# Exploring the cost-effectiveness of a one-off screen for dementia (for people aged 75 years in England and Wales)

**Exploring the Cost-effectiveness of a One-off Screen for Dementia (for People Aged 75 in England and Wales): Exploring the cost-effectiveness of a one-off screen for dementia**

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**Key words**

dementia, diagnosis, screening, care, cost-effectiveness

**4 key points**

- An estimated 3,514 people could be diagnosed as a result of a one-off dementia screen for 75 year olds in England and Wales; 2152 of these would otherwise never receive a diagnosis, with the remaining 1362 being diagnosed earlier than they otherwise would be.
- Around 13,650 people without dementia may be mistakenly identified as potentially having dementia and referred for further diagnostic assessment, where it is assumed they will be identified as having no cognitive impairment, mild neurocognitive disorder or some other, potentially, treatable condition. Those refusing further assessment will remain uncertain of their diagnosis.
- Potential societal net costs associated with the screening programme of £236,012 were identified (thus making the screen almost cost-neutral), with figures ranging from net costs of £3,649,794 to net savings of £4,685,768 in sensitivity analyses.
- Within the scope of this study and available evidence, it was not possible to

address dynamic factors or quantify all possible harms, quality of life benefits or possible cost savings. A larger study would be required for this, requiring complex and innovative approaches for generating estimates

This article has not been published or submitted elsewhere.

The study used only data from publicly available administrative sources and published academic studies such that ethical approval was not required.

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**Structured abstract (250 words)**

Objective

This paper examines the numbers of people with dementia who could be diagnosed and the likely cost-effectiveness of a one-off screen for dementia for people aged 75 in England and Wales.

Methods

The study uses static decision modelling to compare a one-off screen for dementia with a no-screen scenario. Estimates for the model were drawn from systematic reviews, high quality studies and government and administrative sources. A panel of experts also advised the study.

Results

An estimated 3514 people could be diagnosed as a result of screening, 2152 of whom would otherwise never receive a diagnosis. The study identified societal economic impact of between £3,649,794 (net costs) and £4,685,768 (net savings), depending on assumptions. |

Conclusions

Our analysis suggests that screening could be cost-effective, especially as treatments and social care interventions become more effective, and if diagnosis by current routes remains low or occurs later than is optimal. This study was, however, limited by available evidence and a range of quality of life benefits, cost savings and potential harms could not be quantified. It was also beyond the scope of this study to consider dynamic factors such as repeat screening, mortality, disease trajectories or trends in the numbers of people with dementia. A larger study would be needed for this, involving more complex and innovative approaches to generating estimates for modelling. We did not compare population screening for people aged 75 to other methods for increasing diagnosis rates.

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## Background

An estimated 710,000 people have dementia in England and Wales, expected to increase to over 1.5 million by 2051 (Comas-Herrera et al., 2007). However, only 43.8% (311,000 people) have a formal diagnosis (Alzheimer's Society, 2012). In England and Wales, dementia care is guided by national dementia strategies (Department of Health, 2009, 2013a; Welsh Assembly Government, 2011) and clinical guidelines (NICE/SCIE, 2006a, updated 2011; 2006b). Although there are currently no disease-modifying treatments, timely diagnosis allows people with dementia and their families to plan ahead and potentially benefit from symptomatic treatment and support (NICE/SCIE, 2006a).

Increasing diagnosis rates is a key objective of UK dementia policy (Department of Health, 2013a; NAO, 2007; NAO, 2010). However, population screening is not

recommended. The UK National Screening Committee (UKNSC, 2009) argues that there is no early treatment capable of preventing or modifying the disease, inconclusive evidence on the benefits of early pharmacological interventions, no randomised controlled trials linking screening to reduced mortality or morbidity and currently inadequate post-diagnostic services and support. The Preventive Services Task Force in the US (Boustani et al., 2003) reached similar conclusions. Further reviews are imminent in the UK and the US, and in the US a randomised controlled study of dementia screening is due to report in 2016. There is currently limited evidence concerning the economic case for dementia screening (Knapp et al., 2013a; Cartmell, 2012; UKNSC, 2009; Banerjee and Wittenberg, 2009).

**Methods**

This study uses static decision modelling to explore the cost-effectiveness of a one-off screen for dementia for people aged 75 in England and Wales, comparing this to a 'no screen' scenario. Such simulation modelling can be helpful when it is not possible to obtain primary data from a trial or observational study. It was beyond the scope of this study to consider repeat screening or dynamic factors such as mortality, disease trajectories, trends and patterns in unpaid and formal care, or trends in the numbers of people with dementia or associated risk factors. A larger study would be needed for this, with the limitations of available data likely to require complex and innovative approaches to generating estimates.

Model estimates were drawn from systematic reviews, high quality studies and government and administrative sources. These were identified through a rapid

review of effectiveness and cost-effectiveness evidence using key health, social care and economics databases (PubMed/Medline, Embase, PsycINFO, EconLit, Cochrane Library, Centre for Reviews and Dissemination), Google Scholar and key UK websites (e.g. National Institute for Health and Care Excellence (NICE), Social Care Institute for Excellence (SCIE), Alzheimer's Society and National Audit Office). The analyses in this paper are subject to the limitations of available data and research evidence, which we critically discuss. We use conservative estimates throughout and conduct sensitivity analyses. To assist in interpreting the evidence, a panel of experts also advised the study.

The time frame for the model is lifetime to include interventions delivered across the course of the disease trajectory and savings associated with delay to residential care. A societal perspective is taken, covering costs and savings to public services and private individuals. Costs for screening and diagnosis are assumed to fall to primary and secondary health services, and the costs of interventions to health or social care budgets. Identified savings relate to delay to residential care admission, purchased through a mix of public (70%) and private (30%) funding (NAO, 2007). Costs and savings are adjusted to 2012 prices, with future costs and savings discounted at a rate of 3.5% in line with UK Treasury guidance (HM Treasury, 2013).

## Model structure and assumptions

### Screening and diagnosis

Of 391,400 people aged 75 in England and Wales, an estimated 4.3% (16,682 people) have dementia (ONS 2011; Knapp et al., 2007; MRC CFAS, 1998). By adjusting the overall diagnosis rate, 43.8% (for England and Wales combined) (Alzheimer's Society, 2012a), for age-related prevalence, we estimate that 39.9% of people aged 75 with dementia (6,657 people) will have a diagnosis and that the remaining 10,026 are undiagnosed.

We assume screening is administered by clinical nurses and GPs (ratio of 3:1) during a standard 15-minute appointment in a primary care setting, although potentially screening could take place during a general health check or other secondary care appointment. Estimated cost is £32.50 per person (Curtis, 2012). We assume 19% refusal based on a survey of primary care patients in the US (Holsinger et al., 2011). Although various cognitive tests exist, we selected the Mini-Mental State Examination (MMSE) as it is widely used in clinical and research settings (Harvan and Cotter, 2006).

Although not previously used for population-level screening, we assume the MMSE has 89% sensitivity and 95.5% specificity (Harvan and Cotter, 2006), using a cut-off of 23/24 points (or equivalent adjusted for age and education). The model thereby focuses on identifying problems people are already experiencing which are not yet classified as a medical problem, rather than on identifying asymptomatic patients or those with mild cognitive impairment (recently re-classified as mild neurocognitive disorder; American Psychiatric Society, 2013). Those who are identified as potentially having dementia but who do not undertake further diagnostic assessment will remain uncertain of their diagnosis. Those undertaking further diagnostic

assessment but not diagnosed with dementia will be identified as either having no cognitive deficit, mild neurocognitive disorder and then monitored (American Psychiatric Society, 2013; NICE, 2006a) or as having another, potentially treatable, condition. These pathways were not included in our modelling.

Formal diagnostic assessment involves an average two visits to a memory clinic or other specialist, with 75% receiving a computerised tomography (CT) or magnetic resonance imaging (MRI) scan (NICE/SCIE, 2006a), at an average cost of £540 per person (NICE, 2006b; Department of Health, 2012b). We assume 52% of people agree to further diagnostic assessment (Boustani et al., 2005). Boustani et al. (2005) found that people with higher MMSE scores were more likely to refuse further tests. However, we conservatively assume the same likelihood of having dementia in those refusing and accepting.

We assume that 38.7% of people in the non-intervention arm, as well as 38.7% of those remaining undiagnosed after screening in the intervention arm, would go on to be diagnosed through usual routes. This was modelled using the population point estimate for diagnosis of 43.8% and adjusting for estimated age-related prevalence and mortality.

Treatment and support

The study focused on the main forms of treatment and support recommended by NICE/SCIE (2006a), and for which the best evidence of effectiveness currently exists. These are:

- medications
- psycho-social interventions
- carer support, and
- psychological therapy for carers.

We assume everyone with a diagnosis accesses good quality support, although we know that currently this is not universally the case (Brayne et al., 2013; NAO, 2010; Department of Health, 2009; UKNSC, 2009). The model also includes no investment or transition costs. However, we recognise the need to 'scale-up' post-diagnostic support and the need for service, workforce and practice development (Department of Health, 2013).

Acetylcholinesterase inhibitors (Donepezil, Galantamine and Rivastigmine) and Memantine are prescribed for the 62% of people with dementia who have Alzheimer's Disease (NICE/ SCIE, 2006a; Knapp et al., 2007). NICE (2011), based on trial data availability, assume full treatment effects within 6 months. However, optimal duration of therapy remains unclear. We conservatively include costs for a 12-month treatment (Qaseem et al, 2008), which (covering medications and specialist consultations) are an estimated £815 per person.

The National Institute for Clinical Excellence (2011) estimate a consequent delay to residential care of 47 days. The cost of residential care for someone with dementia is an estimated £46.29 a day more than care in the community (Knapp et al., 2007; Alzheimer's Society, 2012b). Potential savings are therefore £2175 per person. Multi-component carer support is also associated with delay to residential care.

Rather than add savings associated with medications to those associated with carer support, we use only the larger of the two estimates for all individuals who receive benefits from both medications and carer support. We nonetheless include both sets of costs.

Following NICE/SCIE (2006a), we assume psychosocial interventions are offered to the 92% of people with mild-moderate dementia, focusing on cognitive stimulation therapy (CST) (Orrell et al., 2012; Woods et al., 2012). Available evidence is primarily based on CST as a group intervention, delivered, for example, in a day or residential care setting. We assume 75% take-up and, following Knapp et al. (2006), an 8-week duration at £300 per person. According to a recent Cochrane Review (Woods et al. 2012), benefits of CST include improvements in cognition (standardised mean difference (SMD) 0.48), communication (0.44 SMD) and quality of life (0.38 SMD). Many of those benefits continue with maintenance CST delivered for a further 24 weeks (Orrell et al. 2014). However, no cost savings could be readily attached to these clinical or quality of life outcomes.

For carers, NICE/SCIE (2006a) recommend multi-component support. NICE/ SCIE (2006b) assumes 0.85 carers for each person with dementia and a 75% take-up rate. Drawing upon a high-quality, uniquely long (9.4 years), randomised controlled trial of a carer support programme for spouses of people with dementia in the US (Mittelman et al., 2006), we assume an average 10 hours of counselling and support across the programme at a cost of £475 per person (Mittelman et al., 2006; Curtis, 2012).

Mittelman et al. (2006) found a median delay to residential care of 557 days, with improved satisfaction with social support, improved response to behavioral problems and reduced symptoms of depression accounting for 61.2% of this effect. Pickard et al. (2012, p. 541), using 2007 data, identify that 36% of people aged 75 and over, with disabilities and in receipt of informal care, receive care from a spouse or cohabitee and 10% from a co-resident child. A further 38% receive care from a non-resident child (p. 539). We assume a full 557-day delay for those with a co-resident carer and reduced benefits (20% of the full rate, 112-day delay) for those with a non-resident carer. We assume that 18% will drop out early and conservatively assume these receive no benefit at all (Mittleman et al., 2006). The average cost of care in the community for someone with dementia is £46.29 a day less than in residential care (Knapp et al., 2007) and benefits are realised up to three and a half years later (Mittleman et al., 2006).

Finally, NICE/SCIE (2006b) estimate that one-third of carers experience

psychological distress. The average cost of a course of therapy is estimated at £412 per person (NICE/SCIE, 2006b). Benefits include measurable reductions in depression (0.66 SMD) and anxiety (0.21 SMD) (Vernooij-Dassen et al., 2011). This is likely to result in cost savings associated with less need for treatment for depression and anxiety, although these could not be readily quantified.

**Results**

*Screening and diagnosis*

There are 9,374 people aged 75 with undiagnosed dementia. In total, 311,114 people are screened at a cost of just over £10 million, 7,593 of whom have dementia. The screen fails to identify 11% of people (835) with dementia and mistakenly identifies 13,658 as potentially having dementia ('false positives'). In total, 20,416 people are identified as potentially having dementia of which, 6758 actually do. These are referred for formal diagnostic assessment and 10,616 people undertake the assessment at a total cost of £5,711,446. Overall, 3,514 people are diagnosed with dementia at a total cost of £15,842,079. A further 2266 people are diagnosed later through usual routes at a cost of £1,353,785. In the 'no screen' scenario, 3628 people are diagnosed through usual routes at a cost of £2,167,279.

*Medications*

The cost of medications is £2,923,778 (£1,777,520 for those diagnosed by screening and £1,146,257 for those diagnosed later). Savings associated with delay to residential care are £6,905,487 (£2,916,873 net of costs). In the 'no screen' scenario the cost of medications is £1,835,047 with associated savings of £4,334,082 (£2,499,035 net of costs). Net savings associated with the screening intervention are therefore £417,838. After adjusting for benefits received from carer support (i.e. including costs of medications but not including benefits of medications where someone receives both interventions), medications account for net costs of £1,942,392 in the model.

*Cognitive stimulation therapy*

The cost of CST is £1,191,911 (£724,627 for those diagnosed by screening and

£467,284 for those diagnosed later). The cost of CST in the ‘no screen’ scenario is £748,077. Measurable improvements in cognition (0.48 SMD), communication (0.44 SMD) and quality of life (0.38 SMD) are identified, but no cost savings could be readily attached to these outcomes.

*Multi-component carer support*

The cost of carer support is £1,750,965 (£1,064,505 for those diagnosed by screening and £686,460 for those diagnosed later). Savings associated with delay to residential care are £43,922,769 (£42,171,804 net of costs). In the ‘no screen’ scenario, the cost is £1,098,956 with associated savings of £27,567,193 (£26,468,237 net of costs). Net savings associated with the screening intervention are £15,703,567.

*Psychological therapy for carers*

The cost of psychological therapy for carers is £502,842 (£306,097 for those diagnosed by screening and £196,745 for those diagnosed later). In the ‘no screen’ scenario, the cost is £314,971. Reductions in symptoms of depression (0.66 SMD) and anxiety (0.21 SMD) are identified, but no cost savings could be readily attached to these outcomes.

*Overall cost-effectiveness*

There are 3514 people diagnosed through screening, 2152 of whom would otherwise never receive a diagnosis and 1362 who are diagnosed earlier than they otherwise would be. Taking into account the costs of diagnosing people through usual routes in both scenarios, the additional costs of screening are £15,028,586.

On the basis of included costs and benefits, the screening scenario (compared to the ‘no screen’ scenario) is almost cost neutral (£236,012 net costs). The screening scenario is also associated with measurable quality benefits (improved cognition, communication and quality of life for the person with dementia and reduced depression and anxiety for carers).

**Sensitivity analyses**

Results are particularly sensitive to the accuracy of the screening tool and the acceptability of screening and diagnostic assessment. To test the impact of these we conducted several one-way sensitivity analyses.

*Accuracy of screening tool*

Selected sensitivity and specificity figures for the MMSE are mid-points, based on a cut-off of 23/24 points (or equivalent adjusted for age and education), from ranges in a review by Harvan and Cotter (2006). Using higher end estimates of 92% and 99% respectively (Harvan and Cotter, 2006; Tangalos et al., 1996; UKNSC, 2009), the number diagnosed at screen increases to 7,592, false positives reduce to 3035 and estimated net savings increase to £3,177,617. Using lower-end estimates of 86% and 92% (Harvan and Cotter, 2006; O’Connor et al., 1989), the number diagnosed at screen reduces to 3,395, false positives increase to 24,282 and there are estimated net costs of £3,649,794. A recent systematic review for the US Preventative Task Force (Lin et al., 2013) gives figures of 88.3% sensitivity and 86.2% specificity for the MMSE. We have not used these figures since they are based on studies with a cut-off of up to 24/25 points and with wide variation in

average age, dementia prevalence and language used.

*Acceptability*

The acceptability of further diagnostic assessment (Boustani et al., 2005) is based on a study involving a predominantly Black-American population and might not be applicable in England and Wales. Acceptability of screening and diagnostic assessment could also increase as attitudes to dementia become less stigmatising (Department of Health, 2013) and treatment and support improves. If we assume the acceptability of screening increases from 81% to 90% and the acceptability of further diagnostic assessment increases from 52% to 75%, the numbers diagnosed through screening increase to 5631, there are 7,508 false positives and net savings of £4,685,768.

## Discussion

*Summary of findings*

An estimated 3514 people (3395 to 7592 in sensitivity analyses) could be diagnosed as a result of a one-off screen for people age 75 in England. The number of 'false positives' is sensitive to the accuracy of the screening tool and ranges, in sensitivity analyses, from 3,035 to 24,282 people. We assume that 'false positives' are referred for full diagnostic assessment and identified as having no cognitive deficit, mild neurocognitive disorder or another, potentially treatable, condition. Using conservative assumptions and focusing on the main symptomatic treatments and psychosocial support interventions recommended by NICE, screening was found to be almost cost-neutral (ranging between £3,649,794 net costs and £4,685,768 net

savings in sensitivity analyses). Measurable quality benefits (improved cognition, communication and quality of life for the person with dementia and reduced depression and anxiety for carers) were identified but it was not possible to attach an economic value to these.

*Limitations*

Available data and research evidence is limited. There are few independently funded trials of anti-dementia medications (Knapp et al., 2013a; Getsios et al., 2007), and evaluations of psychosocial interventions are frequently characterised by short follow-up periods, small or unrepresentative samples, lack of sub-group analysis, lack of evidence on how interventions interact, use of varied outcome measures and a focus on cognition rather than functional capacity, which is a better predictor of dependency-related costs (Knapp et al., 2013a; Cartmell, 2012; Jones et al., 2011; Hulstaert et al., 2009; Geldmacher, 2008; Brayne et al., 2007).

We used conservative estimates and assumptions throughout. For example, in the 'no screen' scenario people are, on average, diagnosed later and likely to benefit less from interventions that delay time to residential care. Nonetheless, we assume the same benefits for those receiving a diagnosis at whatever stage this occurs. We also assume that refusal of further diagnostic assessment is not associated with the presence of dementia although evidence suggests that those refusing are likely to have higher MMSE scores (Boustani et al., 2005).

The model also excludes a range of possible savings, including those already discussed, namely those associated with reduced depression and anxiety for carers

as a result of carer support and psychological therapy, and increased cognition, communication and quality of life for people with dementia participating in CST. The model also excludes the potential quality of life and economic benefits of being able to plan ahead (Department of Health, 2009; NAO, 2007; Brayne et al., 2007). Targeted interventions to reduce avoidable hospital admissions (Lakey at al., 2009; Samson et al., 2009), long hospital stays (Lakey et al., 2009, NAO, 2007; Lang et al., 2006), hospital-based adverse events (Watkin at al., 2012) and poor recovery after injury (Henderson et al., 2007; Yiannopoulou et al., 2012) may also deliver quality of life benefits and cost savings. The potentially high costs of health care use among those with undiagnosed and unmanaged dementia are also not included (Harvan and Cotter, 2006; Boise et al., 2004).

A range of possible harms is also excluded. We were unable, for example, to attach economic value to the anxiety and distress experienced by those mistakenly identified as potentially having dementia (Manthorpe et al., 2013; Brayne et al., 2013), although this may be offset by the benefits of on-going monitoring and potentially more timely diagnosis of those who do go on to develop dementia (NICE, 2006a), as well as the identification of other, potentially treatable, conditions. Other negative consequences may include unwelcome changes and pressures in family relationships and premature adaptations, by the person with dementia or their carer, such as giving up employment or passing over control of finances, as well as potential legal and financial impacts, such as on health and other insurance (Iliffe and Manthorpe, 2004). However, there is currently little empirical research evidence on these possible dis-benefits.

Identified cost savings rely heavily on evidence from a study by Mittleman et al. (2006), which evaluates a case management and carer support initiative in the US. However, this study is a well-conducted, randomised controlled trial and has a uniquely long follow-up period of 9.4 years. Furthermore, a range of other studies lend support to the effectiveness of carer support in dementia care, particularly where this is tailored to the needs of individuals, addresses subjective burden, involves the person with dementia and other family members and is long-term (Livingston et al., 2013; Knapp et al., 2013b; Koch et al., 2012; Vernooij-Dassen et al., 2011; Brodaty and Donkin, 2009; Andren and Elmstahl, 2008; Nichols et al., 2008; Chien and Lee, 2008; Brodaty and Gresham, 1989). More research is needed into the benefits of providing support to non-resident carers, such as adult children. Overall, the prominence of carer support in the model emphasises the important contribution of social care interventions to the economic case (Pelosi, 2006; Walport, 2013).

We also did not compare a one-off dementia screen for people age 75 to other methods for increasing diagnosis rates and therefore cannot comment on whether the screen described in this research would be more or less cost-effective than other approaches.

**Conclusion**

This study provides a helpful exploration of the potential cost-effectiveness of a one-off dementia screen for people age 75, where those diagnosed go on to receive the main symptomatic treatments and psychosocial support interventions recommended by NICE. Our analysis suggests that such a one-off screen for people age 75 in

England and Wales might be cost-effective, especially if treatments and social care interventions become more effective in future and if diagnosis by usual routes remains low or occurs later than is optimal. Comprehensive methods of economically evaluating different approaches to increasing the diagnosis of dementia will, in future, be easier to employ as better epidemiological and effectiveness evidence accumulates.

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