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Keywords

Dementia, costs of dementia, economic sustainability, Alzheimer's Disease, long-term care financing

Disciplines

Economics

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Alzheimer's Disease and Other Dementias**

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Building on Hope or Tackling Fear? Policy Responses to the Growing Costs of Alzheimer's Disease and Other Dementias

Dementia is a syndrome caused by a collection of progressive illnesses associated with an ongoing decline of brain function. The most common forms of dementia are Alzheimer's disease and vascular dementia. Symptoms vary somewhat by disease, but generally involve changes in cognition, personality and behaviour, and people at the more severe stages require high levels of care and support, resulting in large costs.

A huge increase in the numbers of people living longer is a great achievement for humanity, but it has also brought with it important challenges. One of these is that the numbers of people living with dementia are growing at rapid speed and scale. It has been estimated that the numbers of people living with dementia worldwide will grow from 46 million in 2015 to 131.5 million by 2050 (Prince et al. 2015), and that the societal costs of dementia will have reached one trillion dollars globally by 2019 (Wimo et al. 2017).

Dementia Policy Choices

There are many reasons why policymakers are paying increasing attention to dementia. It is a condition with multiple and interdependent impacts: it can affect people's ability to live independently, perform self-care tasks, keep themselves safe, participate in society, continue in the labor market,¹ control their own finances, and it also affects others, usually family members, who often provide care and support for very long hours and may give up or reduce their paid employment in order to provide care, and whose own health may be compromised. This multiplicity of impacts also means that dementia policy spans multiple government departments, and there is a wide range of stakeholders that can potentially have an interest in, and be part of, decision-making processes.

These multiple impacts also mean that there are many policy choices that can be made to address dementia, including: encouragement (financial, regulatory and/or through research infrastructure) of the search for disease-modifying treatments for the causes of dementia; public health approaches to risk-reduction; legislation to protect the rights of people living with dementia; reforms to reduce the financial risk associated with needing (and providing) long-term care for extended periods; policies to improve health and long-term care system responses; policies to encourage the development of technological solutions; policies to reduce stigma and promote the social inclusion of people with dementia; and legal instruments to address the implications of loss of capacity (Binstock et al. 1992; Blank 2019; OECD 2015; WHO 2017).

An added complexity to policymaking in dementia is that policy decisions must be made in the face of great uncertainty and a relatively weak evidence base. There is uncertainty, for example, about the nature of the underlying diseases,² making it almost impossible to estimate the probability that investments in finding disease-modifying treatments will be successful. There is also uncertainty about the future costs of care, which means that traditional insurance mechanisms may not be suitable when one cannot estimate risks accurately (Barr 2010).

Additionally, the evidence base available to policymakers on dementia is limited. The health and care programs in most countries lack information systems that identify people with dementia and allow monitoring of their situation and the outcomes of their care (OECD 2018). In many countries, governments also lack population surveys providing basic data on, for example, how many people have dementia and how they are cared for, as highlighted in the country summaries of the World Alzheimer Report 2016 (Prince et al. 2016). The research evidence base on non-pharmacological aspects of care treatment and support is weak, particularly for low and middle-income countries, although it is improving (Alzheimer's Disease International 2018; Livingston et al. 2017; Pickett et al. 2018; Prince et al. 2016;

Salcher-Konrad et al. 2019; WHO 2017). Pickett and Brayne (2019) analysed dementia research investment between 2011 and 2016 in Canada, France, Germany, Italy, the United Kingdom and the United States. They found that, in that period, dementia research spending grew by nearly 140 percent, reaching 1,374 million euros in 2016, which represented 0.34 percent of the societal costs of dementia in those countries. They also found that most of this research funding was focused on biomedical research, with only 4.9 percent of the spending focused on health and social care research (Pickett and Brayne 2019).

While dementia advocacy groups focus on getting governments to commit to dementia-specific policies, addressing some of the major impacts of dementia require policies that are broader in scope. For example, reducing the risk of dementia at the population level may require addressing broader economic inequalities. Ensuring better health care for people with dementia may require wider reforms of health care systems to improve the resources available for the management of non-communicable diseases and chronic conditions. Addressing workforce shortages in dementia are a key issue for the health and care sectors, and for the economy as a whole. Addressing the risk that the costs of dementia may be catastrophic requires addressing the financing of the long-term care system.

Dementia as an Economic Concern

The high costs of dementia are often cited as a motivation for policy action and used by advocates to draw attention to the condition. For example, the World Health Assembly's global action plan on dementia mentions the financial costs of dementia in its second paragraph (World Health Organization 2017). Advocacy groups have frequently commissioned research to estimate the costs of dementia: for example, see the Alzheimer's Society for the UK (Prince et al. 2014), Dementia Australia (Brown et al. 2017), and Alzheimer's Disease International (Prince et al. 2015). An emphasis on high costs (sometimes referred to as 'economic

catastrophism’) has been particularly strong in the context of making the case for investment in biomedical research to find a disease modifying treatment. For example, at an international Dementia Forum event, the US Alzheimer Association CEO, Harry Johns (2019), was quoted on Twitter as saying, ‘We have increased funding in dementia research by convincing Congress that the cost of dementia is not sustainable’.

Economic concerns surrounding dementia have been identified as including the impact on national economies (in terms of impact on government spending and on economic growth), the impact on individual finances, and the costs and benefits of different types of care (Keen 1993).

Of course, the economic impact of dementia depends on wider economic trends. Changes in economic growth may affect the amount of public spending on health and care services, for example following the Great Recession, and despite growing demand for services, the UK’s public expenditure on adult social care fell in real terms from £22bn in 2010-11 to £20.23bn in 2014-15 (Bottery et al. 2019). Changes in labor markets will also shape the capacity to respond to dementia: in many countries, there are already major difficulties in the recruitment of health and social care workforce, and these difficulties are expected to become much larger in the near future (OECD 2016).

Dementia Costs and Sustainability

It is common to see academic articles and advocacy arguing that, because the costs of dementia are high and expected to grow substantially, they are unsustainable. Yet equating high (and growing) costs with being unsustainable is incorrect, as sustainability does not depend on the size of costs alone.

Thomson et al. (2009), when discussing the sustainability of health financing, argue that spending on care would be *economically sustainable* up to the point at which the societal

costs of care exceed the value produced by that expenditure. So, if spending on dementia care sufficiently threatened other valued areas of economic activity, then dementia care would be considered to be economically unsustainable. They also discuss fiscal and political sustainability. *Fiscal sustainability* relates specifically to public expenditure and how that compares to public revenue. Those authors further explain that fiscal sustainability can typically be addressed in three ways: (1) increasing public revenue to meet the desired level of public spending on care; (2) reducing public spending to the level that can be met by public revenue; and (3) improving the capacity of the care systems to convert resources into value. From a political perspective, sustainability requires that the way in which the government allocates public resources is in line with voters' expectations. From this *political sustainability* perspective, it could even be argued that current public spending on care for people with dementia is too low in many countries, particularly for social care in the UK, where there appears to be consensus on the need for a long-term care financing reform that increases the role of public funding, even if political consensus remains elusive as to the shape of the reform.

It is also interesting to observe that many who seek to emphasize the large scale of the costs of dementia present estimates of the societal costs of dementia (which include the opportunity costs of unpaid care) as a percentage of Gross Domestic Product (GDP), when GDP only includes formal (paid) economic activity. The correct comparison, between the percent of GDP and the formal costs of care, would be less dramatic.³

In practice, economists have often drawn attention to the fact that formal costs of health and social care in relation to dementia are only a relatively small part of GDP. For example, a US report from 1991 entitled 'Alzheimers: Could it bankrupt the health care system?' included an interview with Joshua Wiener, who had carried out estimates of future long-term care expenditure:

'Joshua Wiener, a long-term care specialist with the Urban Institute's Health Policy Center in Washington, is sceptical of claims that more Alzheimer's cases will cripple

the health-care system. He estimates inflation-adjusted spending on long-term care will roughly double from 1993 and 2018, from \$75.5 billion to \$168.2 billion, adjusted for inflation. But, assuming modest economic growth, that will only account for about 2.2 percent of the gross domestic product. “It's a sizable increase, but I don't know if it's the end of civilization as we know it,” Wiener says’ (Bettelheim 1991).

Dementia Workforce and Sustainability

Concerns about sustainability of dementia care are also expressed in relation to the future availability of formal health and social care workers and unpaid carers (OECD 2015). In most middle and high-income countries, the population who would traditionally be of working age is rapidly decreasing in size, compared to those needing care due to dementia or other age-related conditions. While in other sectors it is expected that automation will help reduce demand for labor, it is unlikely that this will happen to a significant extent in the care of people with dementia (Knapp et al. 2015; Pissarides 2018; Goodhart and Pradhan 2020).

As Goodhart and Pradhan (2020) explain, there is also a risk that large increases in the population that require care will require the redirection of an already shrinking labor force towards providing care. As the care sector is considered to have little potential for productivity growth, a shift of labor towards this sector would be expected to result lower productivity growth (Ngai and Pissarides 2007; Pissarides 2018). Nevertheless, automation means that there many jobs in other sectors that will cease to exist. Pissarides (2018:4) argues that the pay and social respect of jobs in the care and services sectors will need to change so that they become ‘good jobs’ if society is to win the ‘war against the robots.’

Other Potential Economic Impacts of Dementia

There are other effects of dementia on the economy that can, at least in part, be attributed to the ways in which care systems are financed and organized. The first is that the absence of well-functioning collective mechanisms to pool the risk of incurring high costs of care as a result of dementia or other conditions may generate distortions in financial planning.

Individuals may over-save in an attempt to make sure that they have enough savings to cope with the highest possible costs of dementia, and reduce their consumption (Barr 2010), or people may put themselves at financial risk by spending down their savings and assets in order to qualify for public care where these are means-tested.

Another outcome that can result from the insufficient availability of good quality, affordable formal care and strong social norms, is the pressure on women to reduce or give up their employment when a relative requires care. As the educational attainment and labor force participation of women increases, the opportunity costs of women giving up paid work in order to provide care grow. This means that lack of opportunities to stay in the labor market by not being able to obtain replacement care (see Brimblecombe et al. 2018) may increasingly result in an inefficient use of human capital. As Korfhage (2019) shows in his analysis of the impact on lifetime earnings and social insurance entitlements of carers who have left employment in Germany, the opportunity costs are much higher at younger ages and at the higher end of the income distribution.

How Much Does Dementia Cost, and How Much Will It Cost in the Future?

There is no standardised methodology on how to estimate the present and future costs of dementia, and studies that produce these estimates do not always seek to answer the same research and policy questions. In practice, because demographic change is driving projected costs, most projection studies find that the costs of dementia will double or treble over the next 20 or 30 years. For example, in England, the costs of dementia have been projected to rise from 23 billion GBP in 2015 to 80.1 billion by 2040, an increase of nearly 250 percent (Wittenberg et al. 2020). Globally, the costs of dementia were estimated to grow from \$818 billion in 2015, to \$1 trillion by 2018 and \$2 trillion in 2030 (Wimo et al. 2017).

These projections models usually use as a baseline a cost of dementia study which, typically, seeks to include all the costs of dementia to society, the direct costs of medical and long-term care services, and at least some indirect costs (usually estimates of the costs of unpaid care) (El-Hayek et al. 2019; Wimo et al. 2017; Wittenberg et al. 2019). A recent review by El-Hayek et al. (2019) set out to consider all the potential costs of dementia and the methodological difficulties in properly measuring them. This work suggested that, in practice, most studies leave out significant costs, such as, for example, the costs of care for the period before dementia is diagnosable.

While differences in the methodologies used in projections of dementia costs studies are often due to data limitations, an important source of differences is also the fact that each poses different research and policy questions. This section considers five policy questions that may be answered using models of future costs of dementia and gives some examples of studies that have sought to address them:

What resources are needed to ensure that the availability of care matches expected changes in demand, and what resources are needed to deliver improved care, treatment, and support? Most cost of dementia studies fall into this group. They usually measure the impact of demographic change and sometimes also of expected epidemiological changes, on the future demand for care, treatment, and support for people who have dementia. They usually implicitly assume that the unit costs of care will rise in line with wages, and that this will guarantee that the supply of services will increase to meet demand (Wittenberg et al. 1998). The studies may also investigate the impact of other expected changes, for example, in the expected supply of unpaid care, improvements in access to care and, in some cases, the impact of different ways of financing care. These studies increasingly attempt to take a societal approach by including the costs of unpaid care. Many of these studies highlight the increase in resources needed by reporting the costs of formal medical and long-term care as a percent of

Gross Domestic Product. In England, for example, it was estimated that the health and social care costs for people with dementia would rise from 0.8 percent of GDP in 2015 to 1.9 percent in 2040 (Wittenberg et al. 2019).

It has been estimated that, globally, 40 percent of the costs of dementia are due to unpaid care, 40 percent to formal long-term care services, and 20 percent to medical care (Wimo et al. 2018). Yet, it is difficult to compare the fractions across studies, due to differences in methods and data used (particularly to estimate the costs of unpaid care), and also due to different definition of boundaries between types of expenditure (particularly between medical/health care and long-term/social care). Relatively few studies report on the balance between publicly and privately financed care.

What would be the impact of new dementia treatments and prevention strategies?

Simulation models can be used to estimate the costs impact of a modifying treatment for Alzheimer's Disease and other forms of dementia, or of successful risk reduction strategies. This has led to an increase in models based on studies that aim to separate the costs of care, treatment, and support attributable to dementia, from costs that are due to other conditions, usually by comparing the service use of people with dementia to those of the same age and gender who do not have the disease (Hurd et al. 2013; White et al. 2019). One difficulty with these models is that usually they implicitly assume that the risk of developing dementia is independent from the risk of having other health conditions, an assumption that is not well supported by epidemiological evidence (Bunn et al, 2014).

As the effects (and costs) of possible new drug treatments are not yet known, the models that simulate their impact are hypothetical, but they can be used, for example, to estimate the maximum price at which, given certain assumed effects, the new drugs would be cost-effective (Anderson et al. 2018).

When estimating the impact of changes in the course of the diseases, it is possible that new treatments for Alzheimer's Disease and prevention strategies may result in increased longevity and could eventually lead to higher overall health and care costs, particularly if they slow progression. For example, a simulation model in the US showed that reducing the incidence of some of the risks that have been identified as being associated with dementia, such as diabetes and hypertension, could eventually lead to higher numbers of people living with dementia as a result of increased longevity (Zissimopoulos et al. 2018).

What will be the fiscal implications of dementia? There are relatively few studies that specifically analyze the fiscal implications of dementia. The ones that do typically estimate the projected costs of the benefits paid out by the social insurance system as a result of dementia, under current entitlement rules, and then they compare these to the projected growth in insurance contributions. As a result of these analyses, recommendations can be made to address the sustainability of the social insurance system which may result in increases in the social insurance contributions or the proportion of the costs of care met by taxes. Examples are analyses that were carried out to assess the implications of a major reform of the German Long-Term Care Insurance system in 2017, which extended the coverage of dementia as a result of consensus that existing eligibility criteria left out people with dementia and also that the levels of benefits were too low. The reform increased access to benefits for people with dementia and the size of the benefits available to them, but it also increased the contribution rates to 2.55 percent of gross income (Doetter and Rothgang 2017; Häcker et al. 2009; Mosca et al. 2017; Nadash et al. 2018).

Analyses of fiscal sustainability will not usually focus on dementia specifically, but its costs will be included in, for example, long-term forecasts of public spending, as in the UK's Office for Budget Responsibility (2018) report. The European Commission regularly produces an Ageing Report which analyses the fiscal impact of public spending on ageing-related

programmes (European Commission Economic Policy Committee 2018). The European Commission's analyses show that, while demography is an important driver of future costs of care, the generosity of the public system is an even more important determinant of future costs.

While most of the debate on sustainability focusses on the costs of publicly funded services, there is increasing awareness of the fiscal impact of the provision of unpaid care (particularly where carers withdraw or reduce their involvement in the labor market). Pickard et al. (2018) estimated that the public expenditure costs of carers leaving employment in England in 2015/16 amounted to £2.9 billion a year (£1.2 in forgone taxes and £1.7 in benefits). This did not account for longer term impact of workers' difficulties returning to employment when the care episode ended. The cost of publicly funded formal long-term care in England in the same year was estimated to be £15.3 billion (Wittenberg and Hu 2015). In Germany, Korfhage (2019) has analysed the fiscal implications of reduced tax and social insurance contributions as a result of unpaid carers withdrawing from the labor market: he showed that they then faced labor market frictions when they attempt to join the labor market again when the care episode ended.

What will be the impact of dementia on the economy? A recent study for different regions in Japan suggests that the impact of labor market reductions as a result of dementia and stroke (due to people of working age developing these conditions and to unpaid carers withdrawing from the labor market) amounted to one percent of GDP. The impact was slightly mitigated in regions with higher investment in R&D and higher private capital stock (Taghizadeh-Hesary et al. 2020).

What is the financial impact of dementia at individual or family level? The lifetime costs of dementia, from diagnosis to the end of life, have been estimated to amount to \$321,780 in 2015 US dollars. Of these, 70 percent were costs incurred by families, 14 percent by Medicaid and 16 percent by Medicare (Jutkowitz et al. 2017). In the absence of strong mechanisms to

share the risk of high costs of dementia among the population, these costs can have a very significant effect on a family's wealth and amplify economic inequalities. For example Kaufman et al. (2018) estimated that, in the US, dementia was associated with a loss of 97 percent of wealth among black Americans, compared with a 42 percent loss among non-black Americans. Their study did not find substantial differences in losses of wealth between families unaffected by dementia.

Unpaid carers who have left employment also face significant lifetime costs, in the US, Skira (2015) estimated that, for women in the mid-50s who exited work to provide care for a parent for two years, the median forgone income was \$51,780.

Responding to Dementia as an Economic Concern

Policy responses to concerns about the growing economic costs of dementia can be broadly classified into two categories: policies to try to reduce or contain the costs of care (which could be considered hopeful policies), and policies to ensure that health, long-term care, and social protection systems are able to deliver levels of care and protection from risk that are in line with social expectations (policies to reduce fears).

Policies to Attempt to Reduce or Contain the Costs of Care. These policies seek to reduce the size of the challenge posed by dementia, through a hopeful future vision of success in biomedical research, healthy ageing, technological innovation, and the adoption of cost-saving interventions.

Such policies may be particularly appealing to policymakers because research into new treatments and risk reduction policies hold the promise of a future free of one of the most feared health conditions (Alzheimer's Disease International 2019; Bond et al. 2005; Burke 2017; Evans 2018; Kessler et al. 2012; Peel 2014). Also, the hope that investment in research and development will have positive externalities that contribute to economic growth can play a role

in such policies finding favour with policymakers. Particularly in times of austerity, policymakers may also see these policies as a way to avoid having to make more difficult policy decisions such as, for example, addressing the financing of chronic health care and long-term care.

The evidence base for cost-effective (and even some cost saving) care, treatment, and support interventions is growing (Knapp et al. 2013; NICE 2018; Nickel et al. 2018). The evidence so far suggests that, for persons living with dementia, treatment with the existing anti-dementia drugs (Donepezil and Memantine) (NICE 2018), physical exercise, occupational therapy and cognitive stimulation therapy (Knapp et al. 2013; Nickel et al. 2018), some types of dementia care management (Michalowsky et al. 2019; Vroomen et al. 2016), and a person-centered care and psychological intervention for people in nursing homes called WHELD (Ballard et al. 2018), can be cost-effective. For dyads of persons with dementia and their care partners, self-management group rehabilitation and cognitive behavioural therapy are also cost-effective (Nickel et al. 2018). For carers, a manual-based individual coping programme (START) and an education and support intervention also seem cost-effective (Nickel et al. 2018).

This evidence base suggests that policymakers can potentially make more efficient resource allocations by making sure that these cost-effective interventions are made more widely available and, where possible, replace other interventions and approaches unsupported by evidence.

Policies to Increase the Capacity of Health, Long-term Care, and Social Protection Systems to Respond to Dementia. Fears around dementia are also linked to the perceived lack of good quality services to deliver care, treatment, and support, to concerns about being a burden to one's family, and to the fear of losing all savings and assets (Evans-Lacko et al. 2019). An assessment by the Organisation for Economic Co-operation and Development

(OECD 2018) concluded that most OECD countries are poorly equipped to identify dementia and uncovered evidence of poor quality of care in most countries, particularly for people with advanced dementia.

Policies needed to address these fears are wider than dementia, encompassing the medical, long-term care, and social protection sectors. They tend to require strong political champions and building consensus across different political groups and stakeholders, which in many countries can take considerable time. In Germany, the establishment of the mandatory Long-Term Care Insurance system took two decades of political debate, which eventually led to consensus across all the major political parties, the unions, employers, and sickness funds as well as private insurers (Götze and Rothgang 2014). In the UK, potential reforms of the public long-term care financing system have been under discussion since at least the 1990s.

Tackling the structure of health and care systems. The models of dementia health care predominant in high-income countries and in some low and middle-income countries, are reliant on the role of specialist care, but in most countries there are already shortages of dementia specialists, usually neurologists, old-age psychiatrists, and geriatricians (Hlávka et al. 2018). To respond to increasing numbers of people living with dementia, alternative models of dementia health care based on primary care and specially trained health workers could potentially be expanded to deliver similar quality of care to larger numbers of people, at a lower cost per person (see Prince et al. 2016).

It is also likely that the models of long-term care delivery that have developed in most high-income countries during the 20th century will need to change. The sharp divisions between ‘health’ and ‘social’ aspects of care is becoming increasingly obsolete, particularly as the proportion of older people with functional dependency but no other chronic conditions will decline, and the growth in future care users that are rising faster are those with dementia and three or more chronic conditions (Kingston et al. 2018). Long-term care systems will

increasingly need to ensure that family and other unpaid carers do not need to give up their jobs in order to provide care, which could see a renewed focus on models of replacement care and care leave policies (Brimblecombe et al. 2018). This would mirror policy developments seen in relation to childcare in many countries. There is also growing interest in innovative care models, including new approaches to more attractive day care and housing with care models, and better integrated services in the wider communities.

Addressing the workforce challenge. The care sector has the opportunity to attract workers that, due to technological change, are no longer able to work in their previous jobs. Yet this transition will need to be carefully managed, not least because most of those workers would have experienced higher levels of pay and better working conditions than those currently working in the care sector.

More innovative approaches to group care may have the potential to offer more attractive environments both for staff and care users, with the potential to use at least some economies of scale to deliver care more oriented to rehabilitation, social participation, and better rooted in the local community.

Tackling the financing of care. Without collective risk pooling mechanisms that cover the whole population for the risk of catastrophic costs of long-term care as a result of conditions such as dementia, universal health coverage cannot be achieved. While some countries have been able to offer this (for example the Scandinavian countries), many others have either added long-term care to existing social health insurance schemes or developed separately financed long-term care social insurance systems. There are also still a few high-income countries where there has not been sufficient political and social support for universal coverage of long-term care needs. Both the UK and the US have public systems that only cover those lacking the means to pay for their own care. In the case of the US, those without pre-existing conditions who have high incomes may be able to buy private long-term care insurance. In the UK, the

market for private long-term care insurance is virtually non-existent (Comas-Herrera et al. 2012). At least in the UK, there is growing recognition that the public expectations and public policies on care are at odds. After many decades of debates on how long-term care funding should be reformed, there is at least consensus that reform needs to happen, even if consensus about the type of reform has not yet been achieved.

Conclusion

‘Hopeful policies’ that support research on understanding the nature of the conditions that result in dementia, promote dementia risk reduction, and encourage technological care innovations have their place. Yet, they do not remove the need to address the more difficult policy decisions on how to ensure health, care, and social protection systems can deliver care, treatment, support and financial protection for people living with dementia in line with public expectations and preferences.

Many barriers that policymakers encounter when seeking to address the capacity of care and social protection systems appear to be linked to concerns about the size of public spending and its potential impact on economic sustainability. As this review highlights, the economic impact of dementia needs to be considered in a wider economic and political context. At a time of increased automation in many other sectors, the care sector could benefit from policies that facilitate transitions from workers from other sectors, as well as improving current models of care and adopting cost-effective interventions.

As the numbers of people living with dementia grows, so do the numbers of people with personal experience of the implications of this condition to both the individuals themselves and their families. Thus, there is likely to be increased awareness of the limitations of current health, care, and protection systems. Unless these systems are able to reflect societal norms and expectations, they too will become politically unsustainable.

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Endnotes

¹ Not all people who develop dementia are over retirement age.

² Only recently a new form of dementia, LATE, has been identified. This form appears to mimic Alzheimer's type dementia and it is suggested that this may explain why some recent trials for treatments of Alzheimer's disease have not been successful (Nelson et al., 2019).

³ For example, Alzheimer's Disease International's (2015) infographic that represents the findings of their World Alzheimer's Report 2015 aims to illustrate the scale of the societal costs of dementia by stating that 'If global dementia care were a country, it would be the 18th largest economy in the world exceeding the market values of companies such as Apple and Google' (Alzheimer's Disease International 2015).