001**
	CCI ≥ 4	1.670	**0.001**	1.825	**< 0.001**	1.856	**< 0.001**	1.813	**< 0.001**	1.783	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.044	0.620	1.176	**0.008**	1.167	**0.002**	1.137	**0.002**	1.128	**0.001**
	Current Smoker	0.941	0.605	1.101	0.242	1.057	0.407	1.029	0.615	1.108	**0.043**
	Unknown	1.247	0.114	1.490	**< 0.001**	1.577	**< 0.001**	1.604	**< 0.001**	1.652	**< 0.001**
NDA Retinal Screening Process		0.590	**< 0.001**	0.684	**< 0.001**	0.778	**< 0.001**	0.815	**< 0.001**	0.840	**< 0.001**

Table A63. Full results from multiple-variable zero-inflated negative binomial regression model of receipt of the NDA retinal screening care process in 2005/06 against readmissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.830	0.183	0.761	**0.007**	0.709	**< 0.001**	0.729	**< 0.001**	0.778	**< 0.001**
Years With DM		1.001	0.776	1.004	0.179	1.005	0.080	1.003	0.149	1.004	0.072
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	0.932	0.357	1.031	0.569	1.053	0.229	1.004	0.912	1.012	0.712
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	1.009	0.986	1.056	0.865	1.200	0.488	1.204	0.410	1.120	0.574
	45 – 64y	0.672	0.399	0.710	0.282	0.829	0.471	0.802	0.323	0.741	0.134
	65 – 74y	0.581	0.250	0.647	0.173	0.720	0.211	0.688	0.097	0.652	**0.033**
	≥ 75y	0.564	0.223	0.578	0.086	0.694	0.162	0.693	0.103	0.641	**0.027**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.912	0.398	0.887	0.121	0.840	**0.006**	0.851	**0.003**	0.832	**< 0.001**
	3	0.819	0.077	0.712	**< 0.001**	0.712	**< 0.001**	0.739	**< 0.001**	0.741	**< 0.001**
	4	0.898	0.361	0.776	**0.002**	0.718	**< 0.001**	0.737	**< 0.001**	0.759	**< 0.001**
	5	0.708	**0.005**	0.710	**< 0.001**	0.687	**< 0.001**	0.693	**< 0.001**	0.705	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.083	0.418	1.253	**0.001**	1.238	**< 0.001**	1.297	**< 0.001**	1.289	**< 0.001**
	CCI = 2	1.084	0.463	1.248	**0.005**	1.255	**< 0.001**	1.321	**< 0.001**	1.312	**< 0.001**
	CCI = 3	1.304	**0.046**	1.460	**< 0.001**	1.494	**< 0.001**	1.555	**< 0.001**	1.600	**< 0.001**
	CCI ≥ 4	1.647	**0.001**	1.814	**< 0.001**	1.847	**< 0.001**	1.812	**< 0.001**	1.788	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.170	0.089	1.240	**0.001**	1.204	**0.001**	1.157	**0.001**	1.123	**0.005**
	Current Smoker	1.034	0.781	1.143	0.123	1.087	0.244	1.047	0.449	1.103	0.074
	Unknown	1.351	**0.033**	1.565	**< 0.001**	1.638	**< 0.001**	1.653	**< 0.001**	1.694	**< 0.001**
NDA Smoking Status Process		0.763	**< 0.001**	0.882	**0.007**	0.926	0.055	0.956	0.205	0.998	0.946

Table A64. Full results from multiple-variable zero-inflated negative binomial regression model of receipt of the NDA smoking status care process in 2005/06 against readmissions.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		IRR	p	IRR	p	IRR	p	IRR	p	IRR	p
DM Type	**T1DM**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.852	0.254	0.761	**0.006**	0.708	**< 0.001**	0.729	**< 0.001**	0.779	**< 0.001**
Years With DM		1.002	0.678	1.004	0.201	1.004	0.093	1.003	0.165	1.004	0.080
Gender	**Male**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	0.926	0.316	1.031	0.564	1.055	0.211	1.006	0.879	1.011	0.742
Age Group	**< 25y**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	0.934	0.887	1.020	0.951	1.184	0.521	1.201	0.417	1.115	0.588
	45 – 64y	0.612	0.301	0.681	0.230	0.816	0.435	0.799	0.315	0.740	0.132
	65 – 74y	0.527	0.179	0.624	0.142	0.710	0.192	0.686	0.095	0.652	**0.033**
	≥ 75y	0.518	0.164	0.559	0.069	0.686	0.151	0.693	0.103	0.642	**0.027**
IMD	**1**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	0.894	0.304	0.877	0.089	0.832	**0.004**	0.847	**0.002**	0.829	**< 0.001**
	3	0.784	**0.031**	0.704	**< 0.001**	0.706	**< 0.001**	0.735	**< 0.001**	0.739	**< 0.001**
	4	0.887	0.307	0.775	**0.002**	0.718	**< 0.001**	0.737	**< 0.001**	0.759	**< 0.001**
	5	0.699	**0.003**	0.707	**< 0.001**	0.685	**< 0.001**	0.691	**< 0.001**	0.704	**< 0.001**
CCI Group	**CCI = 0**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	1.074	0.468	1.248	**0.001**	1.236	**< 0.001**	1.295	**< 0.001**	1.288	**< 0.001**
	CCI = 2	1.107	0.352	1.247	**0.005**	1.253	**< 0.001**	1.317	**< 0.001**	1.309	**< 0.001**
	CCI = 3	1.346	**0.026**	1.476	**< 0.001**	1.503	**< 0.001**	1.559	**< 0.001**	1.603	**< 0.001**
	CCI ≥ 4	1.661	**0.001**	1.819	**< 0.001**	1.849	**< 0.001**	1.811	**< 0.001**	1.784	**< 0.001**
Smoking Status	**Non-Smoker**	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	1.034	0.703	1.162	**0.014**	1.154	**0.004**	1.128	**0.004**	1.121	**0.002**
	Current Smoker	0.885	0.298	1.054	0.521	1.031	0.647	1.016	0.781	1.100	0.062
	Unknown	1.250	0.111	1.504	**< 0.001**	1.597	**< 0.001**	1.629	**< 0.001**	1.679	**< 0.001**
NDA Urinary Albumin Process		0.673	**< 0.001**	0.815	**< 0.001**	0.873	**0.002**	0.921	**0.031**	0.946	0.111

Table A65. Full results from multiple-variable zero-inflated negative binomial regression model of receipt of the NDA urinary albumin care process in 2005/06 against readmissions.

Odds of Death (all-cause) and NDA Attainment

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.713	**0.001**	0.740	**< 0.001**	0.841	**0.014**	0.921	0.199	0.909	0.105
Years With DM		1.002	0.547	1.001	0.576	1.006	**0.005**	1.009	**< 0.001**	1.011	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.752	**< 0.001**	0.807	**< 0.001**	0.821	**< 0.001**	0.815	**< 0.001**	0.814	**< 0.001**
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		2.397	0.143	1.433	0.366	1.672	0.165	1.824	0.069
	45 – 64y	5.963	**< 0.001**	9.093	**< 0.001**	5.086	**< 0.001**	5.708	**< 0.001**	6.034	**< 0.001**
	65 – 74y	22.052	**< 0.001**	28.624	**< 0.001**	16.161	**< 0.001**	17.152	**< 0.001**	18.445	**< 0.001**
	≥ 75y	56.396	**< 0.001**	85.034	**< 0.001**	51.150	**< 0.001**	60.233	**< 0.001**	69.308	**< 0.001**
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.942	0.423	0.841	**0.001**	0.825	**< 0.001**	0.845	**< 0.001**	0.846	**< 0.001**
	3	1.001	0.993	0.803	**< 0.001**	0.793	**< 0.001**	0.784	**< 0.001**	0.789	**< 0.001**
	4	0.873	0.066	0.764	**< 0.001**	0.778	**< 0.001**	0.787	**< 0.001**	0.782	**< 0.001**
	5	0.777	**0.001**	0.671	**< 0.001**	0.664	**< 0.001**	0.655	**< 0.001**	0.663	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.425	**< 0.001**	1.314	**< 0.001**	1.372	**< 0.001**	1.363	**< 0.001**	1.380	**< 0.001**
	CCI = 2	2.555	**< 0.001**	2.345	**< 0.001**	2.479	**< 0.001**	2.517	**< 0.001**	2.509	**< 0.001**
	CCI = 3	3.013	**< 0.001**	3.265	**< 0.001**	3.416	**< 0.001**	3.524	**< 0.001**	3.560	**< 0.001**
	CCI ≥ 4	4.408	**< 0.001**	4.458	**< 0.001**	4.739	**< 0.001**	5.219	**< 0.001**	5.536	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.380	**< 0.001**	1.376	**< 0.001**	1.363	**< 0.001**	1.347	**< 0.001**	1.337	**< 0.001**
	Current Smoker	1.723	**< 0.001**	1.931	**< 0.001**	2.039	**< 0.001**	1.999	**< 0.001**	2.107	**< 0.001**
	Unknown	0.148	**< 0.001**	0.272	**< 0.001**	0.461	**< 0.001**	0.615	**< 0.001**	0.801	**< 0.001**
NDA Processess Met	0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	1	1.853	**< 0.001**	1.938	**< 0.001**	2.025	**< 0.001**	1.936	**< 0.001**	1.984	**< 0.001**
	2	1.747	**< 0.001**	1.916	**< 0.001**	2.117	**< 0.001**	2.043	**< 0.001**	2.117	**< 0.001**
	3	0.905	0.269	1.230	**0.009**	1.400	**< 0.001**	1.507	**< 0.001**	1.585	**< 0.001**
	4	0.596	**< 0.001**	0.905	0.163	1.078	0.252	1.104	0.108	1.228	**0.001**
	5	0.254	**< 0.001**	0.518	**< 0.001**	0.643	**< 0.001**	0.687	**< 0.001**	0.752	**< 0.001**
	6	0.114	**< 0.001**	0.286	**< 0.001**	0.411	**< 0.001**	0.466	**< 0.001**	0.536	**< 0.001**
	7	0.069	**< 0.001**	0.211	**< 0.001**	0.332	**< 0.001**	0.404	**< 0.001**	0.474	**< 0.001**
	8	**0.044**	**< 0.001**	0.173	**< 0.001**	0.287	**< 0.001**	0.354	**< 0.001**	0.419	**< 0.001**
	9	0.055	**< 0.001**	0.148	**< 0.001**	0.242	**< 0.001**	0.322	**< 0.001**	0.404	**< 0.001**

Table A66. Full results from multiple-variable logistic regression model of the number of NDA care processes received in 2005/06 against odds of death (all cause).

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.662	**< 0.001**	0.699	**< 0.001**	0.802	**0.002**	0.883	0.052	0.874	**0.022**
Years With DM		1.004	0.238	1.002	0.301	1.006	**0.001**	1.009	**< 0.001**	1.011	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.762	**< 0.001**	0.819	**< 0.001**	0.832	**< 0.001**	0.824	**< 0.001**	0.823	**< 0.001**
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		2.237	0.177	1.351	0.450	1.583	0.214	1.733	0.096
	45 – 64y	5.232	**< 0.001**	7.736	**< 0.001**	4.448	**< 0.001**	5.069	**< 0.001**	5.411	**< 0.001**
	65 – 74y	17.205	**< 0.001**	22.698	**< 0.001**	13.409	**< 0.001**	14.600	**< 0.001**	15.926	**< 0.001**
	≥ 75y	43.868	**< 0.001**	67.408	**< 0.001**	42.463	**< 0.001**	51.261	**< 0.001**	59.857	**< 0.001**
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.943	0.417	0.835	**0.001**	0.819	**< 0.001**	0.838	**< 0.001**	0.839	**< 0.001**
	3	0.983	0.818	0.793	**< 0.001**	0.785	**< 0.001**	0.777	**< 0.001**	0.781	**< 0.001**
	4	0.877	0.069	0.768	**< 0.001**	0.781	**< 0.001**	0.790	**< 0.001**	0.785	**< 0.001**
	5	0.792	**0.002**	0.681	**< 0.001**	0.670	**< 0.001**	0.660	**< 0.001**	0.668	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.376	**< 0.001**	1.302	**< 0.001**	1.369	**< 0.001**	1.363	**< 0.001**	1.383	**< 0.001**
	CCI = 2	2.475	**< 0.001**	2.314	**< 0.001**	2.460	**< 0.001**	2.504	**< 0.001**	2.502	**< 0.001**
	CCI = 3	3.010	**< 0.001**	3.298	**< 0.001**	3.449	**< 0.001**	3.551	**< 0.001**	3.585	**< 0.001**
	CCI ≥ 4	4.449	**< 0.001**	4.552	**< 0.001**	4.846	**< 0.001**	5.331	**< 0.001**	5.656	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.106	**0.047**	1.149	**< 0.001**	1.180	**< 0.001**	1.197	**< 0.001**	1.203	**< 0.001**
	Current Smoker	1.359	**< 0.001**	1.564	**< 0.001**	1.717	**< 0.001**	1.736	**< 0.001**	1.856	**< 0.001**
	Unknown	0.159	**< 0.001**	0.254	**< 0.001**	0.411	**< 0.001**	0.546	**< 0.001**	0.699	**< 0.001**
NDA BMI Process		0.136	**< 0.001**	0.253	**< 0.001**	0.329	**< 0.001**	0.374	**< 0.001**	0.417	**< 0.001**

Table A67. Full results from multiple-variable logistic regression model of receipt of the NDA BMI care process received in 2005/06 against odds of death (all cause).

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.633	**< 0.001**	0.670	**< 0.001**	0.771	**< 0.001**	0.851	**0.011**	0.844	**0.004**
Years With DM		1.005	0.098	1.003	0.128	1.007	**< 0.001**	1.010	**< 0.001**	1.012	**< 0.001**
Gender	Male			*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.819	**< 0.001**	0.856	**< 0.001**	0.860	**< 0.001**	0.846	**< 0.001**	0.841	**< 0.001**
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		2.246	0.175	1.352	0.448	1.584	0.214	1.730	0.097
	45 – 64y	5.296	**< 0.001**	7.676	**< 0.001**	4.373	**< 0.001**	4.972	**< 0.001**	5.279	**< 0.001**
	65 – 74y	17.667	**< 0.001**	22.489	**< 0.001**	13.092	**< 0.001**	14.202	**< 0.001**	15.381	**< 0.001**
	≥ 75y	50.582	**< 0.001**	71.429	**< 0.001**	43.563	**< 0.001**	51.905	**< 0.001**	59.815	**< 0.001**
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.931	0.315	0.834	**< 0.001**	0.820	**< 0.001**	0.840	**< 0.001**	0.840	**< 0.001**
	3	0.959	0.554	0.788	**< 0.001**	0.783	**< 0.001**	0.776	**< 0.001**	0.781	**< 0.001**
	4	0.861	**0.035**	0.762	**< 0.001**	0.777	**< 0.001**	0.786	**< 0.001**	0.782	**< 0.001**
	5	0.764	**< 0.001**	0.671	**< 0.001**	0.664	**< 0.001**	0.656	**< 0.001**	0.665	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.384	**< 0.001**	1.297	**< 0.001**	1.359	**< 0.001**	1.353	**< 0.001**	1.371	**< 0.001**
	CCI = 2	2.685	**< 0.001**	2.420	**< 0.001**	2.533	**< 0.001**	2.563	**< 0.001**	2.549	**< 0.001**
	CCI = 3	3.164	**< 0.001**	3.368	**< 0.001**	3.499	**< 0.001**	3.595	**< 0.001**	3.626	**< 0.001**
	CCI ≥ 4	5.006	**< 0.001**	4.870	**< 0.001**	5.098	**< 0.001**	5.563	**< 0.001**	5.877	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.062	0.232	1.109	**0.005**	1.146	**< 0.001**	1.166	**< 0.001**	1.175	**< 0.001**
	Current Smoker	1.358	**< 0.001**	1.570	**< 0.001**	1.726	**< 0.001**	1.748	**< 0.001**	1.871	**< 0.001**
	Unknown	0.138	**< 0.001**	0.257	**< 0.001**	0.440	**< 0.001**	0.598	**< 0.001**	0.784	**< 0.001**
NDA BP Process		0.168	**< 0.001**	0.318	**< 0.001**	0.421	**< 0.001**	0.481	**< 0.001**	0.548	**< 0.001**

Table A68. Full results from multiple-variable logistic regression model of receipt of the NDA BP care process in 2005/06 against odds of death (all cause).

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.683	**< 0.001**	0.705	**< 0.001**	0.802	**0.002**	0.880	**0.045**	0.870	**0.017**
Years With DM		1.003	0.320	1.002	0.306	1.006	**0.001**	1.009	**< 0.001**	1.011	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.803	**< 0.001**	0.847	**< 0.001**	0.854	**< 0.001**	0.841	**< 0.001**	0.837	**< 0.001**
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		2.425	0.137	1.437	0.362	1.668	0.167	1.812	0.072
	45 – 64y	5.718	**< 0.001**	8.846	**< 0.001**	4.899	**< 0.001**	5.488	**< 0.001**	5.778	**< 0.001**
	65 – 74y	19.725	**< 0.001**	26.517	**< 0.001**	14.936	**< 0.001**	15.922	**< 0.001**	17.088	**< 0.001**
	≥ 75y	52.862	**< 0.001**	81.412	**< 0.001**	48.515	**< 0.001**	57.094	**< 0.001**	65.403	**< 0.001**
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.934	0.350	0.834	**< 0.001**	0.820	**< 0.001**	0.840	**< 0.001**	0.841	**< 0.001**
	3	0.974	0.717	0.791	**< 0.001**	0.785	**< 0.001**	0.778	**< 0.001**	0.782	**< 0.001**
	4	0.873	0.062	0.766	**< 0.001**	0.780	**< 0.001**	0.790	**< 0.001**	0.785	**< 0.001**
	5	0.798	**0.004**	0.686	**< 0.001**	0.675	**< 0.001**	0.665	**< 0.001**	0.672	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.382	**< 0.001**	1.297	**< 0.001**	1.361	**< 0.001**	1.356	**< 0.001**	1.375	**< 0.001**
	CCI = 2	2.583	**< 0.001**	2.368	**< 0.001**	2.496	**< 0.001**	2.533	**< 0.001**	2.526	**< 0.001**
	CCI = 3	3.126	**< 0.001**	3.360	**< 0.001**	3.492	**< 0.001**	3.589	**< 0.001**	3.619	**< 0.001**
	CCI ≥ 4	4.836	**< 0.001**	4.759	**< 0.001**	4.999	**< 0.001**	5.466	**< 0.001**	5.780	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.091	0.090	1.129	**0.001**	1.161	**< 0.001**	1.179	**< 0.001**	1.188	**< 0.001**
	Current Smoker	1.365	**< 0.001**	1.572	**< 0.001**	1.725	**< 0.001**	1.744	**< 0.001**	1.864	**< 0.001**
	Unknown	0.138	**< 0.001**	0.243	**< 0.001**	0.411	**< 0.001**	0.556	**< 0.001**	0.719	**< 0.001**
NDA Cholesterol Process		0.123	**< 0.001**	0.260	**< 0.001**	0.354	**< 0.001**	0.408	**< 0.001**	0.458	**< 0.001**

Table A69. Full results from multiple-variable logistic regression model of receipt of the NDA cholesterol care process in 2005/06 against odds of death (all cause).

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.623	**< 0.001**	0.666	**< 0.001**	0.768	**< 0.001**	0.849	**0.010**	0.844	**0.004**
Years With DM		1.004	0.174	1.003	0.172	1.007	**< 0.001**	1.010	**< 0.001**	1.012	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.815	**< 0.001**	0.854	**< 0.001**	0.858	**< 0.001**	0.845	**< 0.001**	0.840	**< 0.001**
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		2.339	0.154	1.389	0.408	1.616	0.194	1.760	0.087
	45 – 64y	5.371	**< 0.001**	8.057	**< 0.001**	4.512	**< 0.001**	5.096	**< 0.001**	5.400	**< 0.001**
	65 – 74y	18.365	**< 0.001**	23.867	**< 0.001**	13.597	**< 0.001**	14.633	**< 0.001**	15.812	**< 0.001**
	≥ 75y	52.904	**< 0.001**	76.025	**< 0.001**	45.329	**< 0.001**	53.545	**< 0.001**	61.556	**< 0.001**
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.944	0.420	0.841	**0.001**	0.825	**< 0.001**	0.844	**< 0.001**	0.844	**< 0.001**
	3	0.988	0.866	0.800	**< 0.001**	0.790	**< 0.001**	0.781	**< 0.001**	0.785	**< 0.001**
	4	0.873	0.055	0.767	**< 0.001**	0.780	**< 0.001**	0.789	**< 0.001**	0.784	**< 0.001**
	5	0.795	**0.003**	0.685	**< 0.001**	0.673	**< 0.001**	0.663	**< 0.001**	0.670	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.379	**< 0.001**	1.293	**< 0.001**	1.354	**< 0.001**	1.349	**< 0.001**	1.369	**< 0.001**
	CCI = 2	2.679	**< 0.001**	2.417	**< 0.001**	2.529	**< 0.001**	2.559	**< 0.001**	2.548	**< 0.001**
	CCI = 3	3.285	**< 0.001**	3.428	**< 0.001**	3.540	**< 0.001**	3.629	**< 0.001**	3.655	**< 0.001**
	CCI ≥ 4	5.267	**< 0.001**	4.997	**< 0.001**	5.188	**< 0.001**	5.641	**< 0.001**	5.946	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.060	0.244	1.106	**0.006**	1.143	**< 0.001**	1.163	**< 0.001**	1.174	**< 0.001**
	Current Smoker	1.403	**< 0.001**	1.593	**< 0.001**	1.741	**< 0.001**	1.759	**< 0.001**	1.878	**< 0.001**
	Unknown	0.162	**< 0.001**	0.290	**< 0.001**	0.485	**< 0.001**	0.647	**< 0.001**	0.828	**< 0.001**
NDA Creatinine Process		0.202	**< 0.001**	0.375	**< 0.001**	0.487	**< 0.001**	0.544	**< 0.001**	0.597	**< 0.001**

Table A70. Full results from multiple-variable logistic regression model of receipt of the NDA creatinine care process in 2005/06 against odds of death (all cause).

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.651	**< 0.001**	0.694	**< 0.001**	0.799	**0.001**	0.881	**0.047**	0.873	**0.021**
Years With DM		1.004	0.173	1.003	0.232	1.007	**0.001**	1.009	**< 0.001**	1.011	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.786	**< 0.001**	0.833	**< 0.001**	0.842	**< 0.001**	0.831	**< 0.001**	0.828	**< 0.001**
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		2.258	0.172	1.360	0.440	1.590	0.210	1.740	0.094
	45 – 64y	5.281	**< 0.001**	7.874	**< 0.001**	4.505	**< 0.001**	5.120	**< 0.001**	5.461	**< 0.001**
	65 – 74y	18.190	**< 0.001**	23.803	**< 0.001**	13.880	**< 0.001**	15.020	**< 0.001**	16.341	**< 0.001**
	≥ 75y	49.827	**< 0.001**	73.827	**< 0.001**	45.375	**< 0.001**	54.141	**< 0.001**	62.790	**< 0.001**
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.962	0.596	0.844	**0.001**	0.825	**< 0.001**	0.843	**< 0.001**	0.843	**< 0.001**
	3	0.981	0.789	0.793	**< 0.001**	0.786	**< 0.001**	0.778	**< 0.001**	0.782	**< 0.001**
	4	0.880	0.077	0.770	**< 0.001**	0.782	**< 0.001**	0.791	**< 0.001**	0.786	**< 0.001**
	5	0.785	**0.002**	0.679	**< 0.001**	0.670	**< 0.001**	0.661	**< 0.001**	0.668	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.368	**< 0.001**	1.298	**< 0.001**	1.365	**< 0.001**	1.360	**< 0.001**	1.380	**< 0.001**
	CCI = 2	2.582	**< 0.001**	2.377	**< 0.001**	2.505	**< 0.001**	2.542	**< 0.001**	2.533	**< 0.001**
	CCI = 3	2.901	**< 0.001**	3.236	**< 0.001**	3.407	**< 0.001**	3.521	**< 0.001**	3.563	**< 0.001**
	CCI ≥ 4	4.570	**< 0.001**	4.614	**< 0.001**	4.878	**< 0.001**	5.346	**< 0.001**	5.659	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.099	0.064	1.141	**< 0.001**	1.173	**< 0.001**	1.190	**< 0.001**	1.198	**< 0.001**
	Current Smoker	1.368	**< 0.001**	1.571	**< 0.001**	1.722	**< 0.001**	1.740	**< 0.001**	1.860	**< 0.001**
	Unknown	0.167	**< 0.001**	0.269	**< 0.001**	0.436	**< 0.001**	0.577	**< 0.001**	0.735	**< 0.001**
NDA Foot Check Process		0.124	**< 0.001**	0.262	**< 0.001**	0.352	**< 0.001**	0.402	**< 0.001**	0.445	**< 0.001**

Table A71. Full results from multiple-variable logistic regression model of receipt of the NDA foot check care process in 2005/06 against odds of death (all cause).

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.597	**< 0.001**	0.652	**< 0.001**	0.758	**< 0.001**	0.841	**0.006**	0.839	**0.003**
Years With DM		1.005	0.116	1.003	0.150	1.007	**< 0.001**	1.010	**< 0.001**	1.012	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.823	**< 0.001**	0.856	**< 0.001**	0.859	**< 0.001**	0.845	**< 0.001**	0.840	**< 0.001**
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		2.200	0.186	1.331	0.472	1.561	0.228	1.713	0.103
	45 – 64y	4.842	**< 0.001**	7.145	**0.001**	4.156	**< 0.001**	4.768	**< 0.001**	5.138	**< 0.001**
	65 – 74y	15.319	**< 0.001**	20.400	**< 0.001**	12.229	**< 0.001**	13.433	**< 0.001**	14.838	**< 0.001**
	≥ 75y	45.702	**< 0.001**	66.224	**< 0.001**	41.294	**< 0.001**	49.648	**< 0.001**	58.264	**< 0.001**
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.933	0.329	0.838	**0.001**	0.823	**< 0.001**	0.843	**< 0.001**	0.843	**< 0.001**
	3	0.979	0.763	0.801	**< 0.001**	0.792	**< 0.001**	0.783	**< 0.001**	0.787	**< 0.001**
	4	0.783	**0.001**	0.726	**< 0.001**	0.752	**< 0.001**	0.766	**< 0.001**	0.765	**< 0.001**
	5	0.673	**< 0.001**	0.625	**< 0.001**	0.632	**< 0.001**	0.630	**< 0.001**	0.640	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.330	**< 0.001**	1.272	**< 0.001**	1.341	**< 0.001**	1.338	**< 0.001**	1.361	**< 0.001**
	CCI = 2	2.604	**< 0.001**	2.388	**< 0.001**	2.506	**< 0.001**	2.538	**< 0.001**	2.530	**< 0.001**
	CCI = 3	3.075	**< 0.001**	3.321	**< 0.001**	3.465	**< 0.001**	3.565	**< 0.001**	3.604	**< 0.001**
	CCI ≥ 4	5.020	**< 0.001**	4.881	**< 0.001**	5.097	**< 0.001**	5.549	**< 0.001**	5.857	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.027	0.596	1.091	**0.018**	1.133	**< 0.001**	1.156	**< 0.001**	1.169	**< 0.001**
	Current Smoker	1.432	**< 0.001**	1.610	**< 0.001**	1.754	**< 0.001**	1.769	**< 0.001**	1.888	**< 0.001**
	Unknown	0.260	**< 0.001**	0.389	**< 0.001**	0.601	**< 0.001**	0.774	**< 0.001**	0.951	0.295
NDA HbA1c Process		0.312	**< 0.001**	0.501	**< 0.001**	0.608	**< 0.001**	0.658	**< 0.001**	0.682	**< 0.001**

Table A72. Full results from multiple-variable logistic regression model of receipt of the NDA HbA1c care process in 2005/06 against odds of death (all cause).

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.577	**< 0.001**	0.636	**< 0.001**	0.744	**< 0.001**	0.827	**0.003**	0.827	**0.001**
Years With DM		1.005	0.094	1.003	0.147	1.007	**< 0.001**	1.010	**< 0.001**	1.012	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.817	**< 0.001**	0.849	**< 0.001**	0.853	**< 0.001**	0.840	**< 0.001**	0.835	**< 0.001**
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		2.117	0.208	1.298	0.511	1.532	0.248	1.686	0.114
	45 – 64y	4.399	**< 0.001**	6.525	**0.001**	3.914	**< 0.001**	4.549	**< 0.001**	4.932	**< 0.001**
	65 – 74y	13.585	**< 0.001**	18.405	**< 0.001**	11.430	**< 0.001**	12.739	**< 0.001**	14.160	**< 0.001**
	≥ 75y	39.516	**< 0.001**	58.750	**< 0.001**	38.115	**< 0.001**	46.585	**< 0.001**	55.056	**< 0.001**
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.010	0.883	0.883	**0.015**	0.856	**< 0.001**	0.870	**< 0.001**	0.866	**< 0.001**
	3	1.015	0.832	0.822	**< 0.001**	0.808	**< 0.001**	0.796	**< 0.001**	0.798	**< 0.001**
	4	0.883	0.076	0.783	**< 0.001**	0.795	**< 0.001**	0.802	**< 0.001**	0.797	**< 0.001**
	5	0.832	**0.014**	0.716	**< 0.001**	0.699	**< 0.001**	0.685	**< 0.001**	0.690	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.290	**< 0.001**	1.250	**< 0.001**	1.324	**< 0.001**	1.324	**< 0.001**	1.348	**< 0.001**
	CCI = 2	2.602	**< 0.001**	2.387	**< 0.001**	2.506	**< 0.001**	2.538	**< 0.001**	2.529	**< 0.001**
	CCI = 3	3.034	**< 0.001**	3.285	**< 0.001**	3.436	**< 0.001**	3.540	**< 0.001**	3.579	**< 0.001**
	CCI ≥ 4	5.037	**< 0.001**	4.900	**< 0.001**	5.115	**< 0.001**	5.569	**< 0.001**	5.878	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.020	0.685	1.091	**0.018**	1.135	**< 0.001**	1.158	**< 0.001**	1.171	**< 0.001**
	Current Smoker	1.445	**< 0.001**	1.619	**< 0.001**	1.760	**< 0.001**	1.775	**< 0.001**	1.893	**< 0.001**
	Unknown	0.347	**< 0.001**	0.462	**< 0.001**	0.678	**< 0.001**	0.857	**0.004**	1.045	0.351
NDA Retinal Screening Process		0.290	**< 0.001**	0.464	**< 0.001**	0.563	**< 0.001**	0.623	**< 0.001**	0.658	**< 0.001**

Table A73. Full results from multiple-variable logistic regression model of receipt of the NDA retinal screening care process in 2005/06 against odds of death (all cause).

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.602	**< 0.001**	0.651	**< 0.001**	0.756	**< 0.001**	0.836	**0.005**	0.833	**0.002**
Years With DM		1.005	0.097	1.004	0.105	1.007	**< 0.001**	1.010	**< 0.001**	1.012	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.774	**< 0.001**	0.828	**< 0.001**	0.839	**< 0.001**	0.831	**< 0.001**	0.830	**< 0.001**
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		2.128	0.205	1.302	0.506	1.535	0.246	1.689	0.113
	45 – 64y	4.661	**< 0.001**	6.717	**0.001**	3.978	**< 0.001**	4.589	**< 0.001**	4.951	**< 0.001**
	65 – 74y	14.890	**< 0.001**	19.185	**< 0.001**	11.688	**< 0.001**	12.880	**< 0.001**	14.210	**< 0.001**
	≥ 75y	42.610	**< 0.001**	60.969	**< 0.001**	38.935	**< 0.001**	47.136	**< 0.001**	55.364	**< 0.001**
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.950	0.463	0.843	**0.001**	0.825	**< 0.001**	0.844	**< 0.001**	0.844	**< 0.001**
	3	0.974	0.712	0.796	**< 0.001**	0.787	**< 0.001**	0.779	**< 0.001**	0.783	**< 0.001**
	4	0.839	**0.013**	0.752	**< 0.001**	0.769	**< 0.001**	0.780	**< 0.001**	0.777	**< 0.001**
	5	0.751	**< 0.001**	0.667	**< 0.001**	0.661	**< 0.001**	0.654	**< 0.001**	0.663	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.327	**< 0.001**	1.268	**< 0.001**	1.337	**< 0.001**	1.334	**< 0.001**	1.355	**< 0.001**
	CCI = 2	2.639	**< 0.001**	2.401	**< 0.001**	2.515	**< 0.001**	2.544	**< 0.001**	2.534	**< 0.001**
	CCI = 3	3.160	**< 0.001**	3.357	**< 0.001**	3.486	**< 0.001**	3.580	**< 0.001**	3.615	**< 0.001**
	CCI ≥ 4	5.066	**< 0.001**	4.923	**< 0.001**	5.143	**< 0.001**	5.604	**< 0.001**	5.920	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	1.903	**< 0.001**	1.575	**< 0.001**	1.468	**< 0.001**	1.395	**< 0.001**	1.341	**< 0.001**
	Current Smoker	3.272	**< 0.001**	2.586	**< 0.001**	2.440	**< 0.001**	2.252	**< 0.001**	2.256	**< 0.001**
	Unknown	0.409	**< 0.001**	0.522	**< 0.001**	0.747	**< 0.001**	0.930	0.170	1.123	**0.013**
NDA Smoking Status Process		0.236	**< 0.001**	0.477	**< 0.001**	0.608	**< 0.001**	0.700	**< 0.001**	0.772	**< 0.001**

Table A74. Full results from multiple-variable logistic regression model of receipt of the NDA smoking status care process in 2005/06 against odds of death (all cause).

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	T2DM	0.595	**< 0.001**	0.649	**< 0.001**	0.756	**< 0.001**	0.838	**0.005**	0.835	**0.002**
Years With DM		1.006	**0.029**	1.004	0.055	1.008	**< 0.001**	1.010	**< 0.001**	1.012	**< 0.001**
Gender	Male	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Female	0.819	**< 0.001**	0.851	**< 0.001**	0.854	**< 0.001**	0.841	**< 0.001**	0.837	**< 0.001**
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		2.118	0.208	1.298	0.511	1.532	0.248	1.686	0.114
	45 – 64y	4.408	**< 0.001**	6.520	**0.001**	3.911	**< 0.001**	4.544	**< 0.001**	4.921	**< 0.001**
	65 – 74y	13.650	**< 0.001**	18.406	**< 0.001**	11.427	**< 0.001**	12.727	**< 0.001**	14.116	**< 0.001**
	≥ 75y	40.258	**< 0.001**	59.351	**< 0.001**	38.428	**< 0.001**	46.882	**< 0.001**	55.246	**< 0.001**
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	0.949	0.457	0.843	**0.001**	0.825	**< 0.001**	0.843	**< 0.001**	0.843	**< 0.001**
	3	0.972	0.682	0.796	**< 0.001**	0.787	**< 0.001**	0.778	**< 0.001**	0.782	**< 0.001**
	4	0.866	**0.039**	0.770	**< 0.001**	0.783	**< 0.001**	0.792	**< 0.001**	0.786	**< 0.001**
	5	0.762	**< 0.001**	0.671	**< 0.001**	0.664	**< 0.001**	0.656	**< 0.001**	0.664	**< 0.001**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	1.295	**< 0.001**	1.253	**< 0.001**	1.327	**< 0.001**	1.327	**< 0.001**	1.351	**< 0.001**
	CCI = 2	2.613	**< 0.001**	2.392	**< 0.001**	2.509	**< 0.001**	2.540	**< 0.001**	2.531	**< 0.001**
	CCI = 3	3.110	**< 0.001**	3.337	**< 0.001**	3.479	**< 0.001**	3.577	**< 0.001**	3.613	**< 0.001**
	CCI ≥ 4	5.079	**< 0.001**	4.939	**< 0.001**	5.157	**< 0.001**	5.615	**< 0.001**	5.927	**< 0.001**
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.992	0.876	1.069	0.071	1.117	**< 0.001**	1.142	**< 0.001**	1.157	**< 0.001**
	Current Smoker	1.431	**< 0.001**	1.611	**< 0.001**	1.756	**< 0.001**	1.772	**< 0.001**	1.891	**< 0.001**
	Unknown	0.353	**< 0.001**	0.472	**< 0.001**	0.690	**< 0.001**	0.871	**0.009**	1.066	0.176
NDA Urinary Albumin Process		0.268	**< 0.001**	0.497	**< 0.001**	0.597	**< 0.001**	0.658	**< 0.001**	0.717	**< 0.001**

Table A75. Full results from multiple-variable logistic regression model of receipt of the NDA urinary albumin care process in 2005/06 against odds of death (all cause).

Odds of Death Due to Diabetes-Related Causes and NDA Attainment

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.724	0.078	0.733	**0.022**	0.672	**0.001**	0.739	**0.003**	0.726	**0.001**
Years With DM		1.019	**0.001**	1.014	**0.001**	1.014	**< 0.001**	1.014	**< 0.001**	1.014	**< 0.001**
Gender	Male										
	Female	1.056	0.530	1.024	0.702	1.026	0.615	1.024	0.591	1.012	0.769
Age Group	< 25y	*No Events*		Reference Group		Reference Group		Reference Group		Reference Group	
	25 – 44y	*Reference Group*		1.336	0.820	0.952	0.951	1.200	0.812	0.917	0.895
	45 – 64y	1.892	0.229	1.877	0.614	1.347	0.703	1.630	0.511	0.965	0.956
	65 – 74y	2.038	0.173	1.900	0.607	1.283	0.749	1.525	0.570	0.920	0.897
	≥ 75y	2.260	0.116	2.091	0.554	1.494	0.607	1.783	0.436	1.111	0.870
IMD	1	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	2	1.038	0.778	1.051	0.591	1.003	0.974	1.000	0.997	0.971	0.620
	3	1.043	0.752	1.029	0.760	1.008	0.921	1.018	0.792	0.997	0.964
	4	0.898	0.420	0.907	0.290	0.933	0.354	0.911	0.153	0.885	**0.039**
	5	0.809	0.139	0.808	**0.033**	0.815	**0.012**	0.864	**0.039**	0.847	**0.009**
CCI Group	CCI = 0	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	CCI = 1	0.716	**0.005**	0.886	0.139	0.911	0.156	0.942	0.285	0.967	0.501
	CCI = 2	0.697	**0.001**	0.787	**0.003**	0.847	**0.011**	0.891	**0.044**	0.918	0.097
	CCI = 3	0.888	0.391	1.055	0.587	1.117	0.174	1.136	0.076	1.188	**0.009**
	CCI ≥ 4	0.626	**0.001**	0.803	**0.043**	0.819	**0.031**	0.863	0.073	0.883	0.102
Smoking Status	Non-Smoker	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Ex-Smoker	0.929	0.440	0.886	0.083	0.932	0.219	0.939	0.212	0.955	0.307
	Current Smoker	0.792	0.098	0.768	**0.008**	0.769	**0.001**	0.793	**0.001**	0.801	**0.001**
	Unknown	1.090	0.733	0.849	0.313	0.990	0.929	1.002	0.986	0.964	0.646
NDA Processess Met	0	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	1	0.782	0.099	0.814	0.118	0.887	0.310	0.885	0.263	0.874	0.189
	2	0.898	0.462	0.893	0.383	0.966	0.763	0.963	0.724	0.913	0.368
	3	1.054	0.738	1.007	0.955	0.984	0.890	0.920	0.419	0.948	0.580
	4	1.089	0.578	1.126	0.325	1.141	0.205	1.124	0.218	1.058	0.514
	5	1.010	0.948	1.102	0.366	1.058	0.542	1.064	0.448	1.011	0.885
	6	1.120	0.434	1.141	0.176	1.104	0.222	1.041	0.575	1.003	0.966
	7	1.126	0.473	0.971	0.773	0.958	0.606	0.949	0.472	0.956	0.498
	8	1.400	0.260	0.903	0.490	0.877	0.246	0.843	0.074	0.872	0.110
	9	0.961	0.945	0.990	0.973	0.896	0.631	0.918	0.639	0.889	0.454

Table A76. Full results from multiple-variable logistic regression model of the number of NDA care processes received in 2005/06 against odds of death due to a potentially diabetes-related cause.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.718	0.069	0.731	**0.021**	0.672	**0.001**	0.737	**0.003**	0.725	**0.001**
Years With DM		1.019	**0.001**	1.014	**0.001**	1.014	**< 0.001**	1.014	**< 0.001**	1.014	**< 0.001**
Gender	Male	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	1.047	0.597	1.022	0.730	1.027	0.597	1.026	0.550	1.012	0.766
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		1.406	0.788	0.981	0.981	1.227	0.788	0.937	0.921
	45 – 64y	1.891	0.228	1.996	0.577	1.403	0.663	1.688	0.480	0.994	0.993
	65 – 74y	2.045	0.170	2.011	0.573	1.333	0.712	1.575	0.540	0.945	0.929
	≥ 75y	2.271	0.113	2.207	0.522	1.544	0.576	1.833	0.413	1.136	0.842
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.038	0.781	1.043	0.652	0.993	0.921	0.990	0.874	0.966	0.561
	3	1.042	0.755	1.021	0.823	1.000	0.996	1.008	0.909	0.992	0.895
	4	0.893	0.397	0.902	0.262	0.927	0.311	0.903	0.120	0.882	**0.033**
	5	0.817	0.157	0.804	**0.029**	0.809	**0.009**	0.857	**0.029**	0.845	**0.008**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	0.716	**0.005**	0.890	0.154	0.915	0.174	0.944	0.308	0.968	0.518
	CCI = 2	0.696	**0.001**	0.783	**0.002**	0.843	**0.009**	0.889	**0.039**	0.915	0.087
	CCI = 3	0.895	0.421	1.062	0.538	1.120	0.163	1.140	0.068	1.191	**0.008**
	CCI ≥ 4	0.623	**0.001**	0.795	**0.035**	0.814	**0.026**	0.860	0.066	0.879	0.089
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.935	0.477	0.867	**0.036**	0.908	0.086	0.915	0.069	0.940	0.160
	Current Smoker	0.808	0.127	0.750	**0.003**	0.744	**< 0.001**	0.767	**< 0.001**	0.785	**< 0.001**
	Unknown	1.107	0.688	0.838	0.275	0.961	0.730	0.972	0.759	0.945	0.475
NDA BMI Process		1.102	0.256	1.016	0.784	0.949	0.291	0.939	0.148	0.942	0.135

Table A77. Full results from multiple-variable logistic regression model of receipt of the NDA BMI care process in 2005/06 against odds of death due to a potentially diabetes-related cause.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.718	0.070	0.731	**0.020**	0.669	**0.001**	0.734	**0.003**	0.722	**< 0.001**
Years With DM		1.019	**0.001**	1.014	**0.001**	1.014	**< 0.001**	1.014	**< 0.001**	1.014	**< 0.001**
Gender	Male	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	1.040	0.648	1.021	0.740	1.030	0.562	1.030	0.501	1.015	0.702
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		1.394	0.793	0.978	0.978	1.234	0.782	0.943	0.929
	45 – 64y	1.896	0.226	1.976	0.583	1.387	0.674	1.681	0.484	0.992	0.990
	65 – 74y	2.053	0.168	1.990	0.579	1.318	0.723	1.569	0.543	0.942	0.926
	≥ 75y	2.263	0.115	2.185	0.528	1.537	0.579	1.839	0.411	1.141	0.837
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.034	0.803	1.044	0.644	0.995	0.945	0.991	0.894	0.968	0.580
	3	1.041	0.760	1.023	0.806	1.003	0.965	1.010	0.885	0.993	0.912
	4	0.892	0.391	0.902	0.265	0.927	0.310	0.902	0.116	0.881	**0.031**
	5	0.814	0.151	0.804	**0.029**	0.810	**0.010**	0.857	**0.029**	0.845	**0.008**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	0.716	**0.005**	0.888	0.145	0.914	0.169	0.943	0.297	0.967	0.495
	CCI = 2	0.693	**0.001**	0.783	**0.002**	0.845	**0.010**	0.891	**0.045**	0.918	0.096
	CCI = 3	0.893	0.411	1.062	0.537	1.122	0.158	1.141	0.066	1.192	**0.008**
	CCI ≥ 4	0.619	**0.001**	0.798	**0.037**	0.820	**0.031**	0.866	0.080	0.885	0.106
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.934	0.468	0.864	**0.032**	0.904	0.072	0.911	0.055	0.935	0.128
	Current Smoker	0.804	0.120	0.749	**0.003**	0.743	**< 0.001**	0.766	**< 0.001**	0.785	**< 0.001**
	Unknown	1.100	0.708	0.839	0.275	0.978	0.845	0.996	0.963	0.972	0.724
NDA BP Process		1.069	0.433	1.067	0.334	1.030	0.606	1.018	0.731	1.021	0.664

Table A78. Full results from multiple-variable logistic regression model of receipt of the NDA BP care process in 2005/06 against odds of death due to a potentially diabetes-related cause.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.719	0.071	0.730	**0.020**	0.666	**< 0.001**	0.730	**0.002**	0.720	**< 0.001**
Years With DM		1.019	**0.001**	1.014	**0.001**	1.014	**< 0.001**	1.015	**< 0.001**	1.014	**< 0.001**
Gender	Male	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	1.047	0.595	1.022	0.722	1.031	0.545	1.031	0.482	1.016	0.684
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		1.353	0.811	0.943	0.942	1.197	0.814	0.926	0.907
	45 – 64y	1.866	0.238	1.891	0.607	1.318	0.722	1.614	0.519	0.969	0.961
	65 – 74y	2.025	0.177	1.910	0.601	1.251	0.773	1.506	0.581	0.920	0.897
	≥ 75y	2.246	0.119	2.109	0.546	1.472	0.619	1.773	0.439	1.117	0.863
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.044	0.748	1.048	0.613	0.997	0.974	0.992	0.908	0.968	0.582
	3	1.046	0.737	1.029	0.758	1.007	0.925	1.011	0.871	0.994	0.916
	4	0.898	0.419	0.905	0.282	0.927	0.313	0.902	0.113	0.880	**0.030**
	5	0.811	0.142	0.804	**0.029**	0.808	**0.009**	0.855	**0.027**	0.844	**0.007**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	0.710	**0.004**	0.885	0.134	0.912	0.157	0.941	0.280	0.965	0.481
	CCI = 2	0.701	**0.001**	0.789	**0.003**	0.850	**0.013**	0.894	0.051	0.919	0.103
	CCI = 3	0.897	0.430	1.063	0.532	1.125	0.149	1.143	0.064	1.193	**0.007**
	CCI ≥ 4	0.622	**0.001**	0.802	**0.042**	0.825	**0.037**	0.870	0.089	0.886	0.113
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.929	0.439	0.859	**0.026**	0.900	0.058	0.907	**0.045**	0.933	0.116
	Current Smoker	0.805	0.121	0.747	**0.003**	0.741	**< 0.001**	0.765	**< 0.001**	0.784	**< 0.001**
	Unknown	1.098	0.713	0.851	0.318	1.000	0.999	1.018	0.851	0.984	0.837
NDA Cholesterol Process		1.247	**0.009**	1.174	**0.007**	1.132	**0.015**	1.091	0.054	1.056	0.189

Table A79. Full results from multiple-variable logistic regression model of receipt of the NDA cholesterol care process in 2005/06 against odds of death due to a potentially diabetes-related cause.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.718	0.070	0.732	**0.021**	0.670	**0.001**	0.734	**0.003**	0.723	**< 0.001**
Years With DM		1.019	**0.001**	1.014	**0.001**	1.014	**< 0.001**	1.014	**< 0.001**	1.014	**< 0.001**
Gender	Male										
	Female	1.039	0.656	1.021	0.734	1.030	0.560	1.030	0.502	1.015	0.708
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		1.383	0.798	0.976	0.976	1.236	0.781	0.947	0.934
	45 – 64y	1.890	0.228	1.961	0.587	1.384	0.676	1.686	0.481	1.001	0.999
	65 – 74y	2.047	0.169	1.973	0.583	1.313	0.726	1.574	0.540	0.951	0.938
	≥ 75y	2.251	0.117	2.165	0.533	1.533	0.582	1.844	0.409	1.150	0.827
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.032	0.813	1.042	0.658	0.994	0.939	0.991	0.890	0.967	0.575
	3	1.039	0.772	1.020	0.831	1.002	0.974	1.009	0.889	0.993	0.908
	4	0.891	0.385	0.901	0.259	0.926	0.307	0.902	0.117	0.881	**0.032**
	5	0.817	0.156	0.802	**0.027**	0.809	**0.009**	0.857	**0.029**	0.845	**0.008**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	0.721	**0.005**	0.889	0.150	0.914	0.170	0.944	0.303	0.968	0.510
	CCI = 2	0.693	**0.001**	0.783	**0.002**	0.845	**0.010**	0.891	**0.044**	0.917	0.096
	CCI = 3	0.891	0.402	1.061	0.544	1.121	0.160	1.141	0.066	1.192	**0.008**
	CCI ≥ 4	0.616	**0.001**	0.794	**0.034**	0.819	**0.030**	0.866	0.079	0.884	0.103
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.939	0.503	0.866	**0.035**	0.904	0.072	0.911	0.057	0.937	0.137
	Current Smoker	0.806	0.122	0.750	**0.003**	0.743	**< 0.001**	0.766	**< 0.001**	0.785	**< 0.001**
	Unknown	1.102	0.702	0.840	0.280	0.979	0.854	0.991	0.924	0.960	0.611
NDA Creatinine Process		0.968	0.694	1.030	0.648	1.029	0.611	1.003	0.958	0.989	0.805

Table A80. Full results from multiple-variable logistic regression model of receipt of the NDA creatinine care process in 2005/06 against odds of death due to a potentially diabetes-related cause.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.714	0.065	0.730	**0.020**	0.670	**0.001**	0.735	**0.003**	0.724	**< 0.001**
Years With DM		1.019	**0.001**	1.014	**0.001**	1.014	**< 0.001**	1.014	**< 0.001**	1.014	**< 0.001**
Gender	Male	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	1.046	0.606	1.023	0.717	1.029	0.566	1.028	0.524	1.014	0.729
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		1.421	0.782	0.985	0.985	1.241	0.776	0.945	0.931
	45 – 64y	1.845	0.246	2.005	0.575	1.404	0.663	1.706	0.471	1.002	0.998
	65 – 74y	2.006	0.182	2.022	0.570	1.334	0.711	1.592	0.530	0.952	0.939
	≥ 75y	2.222	0.123	2.221	0.519	1.553	0.570	1.861	0.401	1.149	0.828
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.030	0.825	1.044	0.645	0.994	0.937	0.991	0.889	0.967	0.574
	3	1.043	0.750	1.024	0.802	1.002	0.982	1.009	0.899	0.993	0.904
	4	0.893	0.393	0.903	0.267	0.927	0.311	0.903	0.120	0.882	**0.032**
	5	0.811	0.143	0.804	**0.029**	0.810	**0.009**	0.857	**0.030**	0.846	**0.008**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	0.718	**0.005**	0.890	0.154	0.915	0.176	0.945	0.311	0.968	0.518
	CCI = 2	0.692	**0.001**	0.784	**0.002**	0.845	**0.010**	0.891	**0.043**	0.917	0.094
	CCI = 3	0.889	0.396	1.062	0.539	1.121	0.159	1.141	0.067	1.191	**0.008**
	CCI ≥ 4	0.619	**0.001**	0.797	**0.036**	0.818	**0.029**	0.863	0.073	0.881	0.097
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.930	0.441	0.865	**0.033**	0.907	0.079	0.914	0.065	0.938	0.148
	Current Smoker	0.803	0.118	0.750	**0.003**	0.744	**< 0.001**	0.766	**< 0.001**	0.785	**< 0.001**
	Unknown	1.120	0.655	0.845	0.296	0.970	0.788	0.979	0.819	0.953	0.544
NDA Foot Check Process		1.176	0.077	1.055	0.367	0.989	0.821	0.963	0.377	0.968	0.395

Table A81. Full results from multiple-variable logistic regression model of receipt of the NDA foot check care process in 2005/06 against odds of death due to a potentially diabetes-related cause.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.720	0.072	0.731	**0.021**	0.668	**0.001**	0.733	**0.003**	0.722	**< 0.001**
Years With DM		1.019	**0.001**	1.014	**0.001**	1.014	**< 0.001**	1.014	**< 0.001**	1.014	**< 0.001**
Gender	Male	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	1.042	0.637	1.021	0.741	1.029	0.563	1.030	0.502	1.015	0.704
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		1.458	0.766	0.987	0.987	1.236	0.781	0.943	0.928
	45 – 64y	1.890	0.228	2.056	0.561	1.398	0.666	1.683	0.482	0.991	0.989
	65 – 74y	2.035	0.173	2.065	0.558	1.326	0.717	1.569	0.543	0.941	0.924
	≥ 75y	2.239	0.119	2.264	0.509	1.546	0.574	1.839	0.410	1.139	0.839
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.043	0.751	1.044	0.639	0.995	0.945	0.991	0.891	0.967	0.578
	3	1.042	0.758	1.021	0.826	1.002	0.980	1.009	0.895	0.993	0.903
	4	0.899	0.425	0.905	0.281	0.929	0.323	0.903	0.120	0.882	**0.033**
	5	0.823	0.173	0.807	**0.032**	0.812	**0.010**	0.858	**0.031**	0.847	**0.009**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	0.712	**0.004**	0.887	0.142	0.913	0.165	0.942	0.292	0.966	0.486
	CCI = 2	0.692	**0.001**	0.783	**0.002**	0.846	**0.011**	0.892	**0.045**	0.918	0.098
	CCI = 3	0.894	0.419	1.063	0.534	1.123	0.155	1.142	0.064	1.193	**0.007**
	CCI ≥ 4	0.623	**0.001**	0.797	**0.036**	0.821	**0.032**	0.867	0.083	0.885	0.109
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.929	0.438	0.865	**0.032**	0.904	0.070	0.910	0.053	0.934	0.122
	Current Smoker	0.798	0.107	0.747	**0.003**	0.741	**< 0.001**	0.765	**< 0.001**	0.783	**< 0.001**
	Unknown	1.096	0.717	0.839	0.277	0.978	0.847	0.997	0.970	0.973	0.731
NDA HbA1c Process		1.157	0.087	1.068	0.265	1.045	0.359	1.029	0.495	1.035	0.367

Table A82. Full results from multiple-variable logistic regression model of receipt of the NDA HbA1c care process in 2005/06 against odds of death due to a potentially diabetes-related cause.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.719	0.071	0.732	**0.021**	0.671	**0.001**	0.736	**0.003**	0.724	**< 0.001**
Years With DM		1.019	**0.001**	1.014	**0.001**	1.014	**< 0.001**	1.014	**< 0.001**	1.014	**< 0.001**
Gender	Male	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	1.041	0.647	1.019	0.760	1.028	0.586	1.027	0.537	1.014	0.728
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		1.388	0.796	0.985	0.985	1.224	0.791	0.941	0.927
	45 – 64y	1.883	0.230	1.966	0.586	1.401	0.665	1.674	0.487	0.993	0.992
	65 – 74y	2.037	0.172	1.979	0.582	1.330	0.713	1.563	0.547	0.944	0.928
	≥ 75y	2.242	0.119	2.169	0.532	1.549	0.573	1.826	0.416	1.141	0.837
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.032	0.813	1.044	0.640	0.998	0.975	0.996	0.950	0.969	0.601
	3	1.038	0.776	1.022	0.819	1.003	0.966	1.012	0.860	0.994	0.925
	4	0.890	0.384	0.904	0.272	0.929	0.329	0.906	0.132	0.883	**0.035**
	5	0.815	0.152	0.806	**0.031**	0.814	**0.012**	0.863	**0.039**	0.848	**0.010**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	0.720	**0.005**	0.890	0.153	0.914	0.170	0.943	0.299	0.967	0.504
	CCI = 2	0.693	**0.001**	0.782	**0.002**	0.844	**0.010**	0.890	**0.043**	0.917	0.094
	CCI = 3	0.891	0.403	1.061	0.545	1.119	0.166	1.138	0.072	1.190	**0.008**
	CCI ≥ 4	0.616	**0.001**	0.793	**0.033**	0.818	**0.029**	0.863	0.074	0.882	0.099
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.937	0.489	0.869	**0.039**	0.907	0.081	0.914	0.064	0.937	0.140
	Current Smoker	0.805	0.121	0.752	**0.004**	0.744	**< 0.001**	0.767	**< 0.001**	0.785	**< 0.001**
	Unknown	1.102	0.702	0.836	0.268	0.968	0.779	0.984	0.860	0.960	0.604
NDA Retinal Screening Process		1.006	0.970	0.958	0.620	0.938	0.332	0.919	0.131	0.959	0.391

Table A83. Full results from multiple-variable logistic regression model of receipt of the NDA retinal screening care process in 2005/06 against odds of death due to a potentially diabetes-related cause.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.718	0.070	0.732	**0.021**	0.673	**0.001**	0.736	**0.003**	0.725	**0.001**
Years With DM		1.019	**0.001**	1.014	**0.001**	1.014	**< 0.001**	1.014	**< 0.001**	1.014	**< 0.001**
Gender	Male	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	1.045	0.608	1.020	0.746	1.025	0.619	1.026	0.556	1.011	0.780
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		1.395	0.793	1.001	0.999	1.251	0.769	0.955	0.944
	45 – 64y	1.917	0.218	1.981	0.581	1.427	0.648	1.712	0.468	1.010	0.988
	65 – 74y	2.072	0.163	1.995	0.577	1.357	0.694	1.598	0.527	0.960	0.949
	≥ 75y	2.289	0.110	2.186	0.527	1.574	0.559	1.866	0.399	1.157	0.820
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.039	0.776	1.042	0.660	0.994	0.938	0.991	0.890	0.967	0.571
	3	1.048	0.724	1.020	0.836	0.999	0.995	1.008	0.900	0.993	0.901
	4	0.896	0.412	0.901	0.259	0.925	0.301	0.902	0.115	0.881	**0.031**
	5	0.816	0.154	0.803	**0.028**	0.807	**0.009**	0.856	**0.028**	0.845	**0.008**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	0.719	**0.005**	0.890	0.154	0.917	0.183	0.945	0.316	0.969	0.526
	CCI = 2	0.695	**0.001**	0.782	**0.002**	0.843	**0.009**	0.891	**0.043**	0.917	0.093
	CCI = 3	0.898	0.438	1.062	0.541	1.119	0.166	1.140	0.068	1.191	**0.008**
	CCI ≥ 4	0.622	**0.001**	0.794	**0.033**	0.814	**0.026**	0.863	0.072	0.881	0.096
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.895	0.263	0.872	0.063	0.943	0.340	0.942	0.274	0.970	0.537
	Current Smoker	0.760	0.058	0.755	**0.007**	0.781	**0.004**	0.797	**0.003**	0.819	**0.004**
	Unknown	1.078	0.767	0.839	0.277	0.985	0.897	0.998	0.985	0.970	0.700
NDA Smoking Status Process		1.176	0.126	0.990	0.885	0.916	0.124	0.934	0.175	0.932	0.120

Table A84. Full results from multiple-variable logistic regression model of receipt of the NDA smoking status care process in 2005/06 against odds of death due to a potentially diabetes-related cause.

		2005/06		2005/06 - 2006/07		2005/06 - 2007/08		2005/06 - 2008/09		2005/06 - 2009/10	
		OR	p	OR	p	OR	p	OR	p	OR	p
DM Type	T1DM	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	T2DM	0.719	0.071	0.732	**0.021**	0.670	**0.001**	0.735	**0.003**	0.723	**< 0.001**
Years With DM		1.019	**0.001**	1.014	**0.001**	1.014	**< 0.001**	1.014	**< 0.001**	1.014	**< 0.001**
Gender	Male	Reference Group		Reference Group		Reference Group		Reference Group		Reference Group	
	Female	1.041	0.639	1.021	0.740	1.029	0.570	1.029	0.516	1.014	0.717
Age Group	< 25y	*No Events*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	25 – 44y	*Reference Group*		1.395	0.792	0.987	0.987	1.241	0.777	0.946	0.932
	45 – 64y	1.886	0.229	1.982	0.581	1.404	0.662	1.696	0.476	0.998	0.998
	65 – 74y	2.036	0.172	1.996	0.577	1.334	0.710	1.584	0.535	0.949	0.936
	≥ 75y	2.242	0.119	2.188	0.527	1.554	0.570	1.854	0.404	1.148	0.829
IMD	1	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	2	1.032	0.812	1.042	0.659	0.994	0.935	0.990	0.880	0.966	0.565
	3	1.041	0.762	1.020	0.831	1.002	0.980	1.009	0.892	0.993	0.902
	4	0.892	0.390	0.901	0.260	0.927	0.314	0.903	0.121	0.881	**0.032**
	5	0.815	0.152	0.803	**0.028**	0.810	**0.009**	0.857	**0.029**	0.845	**0.008**
CCI Group	CCI = 0	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	CCI = 1	0.717	**0.005**	0.890	0.154	0.915	0.175	0.944	0.304	0.967	0.504
	CCI = 2	0.693	**0.001**	0.783	**0.002**	0.845	**0.010**	0.891	**0.044**	0.917	0.095
	CCI = 3	0.892	0.409	1.062	0.540	1.121	0.160	1.141	0.067	1.191	**0.008**
	CCI ≥ 4	0.616	**0.001**	0.794	**0.033**	0.819	**0.030**	0.865	0.078	0.883	0.102
Smoking Status	Non-Smoker	*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*		*Reference Group*	
	Ex-Smoker	0.939	0.503	0.868	**0.037**	0.906	0.076	0.911	0.056	0.936	0.132
	Current Smoker	0.807	0.125	0.751	**0.003**	0.743	**< 0.001**	0.765	**< 0.001**	0.784	**< 0.001**
	Unknown	1.109	0.684	0.837	0.270	0.971	0.795	0.987	0.889	0.962	0.617
NDA Urinary Albumin Process		1.189	0.326	1.002	0.981	0.977	0.746	0.956	0.468	0.969	0.553

Table A85. Full results from multiple-variable logistic regression model of receipt of the NDA urinary albumin care process in 2005/06 against odds of death due to a potentially diabetes-related cause.

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