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Article type : Research Article

Title: Diabetic Medicine
Created by: Dylan Hamilton
Email proofs to: Claudia.Geue@glasgow.ac.uk
Article no.: DME-2019-00492
Accepted date: 22 January 2020
Article type: Research
Short title/*Authors running head*: Cost of prevalent and incident CVD in type 2 diabetes • *P. McMeekin et al*.

The cost of prevalent and incident cardiovascular disease in people with type 2 diabetes in Scotland: data from the Scottish Care Information–Diabetes Collaboration

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This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/DME.14253
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What's new?

- People with type 2 diabetes are at an elevated risk of being affected by cardiovascular disease.
- Cardiovascular disease is the leading cause of co-morbidity and death among people with type 2 diabetes.
- Cost comparisons are usually between two groups of people with type 2 diabetes, those with and without cardiovascular disease.
- The majority of studies take a cardiovascular disease prevalence-based approach to estimating the cost of illness.

Abstract

Aim To compare costs for three groups of people with type 2 diabetes, those at high risk of future cardiovascular disease, those without cardiovascular disease and those with established cardiovascular disease, and to also compare costs incurred by people with type 2 diabetes with an incident cardiovascular disease event with those who remain incident event-free over a 3-year period.

Methods Data about people with type 2 diabetes in Scotland were obtained from the Scottish Care Information Diabetes registry. Data linkage was used to retrieve information on healthcare utilization, care home use and deaths. Productivity effects were estimated for those of non-pensionable age. We estimated costs over 12 months (prevalent cardiovascular disease) and 3 years from incident cardiovascular disease event.

Results Mean annual cost per person with established cardiovascular disease was £6900, £3300 for a person at high risk of future cardiovascular disease, and £2500 for a person without cardiovascular disease and not at high risk. In year 1, the cost of an incident cardiovascular disease event was £16 700 compared with £2100 for people without an incident event. Over 2 years, the cumulative costs were £21 500 and £4200, and by year 3, £25 000 and £5900, respectively.

Conclusions Cardiovascular disease in people with type 2 diabetes places a significant financial burden on healthcare and the wider economy. Our results emphasize the financial consequences of cardiovascular disease prevention strategies.

<Typesetter: Format the reference citations throughout the text in the DME journal style, thanks.>

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<H1>Introduction

Cardiovascular disease (CVD) is the leading cause of co-morbidity and death among people with type 2 diabetes [1]. People with type 2 diabetes are at increased risk and are disproportionally affected by CVD [2-5]. In addition to a reduction in quality of life and life expectancy, morbidity associated with CVD places significant burden on health services and the wider economy, as highlighted in a recent systematic review on the economic burden of CVD among people with type 2 diabetes [6]. This review concluded that only a few of the studies included productivity costs [6]. The majority of studies were undertaken over a decade ago, however, the treatment landscape in type 2 diabetes changes rapidly. In addition, comparisons made in the literature were between people with and without CVD. Prevention is also important, and hence inclusion of a third group, that is, people at high risk of developing CVD, will add significantly to the existing evidence on costs associated with prevalent CVD in people with type 2 diabetes. In addition, it is not known how costs and the composition of these costs develop over time after an incident CVD event.

Therefore, this study aims to provide a comprehensive analysis of the cost of both prevalent and incident CVD in people with type 2 diabetes. For prevalent CVD, we compare the cost of illness for a 12-month period for three groups of people with type 2 diabetes: those with no CVD, those at high risk of developing CVD, and those with established CVD. The second analysis compares costs incurred by people with type 2 diabetes who experience an incident CVD event with those who remain CVD event-free over a 3-year period. We also provide evidence on the composition of overall costs over that time period.

<H1>Methods

<H2>Data sources

We utilized the population-wide Scottish Care Information–Diabetes (SCI–Diabetes) database to obtain information about people with type 2 diabetes [7]. SCI–Diabetes is a real-time clinical information system tracking clinical information with more than 99% case ascertainment. It also contains socio-demographic and prescribing data. The Community Health Index, a universal national health service identifier, allowed us to link individual patient-level data on inpatient admissions and mortality.

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<H2>Cohort definitions

<H3>Prevalent CVD

Using a cross-sectional study design, we included all people with type 2 diabetes who were alive on 1 July 2015. Based on a 10-year lookback period, people were classified into three groups: 1) having established CVD, 2) being at high risk of future CVD, and 3) being CVD-free and not at high risk of future CVD. Observations were censored at death or upon incident CVD event. Prevalent CVD was established using inpatient admission and primary care records (see the supporting information for International Classification of Diseases [ICD]-10 codes). Risk of future CVD was defined using SCI–Diabetes and primary care records (read codes) if people with type 2 diabetes aged >60 years also met one of the following criteria: duration of type 2 diabetes for >5 years, HbA_{1c} > 9%, hypertension (defined as blood pressure > 130/80 mm Hg [if no formal diagnosis of hypertensive disease]), dyslipidaemia (defined as total cholesterol > 9.0 mmol/l, non-HDL > 7.5 mmol/l, triglycerides 4.5–9.9 mmol/l, pure hypercholesterolemia [E78.0], pure hyperglyceridaemia [E78.1], mixed hyperlipidaemia [E78.2], other hyperlipidaemia [E78.4], unspecified hyperlipidaemia [E78.5], other lipoprotein metabolism disorders [E78.89], unspecified disorder of lipoprotein metabolism [E78.9]), albuminuria, smoking status (smoker vs. non-smoker), BMI > 30 kg/m^2, >2 drugs specific to CVD, estimated GFR < 60 ml/min/1.73m^2, diabetic retinopathy, left ventricular dysfunction, left ventricular hypertrophy or angina. For these variables, values that were nearest to 1 January were used with a lookback period of 2 years and the most recent value was used for each individual [8].

<H3>Incident CVD

People alive with type 2 diabetes at any point from 1 January 2010 to 30 June 2015 were included and followed up for a maximum of 3 years, during which occurrence of the first CVD event was recorded. A 10-year lookback period was used to exclude people with a previous history of CVD. CVD events were defined using standard definitions as defined for the prevalent cohort above [8]. Observations were censored at death or end of study (June 2016). For people not experiencing a CVD event during follow-up, the study midpoint (2013) was used as their inception date, allowing for the maximum follow-up of 3 years.

<H2>Health and social care utilization

Inpatient admissions and day cases including information on diagnostic codes (ICD-10), length of acute hospital stay, speciality, health board area and discharge destination were obtained from Scottish Morbidity Records [9]. Per diem costs for 2015/2016 were obtained from the Scottish Health Service Costs [10] and mapped to health board and specialty. Prescribing data were retrieved from SCI–Diabetes. Unit costs per prescription were obtained from the Information Services Division

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[11] and were assigned to prescribed items using British National Formulary codes. To derive an estimation of annual frequency of primary care visits, we used a validated algorithm based on the Charlson Co-morbidity Index [12]. Primary care costs were assigned to each visit using published costs from the Personal Social Services Research Unit [13]. Dependency status was derived from the discharge destination in Scottish Morbidity Records. The Scottish Care Home census confirms that, once admitted to a care home, only 5% of patients return to independent living [14]. Therefore, we applied 95% of the mean weekly care costs to all patients in care homes for the duration of the study or until death [15]. For people of working age we applied a weekly cost of £560 (average adult wage [16]) for the period that patients were either in hospital or a care home and thus unable to work. Mortality data were obtained from National Records for Scotland.

<H2>Statistical Analyses

Generalized Linear Models with a gamma distribution and an identity link function were employed to estimate the contribution of different cost categories to total costs for each of the three groups. No imputation was carried out in cases of missing data items except for co-morbidity. We adjusted for clinical (duration of diabetes, blood pressure, HbA_{1c}, total cholesterol and Charlson Co-morbidity Index) and demographic (age, sex, Scottish Index of Multiple Deprivation [17]) factors. Mean annual costs for prevalent CVD over a 12-month period and confidence intervals were obtained from predicted values of these regression models. Similarly, we obtained mean costs for year 1, 2 and 3 since incident CVD event. All cost estimates were reported in 2015/2016 prices. All analyses were carried out in R [18] and the dplyr package was used to prepare the data for analyses.

<H1>Results

<H2>Prevalent CVD

Of 244 752 people alive with type 2 diabetes as of 1 July 2015 (median duration of diabetes 7.7 years), we identified 73 037 people with type 2 diabetes with established CVD, 141 428 at high risk of CVD, and 30 287 with no CVD and not at high risk (Table S1). The mean annual cost for a person without CVD and not at high risk was £2500 (95% CI: £700–£8000), £3300 (95% CI: £1000–£16 100) for a person at high risk of future CVD, and £6900 (95% CI: £1600–£29 700) for a person with established CVD (Table 1). This pattern of increasing costs in connection with CVD was observed across all age groups. Across (non-exclusive) CVD categories and excluding the small number of people with hypertensive diseases, people with peripheral arterial disease and heart failure as their first event incurred the highest costs over the 12-month study period, while those who underwent

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revascularization procedures incurred the lowest costs (Table 2). However, the wide confidence intervals reflect the variation in costs.

[Insert TABLE 1]

[Insert TABLE 2]

For people with established CVD, hospital admissions accounted for the majority of annual costs (Figure 1). Costs related to hospital admission accounted for a smaller share of overall costs for people with no CVD, with prescription and primary care costs accounting for a larger proportion of total costs compared with people with established CVD (Figure 1). The distribution of individual cost elements for people at high risk of CVD is similar to that of people with no CVD, except that their hospital costs represented a greater share of overall costs and their primary care costs a smaller share. Indirect costs due to lost productivity were found to be a very small component of overall costs for all groups (0.2% across all three groups). A breakdown of costs by CVD type and healthcare sector is provided in Table 3.

[Insert Figure 1]

[Insert TABLE 3]

<H2>Incident CVD

Our analysis included 245 428 people with type 2 diabetes with no previous history of CVD, 35 322 of whom experienced an incident CVD event during follow-up. Baseline characteristics are shown in Table S2. We present mean annual costs by subgroups of age and type of CVD incident event in Table 3 alongside 3-year mortality and incidence rates. People experiencing an incident event were 9 years older on average compared with individuals not experiencing a CVD event (Table S2). These people have also had their type 2 diabetes diagnosis for longer.

Mean costs per person after 3 years since the incident CVD event (£25 000) compared with costs for individuals who do not experience an incident CVD event (£5900) were substantially higher (Table 3). Although costs in year 1 include those incurred during the incident event, we find that this pattern persists, and also that costs generally increase with increasing age. Cerebrovascular incident events were associated with the highest cost over 3 years (£37 900) and revascularization procedures were associated with the lowest cost (£17 500). Large cost increments from year 1 to year 3 were found for transient ischaemic attack, where by year 3 costs had doubled compared with those incurred in

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year 1 since incident event. A different pattern is observed for incident events that may require a higher upfront cost, such as revascularization procedures, where costs after 3 years show a smaller increase (Table 4). The overall CVD event rate was 30.81 per 1000 person-years and was found to be highest for ischaemic heart disease (15.35 per 1000 person-years). The CVD categories in Table 4 are not exclusive: people may be counted in more than one category depending upon the diagnosis made at incident event.

<Insert TABLE 4>

In the 12-month period following the incident CVD event, hospital and residential care costs accounted for the largest share of total costs. In years 2 and 3, residential and primary care accounted for a larger proportion than in year 1, with hospital care still being the main contributor (Figure 2). Prescription costs remained relatively proportionately constant over time for individuals experiencing an incident CVD event, but proportionately reduced in relation to other cost categories for those without an event, while hospital costs increased. For both groups, costs associated with lost productivity only accounted for 1–2% of total costs (Figure 2). All analyses were age-adjusted.

[Insert Figure 2]

Sector-specific costs by type of incident CVD event and year are presented in Table 5. Figure S1 provides an overview of the sector-specific cost contributions to overall costs at 3 years for people who experienced an incident event. People without a CVD event incurred costs distributed evenly between primary, hospital, residential care and prescriptions. With the exception of hypertensive diseases, the distribution of cost categories is very similar among CVD types (Figure S1).

<Insert TABLE 5>

<H1>Discussion

Prevalent and incident CVD in people with type 2 diabetes place a significant financial burden on health and social care services and the wider economy. Using national population level data, we identified both prevalent and incident CVD events in people with type 2 diabetes and estimated costs to the healthcare system and the wider economy. The magnitude of that burden varies among groups. Our findings suggest that a person with type 2 diabetes at high CVD risk costs the economy an additional £900 per year on average compared with a person with type 2 diabetes not at high

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risk. If CVD is present, the additional annual cost rises to £4400, excluding the costs associated with earlier CVD event(s).

To date, only a limited number of UK studies have analysed the economic burden of CVD in people with type 2 diabetes [19,20]. Hex *et al*. [19] reported costs for hospital admission and procedures at a population level and Alva *et al*. [20] at an individual level. In comparison with our study, the sample sizes were smaller and the CVD categories differed. However, in terms of secondary care costs in the first year, it is possible to make comparisons. For ischaemic heart disease, Alva *et al*. report a cost of £9800 in 2012 prices (£10 100 when inflated using the hospital and community service index), which is close to our estimate of £11 000.

Rather than just comparing between groups of people with and without CVD, we were able to identify a third group of people with type 2 diabetes at high risk of future CVD, thus providing a more comprehensive picture.

The type of incident CVD event also impacts on costs and the highest costs are incurred during the incident event. However, substantial cost differentials between people with type 2 diabetes with and without CVD event continue to show beyond incident event over a 3-year follow-up. This seems to be caused by the initial high costs associated with the incident event and by complications that develop once CVD is established. The composition of overall costs changes over a 3-year follow-up for people with type 2 diabetes with an incident CVD event with hospital costs decreasing, and costs for residential care increasing over time. For people who remained CVD event-free over a 3-year period, hospital costs increased, whereas prescription costs decreased. Costs due to lost productivity are small, as a majority of patients is above pensionable age. We expanded on earlier research, which reported overall annual costs of $3400 and $9700 for treating people with type 2 diabetes and CVD compared with those without CVD [6]. Our estimated cost differences were higher than those reported in the systematic review; however, most studies only considered direct costs, and the time periods during which cost differences were measured varied greatly [6].

<H2>Strengths and limitations

We were able to include all main cost components for direct and indirect medical costs, estimated costs due to lost productivity, and costs for care home stays. However, we appreciate that there may be uncertainty, in particular regarding the frequency of primary care contacts, as these were estimated using an existing algorithm from the literature, and also concerning costs due to lost productivity, as the estimation relied on the assumption that only a hospitalization would lead to days of work being lost. Using a contemporary and representative cohort we were able to quantify

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the financial burden of CVD in type 2 diabetes, emphasizing the importance of effective prevention strategies and providing guidance to inform risk stratification to guide treatment decisions.

<H2>Acknowledgements

This study was funded by Novo Nordisk A/S. Novo Nordisk provided a medical and scientific accuracy review of the final draft for submission. Programming support for the Scottish Diabetes Research Network is provided by the Chief Scientist Office Scotland.

<H2>Funding sources

This study was funded by an unrestricted educational grant from Novo Nordisk A/S.

<H2>Competing interests

E. M. was employed at Novo Nordisk A/S, Søborg, Denmark, at the time of this study. C. S. H. was employed at Novo Nordisk Ltd, West Sussex, UK, at the time of this study. H. M. C. receives research support and honorarium and is also a member of the advisory panels or speaker's bureaus for Sanofi Aventis, Regeneron, Novartis Pharmaceuticals, Novo-Nordisk and Eli Lilly, also receives or has recently received non-binding research support from Pfizer Inc., AstraZeneca LP and Novo-Nordisk, and is a shareholder of Roche Pharmaceuticals and Bayer. All of the other authors declare no conflicts of interest.

<H2>Ethical approval

Ethical approval for the use of SCI−DIABETES data linked to other datasets for research by the SDRN-Epidemiology team has been obtained under: Ethics 07/MRE00/118 Understanding the Impact of Diabetes in Scotland: A Project to Support Scottish Diabetes Register Data Linkage. Privacy Advisory Committee and Caldicott Guardian approval has been awarded under ref PAC 33/11 with amendment 1617-0147. Subsequent updated PBPP (which replace PAC and Caldicott) approval has been granted: reference number 1617-0147, November 2017.

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<H1>Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Definition of established cardiovascular disease.

Table S1 Demographic characteristics and risk factors by cardiovascular disease status in people with type 2 diabetes.

Table S2 Patient characteristics at study entry (mean (SD); %).

Figure S1 Percentage share of cost categories by cardiovascular disease event type at 3 years.

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Table 1 Total mean cost for people with type 2 diabetes in Scotland for 2015–2016 by cardiovascular disease (CVD) status and age (rounded to the nearest £100)

Age category/ CVD type	Costs (£) over 12 months per patient Mean (95% CI)								
All (n = 244 752)		<60 years (n = 72 055)		60–69 years (n = 70 631)		70–79 years (n = 64 839)		≥80 years (n = 37 227)	
Established (n = 73 037)	6900 (1600–29 700)	Established (n = 10 024)	3800 (1300–15 300)	Established (n = 19 451)	5000 (1500–22 700)	Established (n = 25 345)	6900 (1700–30 800)	Established (n = 18 217)	10 100 (2100–40 400)
High risk (n = 141 428)	3300 (1000–16 100)	High risk (n = 49 094)	1800 (900–4900)	High risk (n = 42 182)	2800 (1100–13 200)	High risk (n = 33 403)	4400 (1400–22 900)	High risk (n = 16 749)	7100 (1800–38 800)
None (n = 30 287)	2500 (700– 8000)	None (n = 12 937)	1300 (700–2600)	None (n = 8998)	2300 (800–5900)	None (n = 6091)	3500 (1100–19 400)	None (n = 2261)	5900 (1300–36 600)

Table 2 Total mean cost for people with type 2 diabetes in Scotland for 2015–2016 by cardiovascular disease (CVD) type (rounded to the nearest £100)

First CVD event	N	Costs (£) over 12 months per patient Mean (95% CI)
Ischaemic heart disease	44 948	5800 (1500–26 300)
Heart failure	2736	8600 (1500–38 300)
Cardiac arrhythmia	9855	8100 (2000–34 000)
Cerebrovascular disease or transient ischaemic attack	8451	5800 (1400–21 700)
Cerebrovascular disease	6123	7900 (1900–32 000)
Transient ischaemic attack	2328	6200 (1600–35 700)
Peripheral arterial disease	3938	9200 (1800–40 900)
Revascularization procedures	3104	4700 (1300–20 600)
Hypertensive diseases	<10	9200 (2700–19 800)

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Table 3 Annual costs by cost component and first cardiovascular disease (CVD) type for people with type 2 diabetes in Scotland for 2015–2016 (rounded to the nearest £100)

	Costs (£) over 12 months – mean (95% CI)				
CVD type	Secondary care	Primary care	Residential care*	Prescriptions	Productivity*
Cardiac arrhythmia (n = 9855)	6000 (60–53 300)	700 (175–1300)	400 (0–1400)	1000 (0–3200)	0 (0–0)
Cerebrovascular disease (n = 6123)	5300 (0–51 900)	700 (200–1300)	500 (0–4300)	900 (0–3300)	0 (0–0)
Cerebrovascular disease or transient ischaemic attack (n = 8451)	5100 (0–49 000)	700 (200–1300)	400 (0–2100)	900 (0–3300)	0 (0–0)
Heart failure (n = 2736)	5600 (0–50 700)	700 (200–1400)	300 (0–0)	970 (0–3300)	0 (0–0)
Hypertensive diseases (n = 5)	5700 (100–10 300)	700 (400–1000)	0 (0–0)	1300 (200–300)	0 (0–0)
Ischaemic heart disease (n = 44 948)	3900 (0–38 400)	700 (200–1300)	200 (0–0)	1000 (0–3400)	0 (0–0)
Peripheral arterial disease (n = 3938)	6500 (0–58 700)	700 (200–1300)	280 (0–0)	1000 (1000–3500)	0 (0–0)
Revascularization procedures (n = 3104)	3400 (100–35 400)	600 (200–1300)	200 (0–0)	900 (0–3100)	0 (0–0)
Transient ischaemic attack (n = 2328)	4600 (0–45 000)	700 (300–1300)	200 (0–0)	900 (0–3500)	0 (0–0)

These values do not sum to the total costs given in the main text. They are regression-based estimates.

*These values reflect the age of incident event occurring typically after state pension eligibility age and the low numbers entering residential care.

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Table 4 Mean annual costs (cumulative); 3-year mortality; incidence rates in people with type 2 diabetes without previous history of cardiovascular disease (CVD) in Scotland 2010–2015 – based on study entry date (rounded to the nearest £100)

	No incident CVD event Mean cost (£) and 95% CI	Incident and subsequent CVD Mean cost (£) and 95% CI
All n = 245 428		
3-year mortality		25.25%
Event rate per 1000 person-years*		30.81
Year 1	2100 (1000–6100)	16 700 (6700–41 700)
Year 1 and 2	4200 (2000–11 900)	21 500 (9000–50 900)
Year 1, 2 and 3	5900 (2800–16 500)	25 000 (10 700–57 100)
<60 years (n = 104 078)		
Year 1	1400 (900–2800)	11 200 (6100–26 100)
Year 1 and 2	3000 (2000–5600)	14 400 (8100–31 300)
Year 1, 2 and 3	4000 (2700–7500)	16 800 (9700–35 200)
60–69 years (n = 68 626)		
Year 1	1900 (1200–4900)	13 800 (7100–31 000)
Year 1 and 2	4000 (2400–9700)	17 400 (9400–37 300)
Year 1, 2 and 3	5600 (3500–13 400)	20 100 (11 100–41 700)
70–79 years (n = 51 769)		
Year 1	2900 (1600–8800)	17 400 (8500–39 400)
Year 1 and 2	5900 (3200–16 600)	22 900 (12 000–48 900)
Year 1, 2 and 3	8300 (4600–23 000)	27000 (14 500–55 300)
≥80 (n = 20 955)		
Year 1	4100 (2000–12 400)	25 200 (12 200–57 800)
Year 1 and 2	8200 (4200–23 400)	32 300 (16 700–68 700)
Year 1, 2 and 3	11 500 (6000–32 200)	37 300 (20 000–76 900)
Cerebrovascular disease (n = 4172)		
3-year mortality		30.37%
Event rate per 1000 person-years*		3.64
Year 1		29 600 (14 700–62 300)
Year 1 and 2		34 600 (17 600–71 600)
Year 1, 2 and 3		37 900 (19 400–78 700)
Ischaemic heart disease (n = 17 594)		
3-year mortality		21.26%
Event rate per 1000 person-years*		15.35
Year 1		12 500 (6500–27 500)
Year 1 and 2		16 700 (8600–35 900)
Year 1, 2 and 3		19 800 (10 200–42 100)
Transient ischaemic attack (n = 1370)		
3-year mortality		17.88%
Event rate per 1000 person-years*		1.2
Year 1		10 000 (5100–21 400)

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Year 1 and 2		14 800 (7700–30 000)
Year 1, 2 and 3		18 500 (9700–36 700)
Peripheral arterial disease (n = 3114)		
3-year mortality		27.65%
Event rate per 1000 person-years*		2.72
Year 1		21 600 (10 300–47 900)
Year 1 and 2		28 200 (13 500–61 100)
Year 1, 2 and 3		32 700 (15 700–69 100)
Heart failure (n = 4205)		
3-year mortality		38.10%
Event rate per 1000 person-years*		3.67
Year 1		20 100 (9200–43 300)
Year 1 and 2		25 900 (11 700–54 700)
Year 1, 2 and 3		29 900 (13 600–62 000)
Cardiac arrhythmia (n = 10 260)		
3-year mortality		30.02%
Event rate per 1000 person-years*		8.95
Year 1		17 600 (8400–38 600)
Year 1 and 2		22 900 (11 100–48 300)
Year 1, 2 and 3		26 700 (13 100–55 200)
Hypertensive diseases (n < 10)		
3-year mortality		66.67%
Event rate per 1000 person-years*		0.00
Year 1		40 000 (28 700–50 600)
Year 1 and 2		40 000 (28 700–50 600)
Year 1, 2 and 3		40 000 (28 700–50 600)
Revascularization procedures (n = 3636)		
3-year mortality		9.85%
Event rate per 1000 person-years*		3.17
Year 1		12 100 (6400–27 900)
Year 1 and 2		15 000 (8100–33 600)
Year 1, 2 and 3		17 500 (9600–38 300)
Cerebrovascular disease/transient ischaemic attack (n = 5435)		
3-year mortality		27.28%
Event rate per 1000 person-years*		1.2
Year 1		15 700 (8900–31 800)
Year 1 and 2		21 000 (2000–42 400)
Year 1, 2 and 3		24 900 (13 500–48 700)

*Event rates refer to the cardiovascular event rather than mortality.

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Table 5 Mean cost (cumulative) by cost component and cardiovascular disease (CVD) type (rounded to the nearest £100)

Cost type/CVD type	Costs (£) over 12 months Mean (95% CI)*	Costs (£) over 24 months Mean (95% CI)*	Costs (£) over 36 months Mean (95% CI)*
Secondary care			
Cerebrovascular disease	25 000 (700–114 900)	28 300 (700–129 500)	30 600 (800–139 100)
Ischaemic heart disease	11 000 (100–63 400)	13 900 (100–80 600)	16 100 (200–91 200)
Transient ischaemic attack	8600 (100–65 200)	12 000 (100–78 900)	14 700 (200–90 200)
Peripheral arterial disease	18 500 (100–98 300)	23 400 (100–116 800)	26 500 (200–131 300)
Heart failure	17 000 (100–79 900)	21 100 (200–101 900)	24 000 (400–112 600)
Cardiac arrhythmia	15 600 (100–84 200)	19 300 (100–100 700)	22 100 (200–122 500)
Hypertensive diseases	16 200 (3800–32 000)	27 100 (14 600–34 300)	27 200 (14 700–34 400)
Revascularization procedures	11 200 (100–74 800)	13 100 (100–86 300)	14 700 (200–99 200)
Cerebrovascular disease or transient ischaemic attack	21 100 (100–105 800)	24 500 (200–121 100)	26 900 (400–130 000)
Primary care			
Cerebrovascular sisease	600 (0–1200)	1100 (0–2300)	1500 (0–3500)
Ischaemic heart disease	500 (0–1200)	1000 (0–2200)	1500 (0–3300)
Transient ischaemic attack	600 (200–1200)	1200 (200–2500)	1800 (200–3600)
Peripheral arterial disease	600 (0–1200)	1100 (0–2400)	1600 (0–3500)
Heart failure	600 (0–1200)	1100 (0–2500)	1600 (0–3700)
Cardiac arrhythmia	600 (0–1200)	1100 (0–2300)	1500 (0–3300)
Hypertensive diseases	500 (100–700)	800 (200–1400)	1100 (200–2100)
Revascularization procedures	500 (100–1000)	1000 (100–2100)	1400 (100–3100)
Cerebrovascular disease or transient ischaemic attack	600 (0–1200)	1100 (0–2300)	1600 (0–3500)
Residential care			
Cerebrovascular disease	700 (0–13 500)	1300 (0–20 000)	1700 (0–25 000)
Ischaemic heart disease	300 (0–0)	500 (0–0)	700 (0–0)
Transient ischaemic attack	300 (0–0)	500 (0–0)	700 (0–0)
Peripheral arterial disease	300 (0–0)	500 (0–1400)	800 (0–3900)
Heart failure	400 (0–1300)	600 (0–4000)	800 (0–5300)
Cardiac arrhythmia	500 (0–3200)	900 (0–7100)	1200 (0–10 800)
Hypertensive diseases	0 (0–0)	4100 (0–11 600)	4100 (0–11 600)
Revascularization procedures	100 (0–0)	300 (0–0)	400 (0–0)
Cerebrovascular disease or transient ischaemic attack	600 (0–10 200)	1100 (0–15 600)	1500 (0–19 300)
Prescriptions			
Cerebrovascular disease	800 (0–2900)	1300 (0–5200)	1600 (0–6800)
Ischaemic heart disease	900 (0–3100)	1600 (0–5900)	1900 (0–7700)
Transient ischaemic attack	800 (0–3200)	1500 (0–6400)	1800 (0–7700)

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Peripheral arterial disease	900 (0–3100)	1600 (0–5900)	2000 (0–7900)
Heart failure	900 (0–3500)	1600 (0–6500)	2000 (0–8400)
Cardiac arrhythmia	800 (0–3000)	1400 (0–5400)	1700 (0–7000)
Hypertensive diseases	2000 (900–3000)	3000 (3000–3100)	4100 (3200–5000)
Revascularization procedures	800 (0–3000)	1300 (0–5200)	1700 (0–6800)
Cerebrovascular disease or transient ischaemic attack	800 (0–3000)	1400 (0–5500)	1700 (0–7100)
Productivity			
Cerebrovascular disease	600 (0–6200)	700 (0–7000)	700 (0–7700)
Ischaemic heart disease	300 (0–2200)	300 (0–2700)	400 (0–3100)
Transient ischaemic attack	100 (0–1000)	200 (0–1700)	200 (0–2400)
Peripheral arterial disease	600 (0–6100)	800 (0–7700)	900 (0–8800)
Heart failure	300 (0–3500)	400 (0–4300)	500 (0–5000)
Cardiac arrhythmia	200 (0–2300)	300 (0–2900)	300 (0–3300)
Hypertensive diseases	100 (0–400)	4800 (0–13 800)	4800 (0–13 800)
Revascularization procedures	600 (0–5400)	700 (0–6200)	800 (0–7100)
Cerebrovascular disease or transient ischaemic attack	500 (0–5600)	600 (0–6100)	600 (0–6900)

*Non-parametric CIs have been estimated.

Figure 1 Contribution of cost categories to average total annual costs for patients with no cardiovascular disease (CVD), at high risk of CVD or with established CVD.

Figure 2 Contribution to average total costs of different cost categories over years 1, 2 and 3 for people experiencing an index cardiovascular disease (CVD) event (left panel) and those not experiencing an index CVD event (right panel).

Supporting material

Definition of established CVD

Established CVD was defined as having codes for any cause of admission for chronic ischaemic heart disease (ICD-10 I20-I25), cerebrovascular disease including transient ischaemic attack (ICD-10 I60-63, I66, I69 & G45), peripheral arterial disease (ICD-I70.2 and I73.9), heart failure (I11.0, I13 I50), cardiac arrhythmia (I48, I49), hypertensive heart disease (I13.0, I15.0) or procedure codes for revascularisation procedures of coronary, carotid or lower limb arteries. In addition, primary care records were also queried for corresponding Read codes for coronary heart disease, cerebrovascular disease and revascularisation procedures, peripheral vascular disease and atrial fibrillation.

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Figure 1.

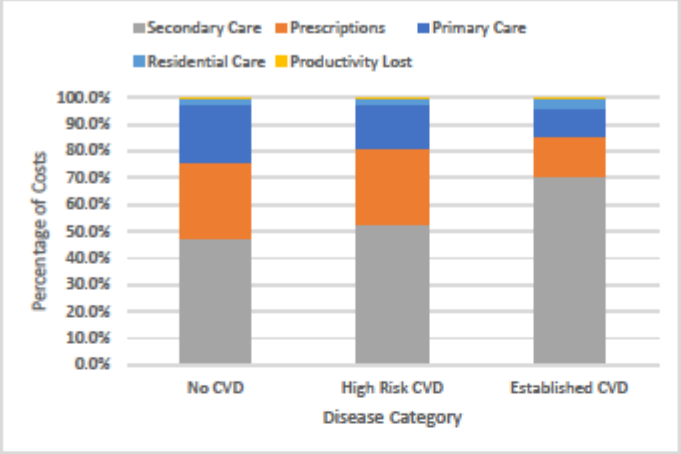

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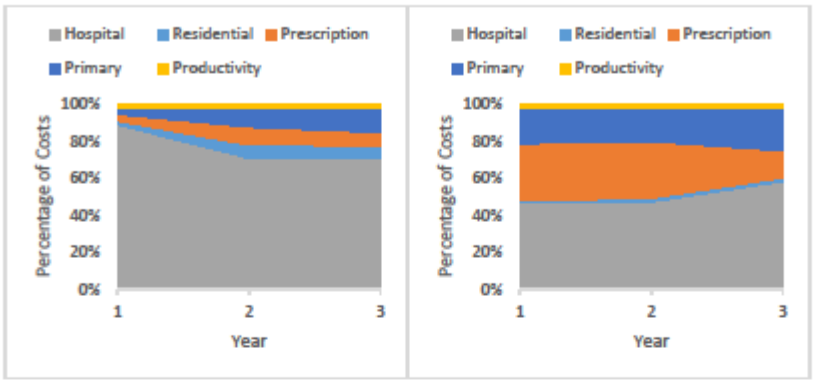
Figure 1.



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