

# Current, future and avoidable costs of stroke in the UK

## Executive summary Part 2:

Societal costs of stroke in the next 20 years and  
potential returns from increased spending on research

Produced by the Centre for Primary Care & Public Health, Queen Mary University of London and the Personal Social Services Research Unit, London School of Economics and Political Science for the Stroke Association

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## Introduction

Stroke is the second largest cause of death worldwide and fourth in the United Kingdom (UK).

There are over 113,000 strokes every year in the UK (Rothwell et al., 2004)\* and over 950,000 stroke survivors among those aged 45 years and over (Geddes et al., 1996).\* Many of these stroke survivors experience significant and long-term physical and psychological impacts, repeat strokes, transient ischaemic attacks (TIAs) and/or death within a year of stroke (Stroke Association, 2017).

Preventing, treating and managing the resulting illness or death from stroke all carry economic consequences, not just for health care services but also more widely across society (Saka et al., 2009; National Audit Office, 2010). For example, given that a quarter of all strokes in the UK happen among people of working age (Stroke Association, 2017), stroke can reduce employment prospects and productivity for society. It can also affect family and friends who are often involved with a stroke survivor's care and are unpaid in this caring role. This is even more concerning given current and likely ongoing financial pressures on health and social care services, families and other unpaid carers.

Despite significant progress in prevention, treatment and rehabilitation, there is still great capacity for further improvements, which in turn could reduce these large economic burdens. Achieving this requires more research, but stroke has received considerably less research investment compared to conditions with similar burdens. For example, the UK annual medical research-spend per stroke patient is £48, compared with £241 per cancer patient and £118 per dementia patient (Luengo-Fernandez et al., 2015).

\*Estimates of the number of strokes and stroke survivors can vary across different studies depending on many factors, including the population sample and data sources that are used. While we have used alternative estimates in our other publications (e.g. Stroke Association, 2017), we use averages from a range of estimates for the purpose of this work.

**We carried out a large body of work that has been split into three distinct parts for reporting:**

**1. Burden of stroke in the next 20 years and potential returns from increased spending on research**

Understanding the scale and range of impacts for a condition as prevalent as stroke can be of enormous value to help prioritise scarce resources. We therefore updated estimates of the current burden of stroke to ensure future research priorities, service and policy responses are based on timely and relevant data.

Furthermore, we forecasted the burden of stroke in the future based on our current estimates. We took into account likely changes in demography and expert views on potential future trends in the numbers of first-time strokes (stroke incidence) and survivors after stroke (stroke prevalence) each year.

However, estimates of the current and future burden of stroke won't in themselves offer solutions. We next gathered expert views on what research areas should be prioritised to reduce the burden of stroke in the UK. We also investigated whether investing in these research areas will help to reduce the burden of stroke in future years.

**2. Societal costs of stroke in the next 20 years and potential returns from increased spending on research**

Further to the burden of stroke, we updated the current societal costs of stroke and examined potential future costs of stroke over the next 10 and 20 years. We forecasted these costs based on our current estimates and accounting for demographic changes, future service costs and future stroke burden estimates. We also examined whether investing in the top research priorities suggested by experts could alleviate some of these longer term costs.

**3. Societal costs of stroke and potential returns from implementing what we know works**

Finally, there is already evidence of interventions that could bring benefits to the care sector and the wider population, but these are not yet fully implemented. We therefore estimated the potential future economic gains from implementing these interventions more widely.

**This executive summary highlights our estimates from Part 2: the current and future societal costs of stroke and potential to alleviate these through further investment in research. The executive summaries of parts 1 and 3 above are reported separately.**

# Methods

## Range of costs considered

We aimed to estimate the annual societal cost of stroke in the UK – now, in 2025 and in 2035. We report all costs at 2015 prices and have accounted for costs falling upon:

- the National Health Service (NHS)
- personal social services (PSS) e.g. care homes (public and private payers)
- informal (unpaid) carers such as family and friends
- broader society in terms of productivity losses associated with lost/reduced employment among stroke survivors.

## Broad approach to estimating current and future costs

1. We first estimated **average annual costs per person with either a new or previous stroke in 2015**, broken down into various categories of stroke survivors (by stroke severity, stroke type, age and sex). Our estimates of health and social care costs build upon recent high quality modelling work completed by others (NGC & SSNAP, 2016), which simulated average one- and five-year care costs for new-onset stroke using national data from the Sentinel Stroke National Audit Programme (SSNAP) and the South London Stroke Register (SLSR). We broke these numbers down further to differentiate between care costs in the first year following a stroke (stroke incidence) and costs in subsequent years (stroke prevalence). We also added estimates of the costs of informal care using appropriately adjusted data from two large stroke trials recently completed in the UK (Forster et al., 2013; Forster et al., 2015). One of these trials (Forster et al., 2015) also provided data on stroke survivors' changing employment status over the year following their stroke and we used this to estimate lost productivity. We applied national wage rates to these losses as a proxy for lost productivity to society.
2. To extend these costs beyond the individual level and gauge the magnitude of costs for the **UK population in 2015**, we combined these individual-level costs with up-to-date estimates from the literature on stroke incidence and prevalence for the UK population (see Patel et al., 2017).

3. Next, we projected these 2015 **UK cost estimates to future years**. We used a cell-based simulation model in Excel that accounted for likely changes in the following:
  - The demography of the UK population: 2014-based population projections suggest that between 2015 and 2035 the total UK population aged 45 and over will rise by 22.5% (Office of National Statistics, 2015).
  - Stroke incidence and prevalence rates (based on expert views; Patel et al., 2017).
  - Wages in health and social care services, since these services are highly labour-intensive (+2% per year in real terms; Office for Budget Responsibility, 2017).
4. Finally, since estimates based on multiple data sources, extrapolations and assumptions necessarily carry risks of estimation errors, we explored how the results would be affected by **alternative estimates and assumptions**. In relation to current costs, we firstly used statistical approaches to create more stable estimates of costs. We then in turn examined the impact of changing values related to incidence/prevalence rates, length of stay in a stroke unit/acute stroke unit following stroke, probability of thrombolysis in ischaemic stroke, probability of post-stroke unit community rehabilitation and care home admission, probability of death in stroke units and stroke recurrence. We also examined the impact of using alternative estimates for the value of informal care and lost productivity. In relation to the projections, we examined the impact of Office of National Statistics variant population projections, variant trends in stroke incidence and prevalence rates (based on expert views; Patel et al., 2017), variant trends in real average earnings in the care sector and in annual costs of care per person.

## Returns from further investment in research

Our process for eliciting expert views on research priorities and for estimating the potential savings associated with their top five priorities is outlined in the executive summary from Part 1 of this work (Patel et al., 2017).

## A note on our methods

Further caveats and assumptions made in our methods can be found in [Appendix 1](#).

# Results

## Stroke costs in 2015

### *Average costs per person*

The **average societal cost of stroke per person is £45,409 in the first 12 months** after stroke (cost of incident stroke), **plus £24,778 in subsequent years** (cost of prevalent stroke). The average cost of NHS and Personal Social Services (PSS) care in the first year after a severe stroke is almost double that for a minor stroke (£24,003 compared to £12,869). More generally, average NHS and PSS costs varied little between males and females, and between those with ischaemic versus haemorrhagic stroke, but were significantly higher for those aged 85 years and older compared to younger adults. However, lower informal care costs among older adults led to a balance in total average costs across age groups.

### *Aggregate costs for the UK*

In order to estimate the aggregate cost of stroke in the UK, we combined incidence and prevalence figures from literature (Rothwell et al., 2004; Wolfe et al., 2002; Stewart et al., 1999; Jagger et al., 2006; Geddes et al., 1996; O'Mahony et al., 1999) with current age-specific population figures (Office of National Statistics, 2015). Average estimated numbers of first time strokes and stroke survivors were 117,600 and 950,200, respectively (Patel et al., 2017). In aggregate terms this translates into a substantial **£25.6 billion attributed to stroke in the UK per year.**

Of note, we estimate that **£15.8 billion of this is the value of care contributed by informal/unpaid carers, which is almost double the NHS and PSS care costs of £8.6 billion.** Of the NHS and PSS costs, the cost attributed to NHS-funded care (including secondary care, early supported discharge and community rehabilitation) is £3.4 billion (13% of cost to society). Formal social care contributes more at £5.2 billion (20%). Although the majority of stroke survivors are of older age, lost productivity amounts to £1.6 billion per year.

### *Incidence versus prevalence*

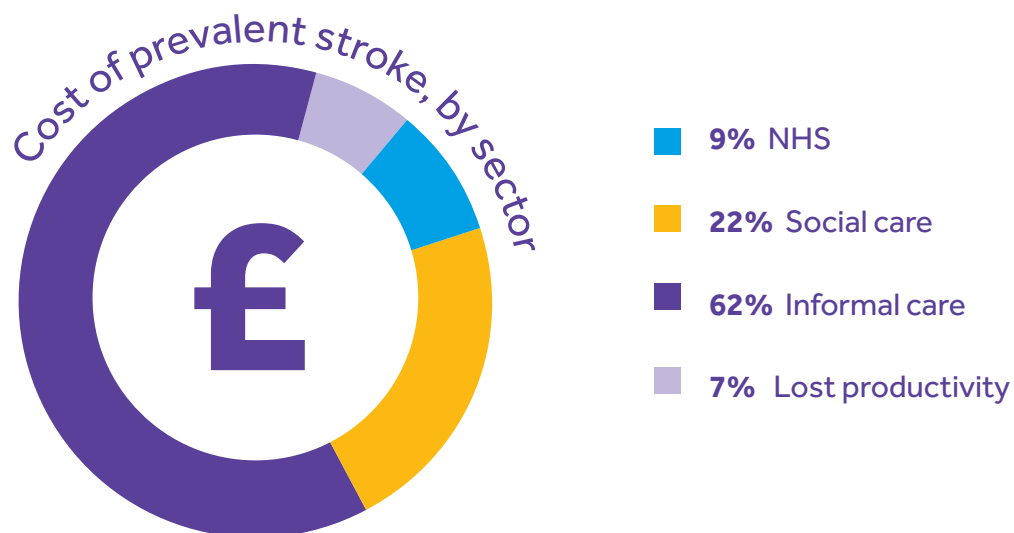
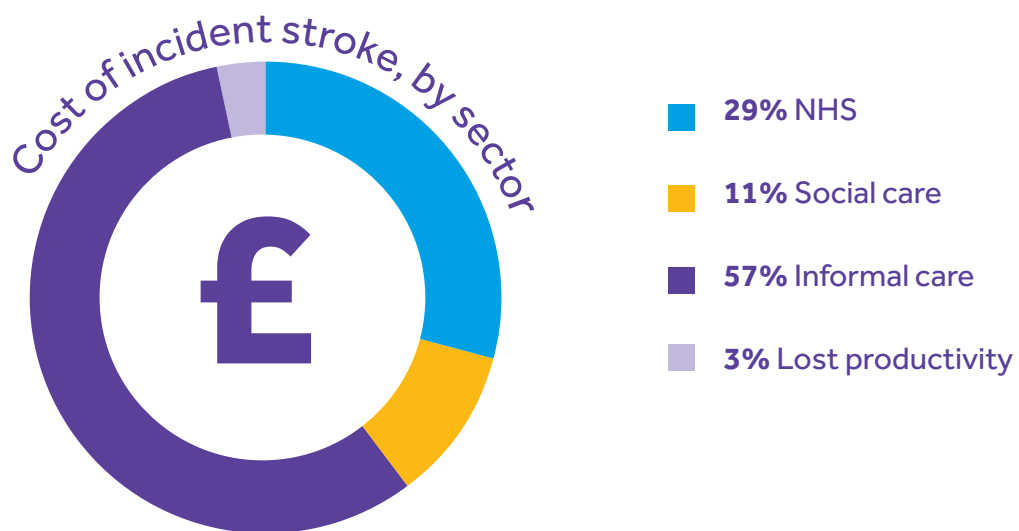
Figure 1 highlights how the economic burden falls upon different sectors of society and how this composition changes over the course of stroke. **The aggregate annual cost to society of new cases of stroke is £5.3 billion, of which £1.6 billion (30%) is NHS care.** As the majority of NHS care is received in the acute phase while the person is in hospital, NHS costs level off in subsequent years to 9%. In contrast, the contribution of formal social care increases from 11% in the first year after stroke to 22% (£4.6 billion) in subsequent years. Furthermore, **the informal care sector contributes a vast £12.8 billion per year in subsequent years, leading to an aggregate annual cost of £20.6 billion for prevalent stroke.**

The main driver for the difference in incident and prevalent stroke costs is the much larger number of stroke survivors (950,200) compared to new stroke cases each year (117,600).

### *Stroke costs in 2015 by country*

A breakdown of estimated, aggregate costs of stroke in England, Wales, Scotland and Northern Ireland can be found in [Appendix 2](#).

**Figure 1: Breakdown of costs for incident and prevalent stroke**



## Stroke costs in 2025 and 2035

We project that the overall costs of stroke in the UK for those aged 45 years and over will rise from £26 billion in 2015 to £43 billion in 2025 and £75 billion in 2035, an increase of 194% over 20 years, based on constant 2015 prices (Figure 2). There are several key drivers for such a substantial increase: first, predictions that the number of older people (especially those aged 85 years and over) in the population will increase substantially due partly to rising life expectancy and partly to the 'baby boom' cohorts reaching old age; second, our assumption that because care is highly labour intensive, the cost per hour of care will rise in line with average earnings, which in turn are expected to rise by 2% per year after accounting for inflation (Office for Budget Responsibility, 2017); and finally, the experts we consulted expect stroke survival rates to improve.

The cost increase comprises projected increases in health care costs by 201%, social care costs by 273%\*\*, informal care costs by 171% and lost productivity costs by 136%. The projected increase is highest for social care because of high use of social care in late old age by survivors of severe strokes. It is estimated that private social care costs will rise to a slightly greater rate than public costs: 278% versus 268% respectively.

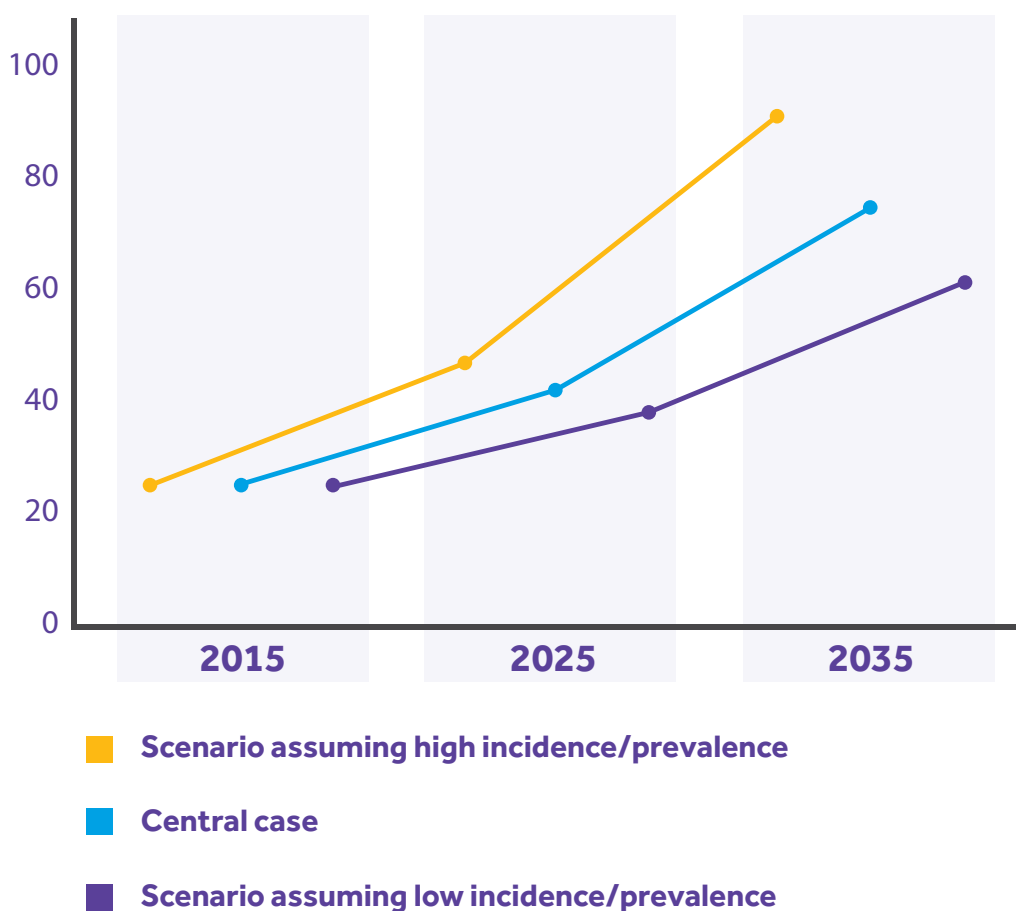
\*\*Social care costs include the costs of both publicly and privately funded care. As we do not have a source for the breakdown between public and private social care expenditure specific to stroke survivors, we draw from other projections for all older adults (Wittenberg and Hu, 2015). Publicly funded social care includes Personal Social Services net expenditure and expenditure funded by Attendance Allowance, but excludes NHS expenditure. Private expenditure includes user charges and privately purchased social care expenditure.

### Stroke costs in 2025 and 2035 by country

A breakdown of estimated, aggregate costs of stroke in England, Wales, Scotland and Northern Ireland can be found in [Appendix 2](#).

Figure 2: Change in aggregate costs over time

(£ billion; 2015 prices)



## Cost estimates under alternative assumptions

Varying the estimated annual incidence and prevalence of stroke over a range of literature-sourced estimates led to the aggregate societal cost of incident stroke in 2015 ranging between £3.9 billion and £6.7 billion and the cost of prevalent stroke ranging between £17.6 billion and £30 billion.

Altering healthcare-related values generated less variation, with the aggregate cost of NHS and PSS ranging between £8.1 billion and £9.1 billion. In contrast, changing estimates related to the value of informal care led to the aggregate cost of informal care ranging between £12.8 and £18.8 billion.

While our methodological approaches preclude estimating a formal confidence interval for aggregate cost, it is possible to gauge uncertainty surrounding this estimate by considering credible low/high ranges for mean cost together with the low/high ranges for incidence and prevalence rates mentioned above. On this basis, our lower bound estimate for the aggregate societal cost of stroke is £18 billion per annum and the higher bound is £43 billion. Following the same approach, the credible range for NHS and PSS costs only is £6.6 billion to 12.8 billion.

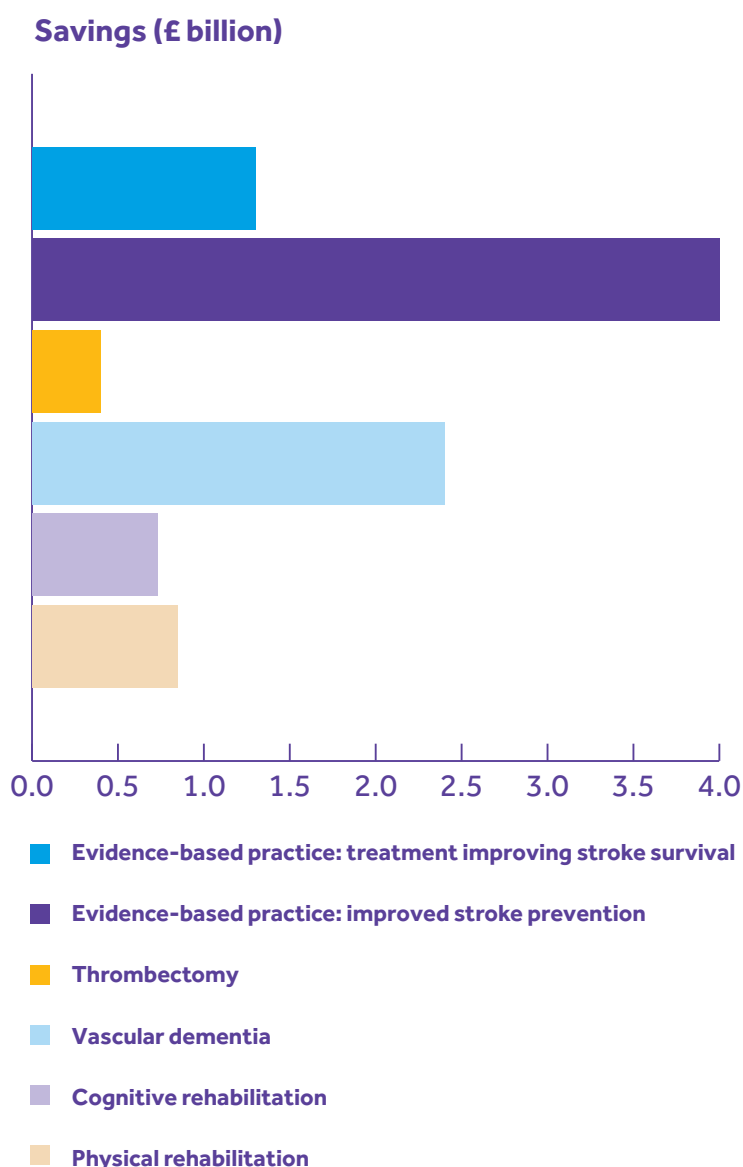
In summary, the **largest source of uncertainty for our estimates of current aggregate costs is the annual rate of stroke prevalence that we apply**, followed by the value we use for the average cost of informal care and the rate we use for annual incidence of stroke.

Changing our rates for trends in incidence, prevalence and costs of care per person show a wide range of cost projections. For example, higher or lower rates of future incidence and prevalence result in estimates of aggregate annual costs of stroke in the UK in 2035 rising to £91.5 billion or only to £61.8 billion respectively (Figure 2). Therefore, the total burden remains high even under more conservative assumptions.

## Returns from further investment in research

We estimate that investing in each of the top five priority research areas identified by stroke experts (Patel et al., 2017) could generate benefits that substantially reduce these costs by 2035 (Figure 3). Savings are greatest – approximately £4 billion – for research related stroke prevention.

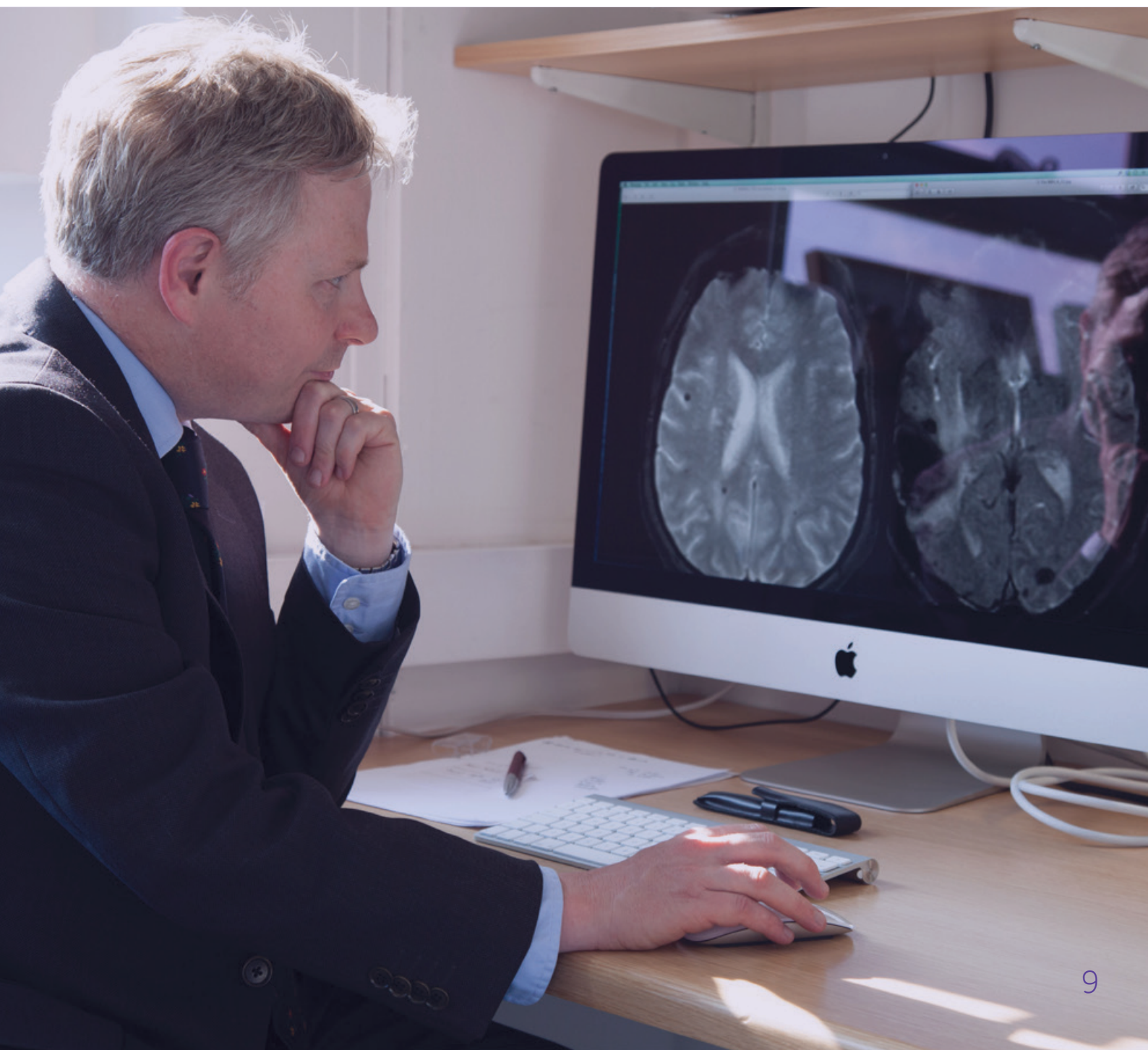
**Figure 3: Potential savings to societal costs of stroke in 2035 through £10 million investment in each priority research topic**





## Conclusions

- We estimated aggregate annual costs of stroke, now and over the next two decades.
- Our results point towards a substantial economic burden on society associated with stroke (£25.6 billion each year).
- Even accounting for the caveats related to our estimates, it is clear that informal carers are significant contributors to stroke care and that social care costs will increase substantially by 2035. Therefore, the burden of stroke extends well beyond that obviously shouldered by people with stroke and health care services.
- The economic burden of stroke will almost treble within 20 years, due to predicted rises in the number of older people in the population, the number of stroke survivors and costs of formal care. This will present real societal challenges in future. There is great potential to alleviate some of these costs through increased investment in research.
- It is clear that a condition that generates such a sizeable economic burden in the UK requires greater priority in care funding and policy support.



## Appendix 1

### A note on our methods

There are of course some caveats related to this work, the main being that we include projections for an unknown future. A significant uncertainty is the number of new strokes that are expected to occur each year and the number of people that will live with stroke. Experts have divergent views on this, and this uncertainty impacts on the cost predictions.

More broadly, 'costs of illness' studies like this are necessarily context-specific and can vary in their approach. For example, the data that are used reflect the availability/quality/outcomes of care at that point in time. Data availability is generally improving over time and estimates of aggregate costs are naturally influenced by the range of costs considered relevant or measurable. For example, our estimates of health care costs cover those relating to Accident and Emergency (A&E) departments, acute and regular stroke units and early supported discharge. These do not include any primary care costs or costs associated with other illnesses occurring at the same time as stroke (co-morbidities).

These variations naturally create challenges for drawing comparisons with other estimates.

To illustrate, our estimate of the aggregate annual cost of stroke is substantially larger than previously estimated by Saka et al. (2009). They estimated direct medical care costs at £4.4 billion compared to our estimate of £8.6 billion. More strikingly, they calculated informal care costs to be £2.4 billion per year, compared to our estimate of £15.8 billion. Such a difference may be driven by several factors. For instance, our data sources differed greatly: we used two large trials of post-stroke care as the basis of our calculations which, although detailed and from a national sample, may have included a more selective sample of people with stroke compared to the more localised but routine data source used by Saka et al. (2009) (the South London Stroke Register). Also, we applied hourly wages of a professional carer to those informal care inputs that related to personal care activities, which generates higher costs than if we assumed that all informal care inputs involve only an opportunity cost of time to carers.

While we use plausible estimates throughout this work, our extensive sensitivity analyses (detailed in the full report) clearly show that alternative values and assumptions can generate different specific estimates. As is the case for all cost of illness studies, our figures thus represent an indicative, rather than definitive, estimate of the economic burden of stroke. Estimates of returns from investment in research are similarly indicative.

## Appendix 2

### Projections of future costs of stroke – age 45 and over, by country and type of cost (in £million)

ENGLAND			
Cost (£million)	2015	2025	2035
Health care	2,983	5,189	9,015
Social care - Public	2,148	4,163	7,936
Social care - Private	2,403	4,733	9,130
Social care - Total	4,551	8,896	17,066
Unpaid care	13,675	21,453	37,300
Lost productivity	1,305	2,012	3,106
<b>Total</b>	<b>22,514</b>	<b>37,550</b>	<b>66,487</b>

WALES			
Cost (£million)	2015	2025	2035
Health care	133	226	379
Social care - Public	96	183	338
Social care - Private	108	208	388
Social care - Total	204	392	726
Unpaid care	613	929	1,549
Lost productivity	58	85	123
<b>Total</b>	<b>1,008</b>	<b>1,631</b>	<b>2,776</b>

## Appendix 2 - continued

### Projections of future costs of stroke – age 45 and over, by country and type of cost (in £million)

SCOTLAND			
Cost (£million)	2015	2025	2035
Health care	213	361	615
Social care - Public	152	285	542
Social care - Private	170	324	624
Social care - Total	323	610	1,166
Unpaid care	988	1,515	2,574
Lost productivity	97	149	218
<b>Total</b>	<b>1,620</b>	<b>2,634</b>	<b>4,572</b>

NORTHERN IRELAND			
Cost (£million)	2015	2025	2035
Health care	64	114	203
Social care - Public	45	89	178
Social care - Private	50	102	204
Social care - Total	96	191	382
Unpaid care	296	480	852
Lost productivity	29	48	74
<b>Total</b>	<b>484</b>	<b>832</b>	<b>1,510</b>

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We'd especially like to thank Legal & General for their generous support that made this report possible.



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