Cost-consequence and cost-utility analysis of an outpatient geriatric multidisciplinary assessment and case management intervention: the 'GRACE' model of care

1 Introduction

This report addresses the following review questions as set out in the guideline topic:

- **Assessment and care planning**: 2.1.1 What are the effects (benefits and harms) of different types of assessment and planning of personalised care on outcomes for older people with multiple long-term conditions and their carers?
- **Service delivery frameworks:** 2.1.2 What are the existing frameworks, models and components of care packages for managing multiple long-term conditions and what outcomes do they deliver?

Review questions 2.1.1 and 2.1.2 are important questions to address due to the potential size of the population affected in relation to health and social care outcomes and resource implications.

The number of older people with multiple long-term conditions in England is expected to rise from 2 million in 2013 to 2.9 million in 2018 (Department of Health, 2012, p. 6). Approximately 58% of people over the age of 60 have at least one long-term condition (Department of Health, 2012, p. 7). The health and social care costs for people with long-term conditions are three to six times higher than for the rest of the population (Department of Health, 2012, p. 10). Interventions in the area of assessment, care planning, and service delivery have been developed in order to maximize health and social care outcomes and to improve the efficiency of resource use.

Common complaints about social care services are the lack of holistic needs assessments (National Voices, 2012) and the fragmentation of services (National Collaboration for Integrated Care and Support, 2013). Current government policy emphasises the need to improve the coordination and personalisation of care and support.

1.1 Evidence review

The initial evidence review carried out by identified several systematic reviews (Trivedi, et al., 2013; Reilly, Hughes, & Challis, 2010; Goodman, Drennan, & Manthorpe, 2012). However, the evidence identified was inconclusive, and none of the reviews focused explicitly on interventions where both health and social care professionals were involved. Three non-UK intervention models were identified in the main search (Beland et al 2006, Canadian study; Counsell et al 2007, US study; Battersby et al 2007, Australian study).

Additional bibliographic searches were carried out by the NCCSC economist. The search identified a range of intervention models (see

Table 1), including, one UK study and 6 non-UK studies (Keeler et al 1999, USA; Challis et al 2004, UK; Sommers et al 2000; Boult et al 2001; Toseland et al 1997, USA; Bernabei et al 1998, Italy; Landi et al 1999, Italy). These additional studies and the three studies identified in the main search are presented in the table below (

Table 1). Detailed information about these studies is provided in the evidence tables and critical appraisal tables.

We grouped these studies into overarching intervention models, separating those that were mainly about integrating health and social care professional input into either: health care planning (Keeler et al 1999); social care planning (Challis et al 2004); or health and social care planning, of which we further segmented into outpatient-based geriatric multidisciplinary evaluation and management plus case management (Beland et al 2006; Counsell et al 2007; Boult et al 2001, Toseland et al 1997, Bernabei et al 1998, and Landi et al 1999) in addition to GP-centred models without case management (Sommers et al 2000) and with case management (Battersby et al 2007).

It is important to note that within the 'GP-based' and 'outpatient-based' models, only three studies explicitly measured the use of social care services. However, we think that there are some aspects of social care planning involved since the intervention did make referrals to community-based services, and for this reason we place them into the category of health and social care planning.

There is also a fourth intervention model type, which combines the input of social care professionals and service users in the social care assessment, care planning, and service delivery frameworks (Individual budgets pilot study, Glenndinning et al 2008).

Table 1

* Indicates the study was identified in the main search.

Note: Internal and external validity scores are provided next to the author citation using the notation of ++ for the best quality, + for moderate quality, and – for poor quality. The quality scores are presented first for internal validity then for external validity, for example (-/+).

For more details on each study, refer to the critical appraisal and evidence tables.

<table>
<tr><td colspan="2">Health and social care professional input into …</td></tr>
<tr><td>1. Health care planning</td><td>2. Social care planning</td></tr>
<tr><td>Keeler et al (1999, +/+) US study

Intervention: One-time geriatric team assessment to guide GP on health care planning plus a patient adherence intervention

Comparison: Usual GP care</td><td>Challis et al (2004, +/++) UK study

Intervention: One-time assessment by a geriatrician or old age psychiatrist to assist the social care manager in social care planning

Comparison: Standard social care</td></tr>
<tr><td colspan="2">3. Health and social care planning + innovations in service delivery frameworks</td></tr>
<tr><td colspan="2">3.1 Outpatient geriatric multidisciplinary evaluation and management + case management</td></tr>
<tr><td colspan="2">*Beland et al (2006, ++/+), Canadian study

*Counsell et al (2007, ++/+), Boult et al (2001, +/+), Toseland et al (1997, +/+), US studies

Bernabei et al (1998, +/+), Landi (1999, –/+); Italian studies

Intervention: varies

Comparison: standard care

Note: The studies noted are in no way identical, however, the main model components were broadly similar and were provided over similar time horizons (range 12 to 24 months, shortest duration was 6 months – please refer to the critical appraisal and evidence tables for more detail).</td></tr>
<tr><td colspan="2">3.2 GP-centred models for service delivery, collaborating with nurse and social worker</td></tr>
<tr><td>3.2.1 Without case management</td><td>3.2.2 With case management</td></tr>
<tr><td>Sommers et al (2000, –/+) US study

Intervention: GP collaboration with a nurse & social worker, providing education on self-management & care, make referrals to community health & social care services.

Comparison: Standard GP care</td><td>*Battersby et al (2007, ++/+) Australian study

Intervention: Addition of service coordinators to GP practices, use non-medical patient-directed and medical goals in the assessment and care planning process.

Comparison: Standard care</td></tr>
<tr><td colspan="2">4. Social care assessment, care planning, and innovations in service delivery frameworks</td></tr>
</table>

Individualised approaches
Glendinning et al (2008, +/+) English study
Intervention: Individual budgets pilot study
Comparison: Standard social care

2 Decision problem

The intervention selected for the economic evaluation is the Counsell (2007) intervention, which is an American study, termed the "GRACE" model of care (Geriatric Resources for Assessment and Care of Elders). The aim of the analysis presented is to assess whether the GRACE model might be cost-effective in the English context.

This analysis takes the perspective of the National Health System (NHS)-funded services as the study only reported on changes in health care resources. However, the intervention does comprise of a social care worker and the use of an occupational therapist and community-services liaison, however whether this would be funded by Personal Social Services or the NHS is unclear.

2.1 Rationale for the chosen economic evaluation approach

In this study, we combine the results from a cost-consequence and a cost-utility analyses.

A cost-utility analysis is a type of cost-effectiveness analysis in which the unit of effect is measured in terms of a utility indicator (in this case the quality-adjusted life-year - QALY).

The cost-effectiveness of an intervention is then determined by examining the incremental cost ($C^I - C^C$) divided by the incremental effect ($E^I - E^C$), where C^I and C^C represent the cost of the intervention and control groups, respectively, and $E^I - E^C$ represent the outcomes of the intervention and control groups, respectively. The higher the ICER, the less cost-effective the intervention is found to be.

A cost-consequence analysis presents the incremental costs alongside incremental consequences for a number of outcome indicators. Consequences (outcomes) are broadly defined and can include utility measures and any other measure, for example health and social care related outcome indicators such as depression scores, social activity scores, etc.

Economic evaluation aims to help decision makers allocate resources to interventions that provide the most value-for-money. When the ICER is less than £0 because the intervention delivers cost savings and delivers more benefit, the intervention is generally recommended. From the NICE clinical perspective, the acceptable maximum amount of money to be paid for an additional QALY is where the ICER is between £0 and £20,000 but advises more caution in concluding something is cost-effective where the ICER is between £20,000 and £30,000. When interventions are above £30,000 per QALY, interventions are generally seen as being not cost-effective, although this is not a strict rule and value judgements are needed.

Such a threshold does not exist in social care economic evaluation because it is recognised that social care is fundamentally different from clinical care in some important aspects. Firstly, the QALY is a measure of health-related quality of life, and does not reflect outcomes considered important in social care, for example, feeling safe, feeling in control over daily life and activities, feeling comfortable and clean, satisfaction with opportunities to socialise, feeling sufficiently occupied, and maintaining a sense of dignity for example (see the Adult Social Care Outcomes Toolkit, ASCOT for further examples). For this reason, the QALY is not the agreed-upon outcome on which to base decisions about cost-effectiveness in social care. Secondly, there is no agreed upon value defining the cost-effectiveness threshold in social care.

In spite of the limitations outlined above, the results from a cost-utility analysis could still be useful for judging the cost-effectiveness of the intervention if (i) cost-effectiveness can be demonstrated on the basis of QALYs and (ii) no additional evidence suggests deteriorations in other relevant outcome indicators. We therefore complement the results from the cost-utility analysis using health-related quality of life as reported in Counsell et al (2007) with a narrative summary of the changes in outcomes reported in the supporting studies of similar interventions (see

Table 1).

The remainder of Section 2 describes the rationale for the selection of the Counsell (2007) intervention. Details of the study are provided in the following sections including information on the sample (Section 2.3), the nature of the intervention (Section 2.4), the comparison group (Section 2.5), the outcome measures reported (Section 2.6) and the study results (Section 2.7). Where Counsell (2007) lacks information, we draw on evidence from additional studies in order to supplement the gaps (Section 2.8). Section **Error! Reference source not found.** describes the evidence and methods used to conduct the cost-utility analysis in the UK context. Section 4 reports the results obtained and sections 5 provides a narrative summary of additional studies with relevant evidence about the outcomes of interventions using outpatient geriatric multidisciplinary evaluation and management plus case management. This is used to support the cost-consequence analysis. Section 7 discusses the results of both the cost-utility and cost-consequence analysis. Finally, Section 7 summarises the recommendations about the cost-effectiveness of the intervention.

2.2 Rationale for selecting the Counsell et al (2007) intervention

The rationale for focusing on the outpatient geriatric multidisciplinary evaluation and case management intervention model for the economic analysis is that, relative to all other model types (see Table 1) the evidence base was stronger. We define 'stronger' in that there was a majority of studies of moderate or high quality with respect to internal and external validity (see

Table 1) and there was a consistent trend across studies for improvements in a range of outcomes (and none of them found worse outcomes) and that they had consistent impacts on acute care service use (generally, reduced or no different, or trending to reductions but were not statistically significantly so). The impact on community health and social care services was mixed: in some cases there were increases, decreases, or no changes. Therefore, it seemed that the intervention was improving outcomes, but the impact on costs was less clear as these were non-UK studies, and further analysis is needed to take into account differences in institutional context (i.e. baseline patterns of service use) and differences in unit costs.

The selection of the Counsell et al (2007) study specifically is due to the research being more recent (conducted between 2002-2004). The other studies are older, and patterns of resource use may not be representative. We do not include Beland et al (2006) in our analysis for the same reason (the study was carried out between 1999 and 2001) buts also because this was a cost-minimization analysis and so does not include health or social care individual-level outcomes.

The Counsell et al (2007) study is a randomised control trial rated as having good internal validity (++) and moderate external validity (+), as rated by the systematic reviewers (for more detail see the critical appraisal and evidence tables). Furthermore, the time horizon of the analysis was suitably long for most outcomes: the intervention was delivered over a two-year period and followed up for a third year. Healthcare resource use was collected over the three-year period but information on health-related quality of life and activities of daily living (both instrumental (IADL) and basic, (ADL)) were measured over the two-year period only.

2.3 Sample characteristics

The intervention was carried out on a sample of 951 individuals who were recruited from six community-based health centres that serves approximately 6,000 older adults. These community health centres are a part of a university-affiliated urban health care system that mainly serves individuals of low socioeconomic status (Counsell et al 2007, p.2624).

However, our analysis is based on a sub-group of the entire sample (N=224, intervention, n=112, comparison group, n=114)[1], defined as those with a 40%+ chance of hospital admission, a measure constructed by the authors on the basis of patient age, sex, perceived health, availability of an informal caregiver, heart disease, diabetes, physician visits, and hospitalisations (Counsell et al 2007, p.2626). The reason for selecting this subgroup is that individuals with higher baseline use of acute care services might benefit more from interventions that aim to reduce hospitalisation and therefore may be better to target this particular group.

Hospital admissions

The mean number of admissions in the 6 months prior to the intervention was 0.8 and 0.6 admissions per person for the intervention and control group respectively although statistical

[1] We do not know whether this subgroup is evenly distributed across the six centres.

significance figures are not provided (Counsell et al 2007, p.2631, Figure 2). However, using the aforementioned probability of repeated admission, both groups had a mean (standard deviation) rating of 0.47 (0.06) for the intervention group (N=112) and 0.49 (0.07) for the control group (N=114), which was statistically significant (p=0.04) (Counsell et al 2009, p.9).

Demographics

The sample mean age was 72 years old, 64% female, 57% black, 67% with less than 12 years of education, 75% with low socioeconomic status (defined as having household income less than $10,000 per year), 37% receiving publicly funded health insurance due to low income (Medicaid), and 91% receiving publicly funded health insurance due to old age (Medicare). Both groups were similar at baseline (p-values indicate they were not statistically different) (Counsell et al 2009, p.9).

Health status and chronic conditions

In relation to levels of need and health status, groups were also similar at baseline (p-values indicate they were not statistically different) (Counsell et al 2009, p.9).

The percentage of individuals' whose perceived health was rated fair or poor was 80% and the mean (standard deviation) number of chronic conditions was 3.6 (1.5).[2]

Instrumental and Basic Activities of Daily Living (ADL)

The measurement tool used for measuring instrumental and basic ADLs was the Assets & Health Dynamics of the Oldest-Old (AHEAD) tool, which is a 6-item ADL and 7-item ADL measured on a scale of 0-3, where 0 represents no difficulty and 3 indicates needing help, with total scores for instrumental and basic ADLs ranging from 0 to 21 and 0 to 18, respectively (Counsell et al 2007, p.2626-7).

The mean (standard deviation) baseline scores for instrumental ADLs were 3.8 (4.5) for the intervention group and 3.5 (4.6) for the control group. The mean (standard deviation) baseline scores for basic ADLs were 2.6 (4.0) for the intervention group and 1.9 (2.9) for the control group (Information provided through email correspondence with the authors).

The proportion of individuals who required help with one or more instrumental ADLs was 47% and the proportion that required help with one or more basic ADLs 26% (Counsell et al 2009, p.9).

Other characteristics

[2] From a list of 10: hypertension, angina pectoris or coronary artery disease, congestive heart failure, heart attack, stroke, chronic lung disease, inflammatory bowel disease, arthritis of hip or knee, diabetes mellitus, and cancer (Counsell et al 2009, p.9).

Characteristics in relation to the proportion of the sample living alone, with a carer helping at home, with depression, or with cognitive impairments was available for the entire sample (N=951) but we could not obtain this information on the sub-group of interest (N=224). However, we list these characteristics for the entire sample here, but emphasise that we cannot know whether these characteristics belong to our subgroup of interest (N=224 individuals with higher use of hospital services and higher needs in relation to instrumental and basic ADLs).

Of the entire sample (N=951)

- Living alone: 44%
- Carer helping at home: 25%
- Depressed or sad: 26%
- Depression case: 11.5% (as measured by the Patient Health Questionnaire-9 (PHQ-9) with a score greater than or equal to 10)
- Dementia: 0.8% (as measured by the Short Portable Mental Status Questionnaire (SPMSQ))

Eligibility criteria (Counsell et al 2007, p.2425)

Inclusion criteria

- Age 65 years or older,
- An established patient (defined as at least 1 visit to a primary care clinician at the same site within the past 12 months),
- An income less than 200% of the federal poverty level (defined as qualifying for Indiana Medicaid coverage or being enrolled in the county medical assistance plan)

Exclusion criteria

- Residence in a nursing home or
- Living with a study participant already enrolled in the trial,
- Enrolled in another research study,
- Receiving dialysis,
- Severe hearing loss,
- English-language barrier,
- No access to a telephone, or
- Severe cognitive impairment (defined by Short Portable Mental Status Questionnaire score ≤5) and without an available caregiver to consent to participate.

2.4 Description of the intervention

The GRACE model is one example of an intervention that integrates health and social care professional input into the assessment, care planning, and service delivery process to meet the health and social care needs of community dwelling older people over the age of 65 years old.

More specifically, the GRACE model of care is an outpatient, multidisciplinary geriatric team (composed of a geriatrician, pharmacist, physical therapist, mental health social worker, community-based services liaison, practice manager and administrative assistant) plus case management (performed jointly by an advanced practice nurse and social worker). The average caseload for the case manager team is 125 individuals based on 1 full time nurse and 1 full time social worker. The average input from each member in the geriatric team was reported to be around 0.05 fulltime equivalent (with the exception of 0.25 FTE for the practice manager), for a caseload of 125 patients.

The GRACE model comprises an initial and annual in-home comprehensive geriatric assessment from the case managers. The assessment is used to create an individualised care plan that is discussed with the multidisciplinary team. The individual's needs are then linked to the 'GRACE' protocol – a standardised checklist and response to 12 common geriatric conditions – advance care planning, health maintenance, medication management, difficulty walking/falls, chronic pain, urinary incontinence, depression, hearing loss, visual impairment, malnutrition or weight loss, dementia, and care giver burden.

The individual care plan is also comprised of the individual's goals. The individual's care plan is also discussed with their GP.

In relation to service delivery, there are weekly meetings amongst the multidisciplinary team and the case managers to discuss the successes and barriers in implementing the GRACE protocols. Case managers also use electronic medical records and a web-based tracking system to coordinate amongst health professionals and sites of care.

In relation to case management, individuals receive on-going support from the case managers at least once a month (either face-to-face or telephone). Case managers are required to visit the individual face-to-face after any A&E or hospital admission. Other contacts are arranged as appropriate to implement the care plan.

2.5 Description of the comparison group

Individuals in the comparison group accessed usual primary and specialty care services. Both intervention and control groups had access to GP house calls and skilled nursing facilities. They also had access to the inpatient "ACE" unit and consult services (inpatient acute care for elders model), which provide a "geriatrics interdisciplinary team that integrates and enhances care delivered by the hospital attending physician" (Counsell et al 2007, p.2624). Previous US-based studies found that the ACE intervention improves outcomes in hospitalised older patients (Counsell et al 2007, p.2624, citing (Landefeld, Palmer, Kresevic, & al., 1995), (Counsell, Holder, Liebenauer, & al., 2000), (Covinsky, King, Quinn, & al., 1997), (Palmer, Counsell, & Landefeld, 2003), however the quality of the studies has not been assessed.

2.6 Outcome measures (individual-level outcomes and resource use)

Individual-level outcomes

The individual-level outcomes measured in the study include:

- Medical Outcomes 36-Item Short-Form 36 (SF-36) scale, which measures patient health-related quality of life using the eight SF-36 scales (physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health).
- The summary measures of the SF-36 (aggregated into physical health, the physical component summary (PCS) and mental health, Mental Component Summary (MCS)
- Instrumental and basic activities of daily living (IADLs and ADLs);
- Mortality

These individual-level outcomes were obtained via email communication with the authors, as they were not presented within the published studies (See Table 2).

Resource use

Resource use was collected via computer database through the RCT.

Resource use included A&E visits, hospital admissions, and inpatient stay. These were measured in natural units for the two-year period and also presented as costs. In the third year, they were only measured as costs in the combined category of 'acute care'. Community healthcare services included mental health, rehabilitation, primary care, speciality care, procedures, and diagnostics. These were only measured as costs and are provided as a two-year average rather than being presented for years 1 and 2 separately. In the third year, community care costs are not disaggregated; rather, they are provided in the combined category of 'community care costs' (See Table 3).

2.7 Results of the study

Individual-level outcomes

Mortality

There were no differences in mortality over the two-year period (p=0.64) (Counsell et al 2007).

Instrumental and Basic Activities of Daily Living

Over the two-year period there were no differences between groups in both instrumental and basic activities of daily living (IADL, ADL) (p=0.97 and p=0.61, respectively). High scores and positive changes on IADL and ADL indicate worse functioning over time, as presented in the following table. These were not measured in the third, post-intervention year (See Table 2).

Patient health-related quality of life

At the end of the intervention over the two-year period, patient health-related quality of life, measured by the SF-36, was statistically significant and improved for the intervention group on the subscale of mental health (p=0.02). Some of the subscales were not statistically significant

at the p=0.05 level, but were trending towards significance in the areas of vitality (p=0.10), general health (p=0.12), social function (p=0.13), and role emotional (p=0.14). No differences were observed in the remaining subscales of physical function (p=0.41), role physical (p=0.96), and bodily pain (p=0.96). (See Table 2).

Higher scores and positive changes on the SF-36 indicate improvements over time. In a majority of subscales, the intervention group was associated with positive changes in the SF-36 subscale while the usual care group was associated with negative changes. Patient health related quality of life was not measured in the third, post-intervention year.

Mapping SF-36 measures to the EQ-5D.

Within the UK the most widely recognised measures of health-related quality of life is the EQ-5D, therefore it is the preferred instrument when an economic evaluation is conducted. NICE permits that where EQ-5D measures are not available, they can be cross-walked using a mapping function. A search on the Health Economics Research Centre database of mapping functions (Dakin, 2014) identified one study (Ara & Brazier, 2008). Details on the statistical properties of the mapping function are provided in the Appendix (Appendix: Statistical properties of the mapping function (SF-36 to EQ-5D).

Results of the mapping function

Using the formula, equivalent EQ-5D scores for the SF-36 measures is 0.068 QALYS (Table 2). This is the incremental effect of the intervention compared to the control group and we use this value in our analysis.

<u>Resource use</u>

Acute care service use (A&E and hospital admissions)

Over the two-year period of the intervention, the main outcomes measured were A&E and hospital admissions.

In the first year, there were no statistical differences between groups for both A&E and hospital admissions (measured either as hospital admissions per person or as inpatient stays per 1,000 people) (p=0.79, p=0.60, p=0.68, respectively).

In the second year, the intervention had statistically significant reductions in both A&E and hospital admissions per person (-35%, p=0.03 and -44%, p=0.03, respectively). Inpatient stays per 1,000 in the second year were trending towards statistically significant reductions favouring the intervention group (-45%, p=0.13).

In the third year, measures of A&E and hospital admissions were consolidated into a single measure of acute care costs, which was not statistically significant, but may be trending towards significant reductions favouring the intervention (-28%, p=0.21) (Intervention: $3,275 vs. Control: $4,544). (See Table 3).

Community healthcare service use

In the two years of the intervention, the use of community health care services, measured as costs, were statistically significant and greater in the intervention group in mental health services ($p<0.001$) and rehabilitation ($p<0.001$). The use of primary care services (GP visits), speciality care, and procedures and diagnostics were not statistically different ($p=0.64$, $p=0.49$, and $p=0.22$, respectively).

In the third year, community health care resource use was provided as an aggregate cost. The intervention had statistically lower community health care costs ($p<0.001$), a reduction by 11%. It is not possible to distinguish which components of community care services contributed to the overall reduction. (See **Table 4**).

Overall findings

Overall, the 3-year study indicated a statistically significant reduction in the use of A&E and hospital admissions in the second year, but not in the first year or in the third, post-intervention year. Use of community health care services increased in the first two years (for some services) but was reduced in the third year. These were accompanied by improvements in some of the SF-36 subscales and no differences in instrumental or basic activities of daily living.

Authors' discussion

The authors suggest that the lack of statistically significant reductions in the use of acute care services in the first year may be due to the time needed for the case management team to develop trust and a working relationship with the patient and the primary care physician. The authors point to two US studies where similar conclusions were drawn (Sommers, Marton, Babaccia, & Randolph, 2000) and (Burton, Weiner, Stevens, & Kasper, 2002) however both of these intervention designs were not similar, but did target similar populations.

The authors' also caution that there may be confounding factors, for example, that the improvements may be due to social contacts, as the study design did not incorporate sham contacts for the control group (Counsell et al 2007, p. 2632).

The authors suggest that the intervention's improved recognition and treatment of depression may have led to better mental health status, and general improvement and recognition of common geriatric conditions and other quality improvements may have contributed to positive impacts on health status, which may have influenced the reductions in the use of acute care services (Counsell et al 2007, p. 2632).

The authors also point to other studies of outpatient geriatric assessment and community and home based care management that have not found reductions in the use of acute care services and equally some studies that found reductions (Counsell et al 2007, p. 2631). However, these studies reflect different intervention models. However, in our own review of the literature with more similar models, some studies found reductions in the use of acute care services (Toseland

1996, 1997, Bernabei 1998), and some with no differences (Boult et al 2001) or were trending towards reductions but were not statistically significant (Beland et al 2006).

2.8 Modeling resource use from additional studies

One of the limitations of the Counsell et al (2007) study is that it does not comprehensively collect all relevant resource use. It does not measure community social care resource use[3] or measure admissions to nursing or care homes.

We drew on additional evidence to fill these gaps in knowledge.

In relation to social care services, only three of six studies reported on social care resource use. Findings from two studies showed mixed results, with one showing statistically significant increases in the percentage accessing social services (Intervention, 82% vs. Control, 68%, $p<0.05$) but when this is translated to total hours of social services this was not statistically significant (Beland et al 2006, Canada, ++/+, 22 month follow-up). In the second study, there were no statistically significant differences between hours of home support or in the percentage accessing meals on wheels (Bernabei et al 1998, Italy, +/+, 12-month follow-up). In the third study, while social care services was measured, it was not possible to determine whether there were statistically significant differences between groups because this was not presented separately; rather it was presented as a part of total costs (Toseland et al 1997, USA, +/+, 24-month follow-up). Due to mixed and limited evidence in this area, we could not come to any strong conclusions for use in our analysis and is an area of uncertainty (Table 5).

In relation to admissions to institutional or nursing home care, the same three studies reported on this outcome, all of which found no differences between groups (Beland et al 2006; Bernabei et al 1998; Toseland et al 1997) a fourth study, Boult et al (2001, +/+), using self-report data, also found no differences in the use of nursing homes. Even though these results are based on just 1 good quality and 3 moderate quality studies, the findings are consistent, and we believe they provide a useful indication of potential changes of resource use, although we cannot be certain (Table 5).

[3] However, some of the services provided as a part of community health care may be funded by social care services in England, for example, rehabilitative services, including occupational or physical therapists may be funded by social care services.

Table 2
Counsell et al (via e-mail communication with authors – these data are not available in published studies)

Patient health-related quality of life, SF-36 measurement tool											
Variable	**Intervention (N=112)**				**Usual Care (N=114)**				**Incremental effect (Intervention – Usual care) 2 year change**		
	Baseline		**Difference**		Baseline		**Difference**				
	Mean	SD	Change	SD	Mean	SD	Change	SD	**Mean change**	**SD**	**P-value***
SF-36 subscales*											
Physical function	41.6	24.4	**-3.2**	25.5	46.3	24.7	**-5.8**	21.7	**2.6**	23.7	0.41
Role physical	28.3	33.8	**1.0**	38.5	30.0	34.9	**0.8**	38.3	**0.2**	38.4	0.96
Bodily pain	49.0	25.6	**-1.0**	26.8	51.7	25.6	**-0.8**	38.3	**-0.2**	26.4	0.96
General health	39.3	19.8	**1.8**	19.4	41.1	17.5	**-2.2**	19.0	**4.0**	19.2	0.12
Vitality	36.9	21.0	**3.9**	20.1	41.3	24.3	**-0.6**	20.9	**4.5**	20.5	0.10
Social function	62.2	26.7	**3.3**	34.7	66.3	27.8	**-3.6**	34.4	**7.0**	34.6	0.13
Role emotional	61.9	40.2	**3.6**	46.6	68.7	39.2	**-6.5**	56.1	**10.1**	51.6	0.14
Mental health	64.7	22.6	**4.5**	20.4	67.7	20.0	**-2.3**	21.4	**6.8**	20.9	0.02
SF-36 summary scales*											
PCS (physical)	31.0	9.0	**-1.0**	8.3	31.9	8.8	**-0.60**	8.0	**-0.40**	8.20	0.72
MCS (mental)	47.0	11.5	**2.90**	12.1	49.1	10.2	**-1.50**	13.0	**4.40**	12.6	0.01

Instrumental and basic activities of daily living										
Variable	**Intervention (N=112)**				**Usual Care (N=114)**				**Incremental effect, 2 years (Intervention – Usual care)**	**P-value***
	Baseline	SD	2 year change		Baseline	SD	2 year change			
IADL*, mean (SD)	3.8	(4.5)	0.3	(3.6)	3.5	(4.6)	0.3	(3.9)	**0.0**	(3.74)	0.97
ADL*, mean (SD)	2.6	(4.0)	0.0	(3.5)	1.9	(2.9)	0.2	(2.9)	**-0.2**	(3.23)	0.61

NOTES
*Change calculated as 2 year – baseline. High scores and positive changes on SF-36 indicate improvements over time. High scores and positive change on IADL and ADL indicate worse functioning over time.
**p-value obtained from a t-test comparing intervention and usual care groups.

Table 3

Counsell et al (2007, 2009)

Acute care service use

Resource use	Time horizon	Intervention	N=	Control	N=	P-value	% Change	Counsell et al 2007
A&E visits per person	6m prior	1.40	112	1.40	114	*	*	p.2631
	Year 1	1.10	112	1.15	114	p=0.79	-4%	p.2629
	Year 2	0.85	106	1.31	105	p=0.03	-35%	p.2631
Hospital admission per person	6m prior	0.80	112	0.60	114	*	*	p.2631
	Year 1	0.71	108	0.80	109	p=0.60	-12%	p.2629
	Year 2	0.40	106	0.71	105	p=0.03	-44%	p.2631
Inpatient stays per 1,000	Year 1	3,938	112	4,544	114	p=0.68	-13%	p.2629
	Year 2	2,152	106	3,943	105	p=0.13	-45%	p.2629
Acute care costs, mean (standard deviation)	Year 3	$3,275 ($7,113)	100	$4,544 ($8,376)	96	p=0.21	-28%	**Counsell et al (2009)** pp. 11, 12

*In the six months prior to the intervention, mean A&E visits per person were estimated to be 1.4 visits and mean hospital admissions per person were estimated at 0.8 and 0.6. Both figures were obtained as a visual estimate using the figure provided in Counsell et al (2007, p. 2631, Figure 2). There were no accompanying estimates of statistical significance for these baseline figures.

Information on acute care services is provided in natural units for years 1 and 2. In year 3, they are only provided in monetary units and furthermore, A&E and inpatient stays are not provided separately, rather consolidated into the category, “acute care costs”.

Table 4

Counsell et al (2009)

Community healthcare service use

Item	Time horizon	Intervention		N=	Control		N=	P-value	% Change
		Mean	SD		Mean	SD			
Primary care	Presented as a 2-year average	$2,397	$2,307	112	$2,415	$2,126	114	p=0.64	-1%
Specialty care		$2,748	$3,299		$2,549	$3,213		p=0.49	8%
Procedures & diagnostics		$898	$1,074		$1,057	$2,178		p=0.22	-15%
Mental health		$776	$3,298		$132	$1,073		p<0.001	488%
Rehabilitation		$214	$758		$58	$190		p<0.001	269%
Community health care	Year 3	$1,813	$2,248	100	$2,031	$2,923	96	p<0.001	-11%

Source: Counsell et al (2009, p.11, 12)

Estimates of community care service use are not provided in natural units. They are only provided in monetary units. Furthermore, we are not provided with estimates for years 1 and 2 separately; rather they are presented as a 2-year average. In year 3, healthcare resource use is not disaggregated; rather, they are presented as a composite category, "community healthcare".

Table 5

Modelling resource use from additional studies

Study	Community social care services	Admission to nursing or care homes	Time period
Counsell 2007 (++/+)	Not measured	Not measured	24 months
Landi 1999 (–/+)	Not measured	Unclear: before & after study.	12 months
Bernabei 1998 (+/+)	No statistically significant differences in hours of home support or in the percentage accessing meals on wheels	Not statistically different	12 months
Boult 2001 (+/+)	Not measured		18 months
Beland 2006 (++/+)	Statistically significant increases in the percentage accessing social services (Intervention, 82% vs. Control, 68%, p<0.05) but when this is translated to total hours of social services this was not statistically significant.		22 months
Toseland 1997 (+/+)	Not possible to determine because it was not presented separately; it was presented as a part of total costs		24 months

3 Methods for undertaking cost-utility analysis

The non-UK interventions considered in the review might not be expected to yield the same results when applied in the English context because of:

- Differences between countries in the patterns of services use. For instance, a service which yields cost savings because it leads to reductions in the use of acute care services is less likely to be cost-effective in settings with very low "standard' use of acute care, other things being equal.
- Differences in the unit costs of services.
- Differences in the implementation of the intervention, because for instance of differences in skills and technologies.

Modelling analysis can be used to test the robustness of the published results to different assumptions about patterns of service use and service unit costs, and in doing so to attempt to approximate the non-UK published results to the English service context.

The steps undertaken to carry out this analysis are summarized below and further detail is provided in subsequent sections. The analysis was calculated using a MS Excel spread sheet.

1. Estimating patterns of health and social care resource use in England for the type of recipients targeted by the intervention, using available data from two different samples: the IBSEN (Individual Budgets) pilot study (2008) and from Bardsley et al (2012). We use estimates from two different samples to reflect uncertainties in evidence about the "standard care" for older people with health and social care needs in England. Service costs were estimated using use English unit costs estimates from the PSSRU Unit Cost book (Curtis, 2010) (Curtis, 2013) (Curtis, 2014).
2. Estimating the incremental cost of implementing the intervention (from Counsell et al 2007) using English unit costs from the PSSRU Unit Cost booklet.
3. Applying the proportionate changes in service use associated with the intervention in Counsell et al 2007 to the baseline use of services in to the two English samples (IBSEN study 2008; Bardsley et al 2012).
4. Estimating changes in QALY gains over a two and three-year period on the basis of the evidence in Counsell et al 2007. We make two different assumptions about total QALYs gained in the two-year period ("QALY 1" and "QALY 2"), and two assumptions about total QALYs gained in the third year ("QALY 3" and "QALY 4"). Altogether we have four estimates of total QALYs gained over a two- and three-year time horizons.

   We then calculate the incremental cost effectiveness ratio (ICER) for the two English samples (IBSEN 2008 and Bardsley et al 2012) and for the two time horizons: the two-year and three-year period. Altogether, the analysis therefore produces eight ICERs (see
5. Table 6).

- While we recognize that there is no agreed-upon cost-effectiveness threshold in social care, the results of the cost-utility analysis are interpreted in the context of the £20,000 to £30,000 ICER range.

Table 6

Total number of ICERs reflecting different scenarios about the two English samples used, the two time horizons, and two assumptions about QALYs gained

Possible scenarios & number of ICERs	**Time horizon**	**IBSEN (2008)**	**Bardsley et al (2012)**
	2-year time horizon	QALY 1 QALY 2	QALY 1 QALY 2
	3-year time horizon	QALY 3 QALY 4	QALY 3 QALY 4

6. Finally, we perform sensitivity analysis on the results (ICER) to test the influence of different parameters. Examples of 'parameters' include the baseline use of GP visits in the English context and the impact of the intervention on inpatient stays. The sensitivity analyses incorporates uncertainties in:
    - English patterns of baseline service use, by reflecting
        - Existing variations in the patterns of service use in England
        - Some of the limitations of the English data available (e.g. incomplete information on community healthcare resource use or the time horizon over which resource use was measured, in particular, resource use was extrapolated to a 24-month period using information on utilisation rates at 3 or 6 months).
    - The stochastic nature of the intervention's effect on resources and QALYs gained
        - That replications of the study may lead to different results
    - The transferability of US results to the English context because of
        - Differences between settings with respect to "usual care" (the comparator group)
        - Differences in utilisation rates of similar services
        - Differences in total resource use (differences in the types of care packages)
        - Differences in the implementation of the intervention (the English context may require different levels of intensity or types of health and social care professionals)

- Differences in population demographics and health status (e.g. the US sample were of lower socioeconomic status than the UK samples used, majority are non-white, and low socioeconomic status)

- The accuracy in measuring benefits (QALY gains), either because of:
  - Mapping SF-36 measures to the EQ-5D
  - The time duration over which the impact of the intervention on QALYs is considered

3.1 Estimating patterns of health and social care resource use in England

One of the difficulties in this analysis was obtaining long-term health and social care utilisation data for older people with multiple long-term conditions and social care needs in England, because the lack of nationally linked NHS and social care data in England (Ismail, Thorlby, & Holder, 2014, p. 37) (Whalley, 2013, p. 4).

In the absence of a national dataset, our analysis used data from two English studies: the IBSEN study (2008) and Bardsley et al (2012). An important difference in the two data sets is the higher baseline rates of inpatient care use in the IBSEN study compared with data in Bardsley et al (2012). The comparability of these data to Counsell et al (2007) is provided in Appendix 12.

<u>IBSEN study (2008)</u>

The IBSEN data comes from a small sample (N=316) of older people in receipt of publicly-arranged[4] social care services in the community who were a part of the Individual Budgets pilot study. This study was funded by the Department of Health between 2005 and 2007.[5] We use baseline information on *the whole sample* in our analysis.

The main limitations with this data are:

1. Lack of information about the number of chronic conditions
2. Short time horizon: data on resource use is measured over 3 or 6 months
3. Limited comparability of care packages and services measured in IBSEN (2008) and services provided in Counsell (2007)

[4] Publicly arranged social care services, at the time, would have been almost entirely funded by local government given that the threshold for social care and financial need would have been high at the time. Therefore, the sample in the IBSEN study, in terms of level of need, may be very similar to those in the Counsell (2007) sample.

[5] The individual budgets data contain a sample of both new referrals and existing service users. The appropriateness of using data for new referrals depends on how different they are to existing service users. A t-test indicated no significant differences in mean costs. Therefore, it was decided that it was appropriate to include new referrals in the analysis.

1. *Mean number of chronic conditions*

It was not possible to determine whether individuals in the IBSEN study had multiple chronic conditions. However, we believe that it is probable that these individuals may have had at least one, if not multiple chronic conditions. We support this assumption on the basis that multi-morbidity increases with age and the level of dependence of the IBSEN sample. The relationship between age and chronic conditions is evidenced for instance by one English study (Salisbury, Johnson, Purdy, Valderas, & Montgomery, 2011) and several international studies from Scotland, (Barnett, Mercer, Norbury, Watt, Wyke, & Guthrie, 2012), the USA, (St Sauver, et al., 2015), (Ornstein, Nietert, Jenkins, Litvin, & MD, 2013), Switzerland, (Rizza, Kaplan, Senn, Rosemann, Bhend, & Tandjung, 2012), and the Netherlands, (Uijen & van de Lisdonk, 2008).

However, recognizing that such data are not reported, this introduces uncertainty about levels of baseline resource use. However, this is captured in the sensitivity analysis.

2. Time horizon of the IBSEN (2008) study

Data on service use was collected via interview and service users were asked to retrospectively account for service use in the:

- past 6 months (for length of hospital stays and number of hospital admissions)
- past 3 months (for A&E and other community health and social care services).

To be useful to the analysis, we need to use the IBSEN data to calculate resource use over a three-year period in order to be comparable to the Counsell et al (2007) study. We therefore use IBSEN baseline data and extrapolate it over a three-year period.

- The assumption we use in extrapolating the data beyond the three and six months period is that the rate of resource use remains constant over the following time period. Therefore, resource use over a 3-month period is multiplied by 4 to estimate 12-month resource use and resource use over a 6-month period is multiplied by 2 to estimate 12-month resource use.

3. *Comparability of services in IBSEN (2008) and Counsell et al (2007)*

Table 7 provides the (assumed) English-equivalent healthcare resources that were reported in the Counsell et al (2007) study. There are several issues in relation to comparability: services not measured and services with inadequate description.

1. The IBSEN sample did not measure the use of mental health services or procedures and diagnostic services (these were measured in Counsell et al 2007).
    a. We exclude the estimates of procedures and diagnostic services from our analysis, as Counsell et al (2007) reported no statistically significant differences between groups (p=0.22). It is important to note that even though estimates were not statistically significant, use of procedures and diagnostics was trending lower in the intervention group.
    b. We model estimates of mental health service use with data from another source because the intervention was associated with a statistically significant increase in service use (p<0.001).
        i. We modelled utilisation using an RCT (N=256) based on a sample of community dwelling older adults with substantial levels of social care needs and at least one chronic condition (Challis et al 2004). Baseline resource use was not collected; therefore we estimate resource use as an average of both intervention and control groups' utilisation at the end of the 6-month period. These are also provided in

Table 7**.**

ii. It is not clear whether these data, measured in 2000, are comparable to current patterns of service use and we could not find other studies for validation.

2. The Counsell et al (2007) study provides inadequate detail on the types of services involved in "rehabilitative services" and "specialist services". We attempted to match these services with available data from the IBSEN (2008) study.

    a. We assumed the English equivalent of rehabilitation was the use of occupational therapists (as this was the only measure in the IBSEN study). It was not clear from the IBSEN data whether these occupational therapists were funded through the NHS or social services. For this reason, our unit cost estimates for occupational therapists was an average of NHS and personal social services-provided care (see Appendix 11).

    b. We assumed the English equivalent of specialist services to be chiropodists, as this was the comparable reported resource use in the IBSEN data.

3. There is also inadequate detail associated with Counsell et al (2007) reporting of "primary care" services. We are unclear as to whether these are home or office visits.

    a. The IBSEN sample measures both GP home visits and office visits and we use both in our estimates.

4. Counsell et al (2007) and the IBSEN data provide estimates on hospital admissions, inpatient stays, and A&E visits.

Degree of uncertainty in the comparability of services and impact on total cost

Overall, there is some uncertainty around the comprehensiveness of our estimates of mental health, rehabilitative, specialist, and GP resource use. Furthermore, Counsell et al (2007) did not report whether community health care services were home or office visits. For some services, the IBSEN data also do not report this information. In our analysis the assumption was that unit costs were an average of both home and office visits, depending on the information provided in the PSSRU unit cost reports (see Appendix 11). Insofar as these issues influence cost estimates, these issues are captured in the sensitivity analysis by varying the baseline utilisation of all community care services.

<u>Bardsley et al (2012)</u>

We also use a second data set based on Bardsley et al (2012) research; a retrospective analysis on four primary care trusts and corresponding local authorities, making up a total sample of 133,000 people aged 75 and over. We use a subset of the Bardsley data (mean age 82 years old, annual social care costs of £5,000+ (2012, p.134) that are comparable to the IBSEN sample (mean age 80 years old, weekly social care costs of £227 per week, almost £12,000 per year,

Glendinning et al 2008, p.90).[6] It was not reported what proportion had multiple long-term conditions.

We use this second data set to reflect variation of acute care service use in England. The study did not collect information on community health and social care service use. While the Bardsley sample provided information on A&E visits and inpatient admission rates, there was no information on the average inpatient stay (defined as the total length of stay for the sample divided by the sample size for a given time period), therefore we used IBSEN (2008) data to make assumptions about average inpatient stays.

Table 8 summarizes the differences in acute care service use among the Bardsley et al (2012) and IBSEN (2008) samples.

- The IBSEN (2008) sample has an average length of stay of 17 days and an average inpatient stay of 9 days.[7] We use the average length of stay estimate from IBSEN (2008) to calculate the average inpatient stay for the Bardsley et al (2012) sample. On this assumption, the Bardsley et al (2012) sample has an average inpatient stay of 15.5 days. This is calculated by multiplying 0.91 inpatient admissions reported in Bardsley et al (2012, p.136) with the average of 17 days length of stay in IBSEN (2008).
- Our analysis therefore assumes that the Bardsley et al (2012) sample has a higher level of acute care service use (15.5 days per year) compared to the IBSEN (2008) data. The IBSEN (2008) data have a 12-month inpatient stay of 9 days (extrapolating from a 6-month inpatient stay of 4.5 days).

[6] The Bardsley et al (2012) study used cost estimates from 2006/2007 whereas the IBSEN (2008) sample reflect 2007/08 prices, however the overall impact on costs and comparability are likely to be negligible.

[7] Length of stay defined as the duration of a hospital stay for only those individuals who were admitted to hospital. Average inpatient stay defined as the total length of stay for the sample divided by the total sample size.

Table 7

English baseline patterns of resource use, per person

Source: IBSEN (2008) data						
Mean resource use per person*	**IBSEN Variable**	**Measurement method**	**Sample size**	**Time horizon & Original value**		***Extrapolating to 12 months**
Admission rate	v0112	Service user (SU) reported	316	Last 6 months	0.38	†
Average inpatient stay *(Total length of stay divided by the sample size)*	v0110_d	Scale	316		4.5	9†
Length of stay *(Length of stay for those with a hospital admission)*	v0110_d	Scale	84		17	17‡
* Estimates provided for the original value and extrapolated values are rounded. † To avoid double counting we only double the average inpatient stay for the 12-month period as this already takes into account the admission rate. ‡We assume that the mean length of stay for those with an admission will remain the same in the following 6 months.						
A&E visits (Average of 1 + 2)				Last 3 months	0.18	0.71
A&E visits (1)	v0097_d	SU reported	311		0.17	0.70
A&E visits (2)	v0098_d	Scale	310		0.18	0.73
Specialist (Chiropodist)	v0101_d	SU reported	274		0.73	2.9
***Primary care* (GP visits)** **Average of home (1, 2) & clinic visits (3,4)**					1.1	4.4
GP home visits (1)	v0093_d	SU reported	285		0.4	1.8
GP home visits (2)	v0094_d	Scale	311		0.5	2.1
GP surgery visits (3)	v0091_d	SU reported	268		0.5	2.1
GP surgery visits (4)	v0092_d	Scale	305		0.7	2.7
Rehabilitation (Occupational Therapist) (Average of 1+2)					0.4	1.7
Occupational therapist (1)	v0083_d	SU reported	285		0.4	1.7
Occupational therapist (2)	v0084_d	Scale	305		0.4	1.8

Source: Challis et al (2004)				
Mental health services per person *(Psychiatrist home visit)*	Estimated from Challis et al (2004) based a two-site RCT (N=256) at 6 months follow-up among community dwelling older people with at least one long-term condition who have substantial levels of social care needs and are in receipt of social care services.	Last 6 months	0.035	0.07

	At 6 months follow-up, 9 out of 256 individuals in the combined intervention and control group had a mean of one contact with a psychiatrist (home visit) over a 6-month period. (9/256) *(1 service contact each) + (247/256) * (0 service contacts) = 9/256 = 0.035 mean psychiatrist visits per person in 6 month period			

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224 **Table 8 Comparability of IBSEN (2008) & Bardsley et al (2012) acute care use per person**

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Mean (standard deviation)	**IBSEN (2008)** **12 month figures (extrapolated)**	**Bardsley et al (2012)** **12-month period (as reported)**
A&E visits per person per year	0.71	0.65 (0.025)
Inpatient days per year	9	15.5
Hospital admission rate	-	0.91 (0.034)
Source	IBSEN (2008)	Bardsley et al 2012, p.136, table 3

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3.2 Estimating intervention costs and unit costs

Data sources for estimating English unit costs

Estimating the unit costs of the intervention and health and social care resources are based on the PSSRU unit cost reports (in very few cases they were some were taken from other sources). Unit cost data are taken from the most recent 2014 publication but if information was not available we searched earlier publications; however, all prices used in our analysis reflect the 2012/13-year.

Costing approach

We used a full cost approach in estimating intervention and unit costs. A full cost approach reflects the true opportunity cost of the inputs considered. Full cost approach considers not only salary, but also employer's contribution to national insurance and pension (oncosts), the direct and indirect overheads, capital overheads (working in an office space, for example), and qualifications costs.

A full cost approach also includes the indirect cost of any given activity. For example, a 30-minute GP visit with a patient incurs costs related to travel and paperwork. Indirect costs are expressed as the ratio of direct to indirect time, where direct time is usually considered face-to-face time with the patient. We estimate indirect costs using PSSRU unit cost publications.

Estimates of intervention costs

Table 9 provides the England-based intervention cost estimate per person. Costs are estimated to be £4,100 per person (total for the two-year intervention period).

Table 11 provides information on the intensity of inputs per care professional per caseload. The calculation is based on a caseload of N=114 individuals, which is the intervention sample size (Counsell et al 2007, 2009). The table also provides our assumption about the English-equivalent care professional, using PSSRU unit cost information (Curtis, 2014).

Appendix 10 provides detail on the full cost approach used to calculate intervention costs associated with a full-time equivalent health or social care professional. In some cases we made assumptions where information was not available, and these are explained as notes within the table.

Estimates of healthcare utilisation costs

Table 11 presents the unit costs of healthcare resources used in the analysis. Our unit cost estimates for

Appendix 11 presents the details on full cost approach used to estimate the unit costs of healthcare resources (in particular, incorporating the direct and indirect costs of care professional input).

Table 12 provides the inflation rates used to estimate 2012/13 unit costs.

Table 9 English-equivalent, incremental intervention costs per person, 2012/13 prices

Per person cost, two-year total (intervention duration of two years)	£4,100
The calculation is based on multiplying the resource inputs per person by the full-time equivalent cost per year per care professional (as in Table 9), to first obtain the yearly cost, which is then multiplied by two to obtain the total two-year intervention costs.	

Table 10 Intervention resource inputs per caseload and English equivalent costs

Care professional, Counsell et al (2009)		**Assumed English equivalent care professional**		
*Resource inputs per caseload		Full-time equivalent costs (FTE), using PSSRU unit costs		
Case manager: Nurse	1 FTE	Community nurse specialist	£78,327	2014, p.190
Case manager: Social worker	1 FTE	Social worker team leader	£102,634	2014, p.205
Physiotherapist	0.05	NHS Community physiotherapist	£56,576	2014, p.179
Pharmacist	0.05	Community pharmacist	£90,662	2014, p.184
Community organizer	0.05	Social worker assistant	£43,306	2014, p.208
Mental health social worker	0.05	Mental health social worker	£93,629	2010, p.175
Geriatrician	0.05	Medical consultant	£254,819	2014, p.257
Practice manager	0.05	GP administrative assistant	£80,834	2014, p.194
Administrative assistant	0.25	Practice manager	£111,068	2014, p.277
*Our estimates are based on a caseload of N=114, based on the intervention sample size (Counsell et al 2009, p.3)				

Table 11
Unit costs of healthcare utilisation in the analysis, 2012/13 prices

2012/13 prices Total cost per contact	Healthcare resource	Original values	Original value, year, source	Inflation rate applied to the original value to obtain 2012/13 prices	
£269	**Average cost per inpatient bed day**	£231	2007/2008 prices, Glendinning et al (2008, p.291)	17%	Calculated using HSCIC, prices index, Inflated from 2007/08 to 2012/13 prices (PSSRU unit costs, 2014, p.263)
			(Glendinning et al 2008, p.291) Based on a weighted average of all patient rehabilitation stays, excludes patients with brain injuries.		
£37	**Average A&E cost**	£32	2007/2008 prices, Glendinning et al (2008, p.291)	17%	Calculated using HSCIC, prices index, Inflated from 2007/08 to 2012/13 prices PSSRU unit costs (Curtis 2014, p.263)
			(Glendinning et al 2008, p.291) Based on an average cost of walk-in, follow attendance and non 24 hour A&E department.		
£38	**Chiropodist visit**	£36	2009/10 prices, (PSSRU unit costs, 2010, p.156)	5.7%	Calculated using HSCIC, pay index, inflated from 2009/10 to 2012/13 prices PSSRU unit costs (Curtis 2014, p.263)
			No information available from PSSRU unit costs 2013/14, they refer us to older editions, most recent is from 2010 PSSRU unit costs (Curtis 2010, p.156). The estimate is based on the NHS reference cost, based on a mean cost per contact. No information is given as to the duration of an average contact.		
£214	**Psychiatrist home visit**	PSSRU unit costs (Curtis 2014, p.183). No information was identified for the mean duration of a psychiatric home visit. More detail is provided in Table 13 about assumptions used and for estimating the indirect cost of a face-to-face contact.			
£63	**Primary care (GP visit)**	PSSRU unit costs (Curtis 2014, p.195). Calculated using average of home and surgery visits and includes assumptions about the average duration of contact. Unit costs include the indirect costs of face-to-face contacts using PSSRU unit cost reports (detail in Table 13).			
£56	**Occupational Therapist Contact**	PSSRU unit costs (Curtis 2010, p.152, 177). Calculated using average of Local Authority and NHS provided (home and clinic visits). Assumptions were made to estimate mean duration of contact. Unit costs include the indirect costs associated with face-to-face time using PSSRU unit cost reports (more detail in Table 13).			

Table 12 Calculation of inflation rates, NHS and Personal Social Services

Hospital & community health services (HCHS) index				
Year	**Prices**	2007/8 as base year	**Pay**	2009/10 as base year
		Index, prices		Index, pay
2007/08	1.8	100.0	3.5	
2008/09	5.2	105.2	3	
2009/10	-1.3	103.8	1.8	100.0
2010/11	2.8	106.7	3.1	103.1
2011/12	4.1	111.1	0.9	104.0
2012/13	3.1	114.5	0.9	104.9
2013/14	1.8	116.6	0.7	105.6
Inflation rate used		1.166 = 17%	1.057 = 5.7%	
Source: PSSRU Unit Costs (Curtis 2014, p.263)		Calculated as index from 2013/14 ÷ index from 2007/08	Calculated as index from 2013/14 ÷ index from 2009/10	

The PSS annual percentage increases for adult services, all sectors		
Year	**Pay**	2009/10 as base year
		Index, pay
2009/10	2.2	100.0
2010/11	-0.4	99.6
2011/12	0.1	99.7
2012/13	0.9	100.5
2013/14	-0.1	100.4
Source: PSSRU Unit Costs, 2014, p.265		1.005 = 0.5%
		Calculated as index from 2013/14 ÷ index from 2009/10

3.3 Proportional changes in service use observed in Counsell et al 2007

As discussed in the last section, there are some uncertainties around baseline estimates of health care resource use, for both community and acute health care services. These issues relate both to the representativeness of service use in the English context but also whether observed changes in the Counsell et al (2007) intervention would occur to the same degree.

Both of these issues are captured in the sensitivity analyses.

3.4 Effects on QALYs gained as observed in Counsell et al 2007

Uncertainty surrounding QALYs gained in the two-year period

We needed to make some assumptions when estimating the impact of the intervention on QALYs gained.

The impact of the intervention leads to an incremental effect of 0.068 QALYs. However, this change is reflected as a single data point at the end of the two-year period (**Figures 1A**). Therefore we do not know the trajectory of QALY gains; and so we have an incomplete picture of the intervention's impact because total QALY gains are estimated as the total changes in QALYs over time, whereas we are presented with a change at one point in time. This is important because different trajectories result in different total QALYs gained.

Not knowing the trajectory results in uncertainty about the intervention's ICER. Consider the following scenarios (**Figure 1B**):

- QALY gains could start immediately (point 0) and continue to year 2. This is likely to be unrealistic given the nature of the intervention (it takes time to implement the care plan, for example). Or that half of the 0.068 QALYs accrue in year 1 (point 1) and 0.068 QALYs are only fully gained at the end of year 2. Or that 0.068 QALYs accrue at year 1 (point 2), continuing to year 2.

Our analysis assumes both points 1 and 2 are realistic, and we use both estimates in calculating the intervention ICER (Figure 2**,** Table 13**).**

- Scenario 1 "QALY 1" assumes a total gain of 0.068 QALYS at the end of two years.
- Scenario 2 "QALY 2" leads to an overall gain of 0.102 QALYs at the end of two years.

Figure 1 – Difference in QALYs gained at 2 years

Figure 1A

Information available from the study author

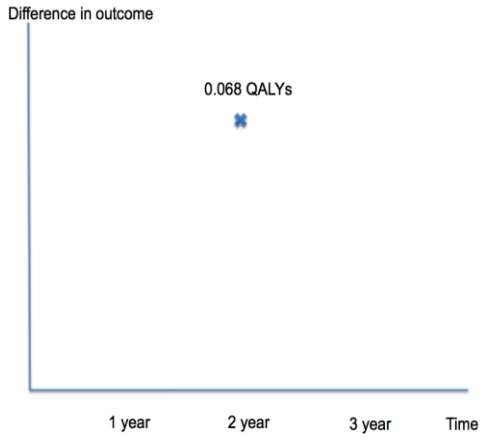


Figure 1B

Uncertainty about the rate of QALYs gained

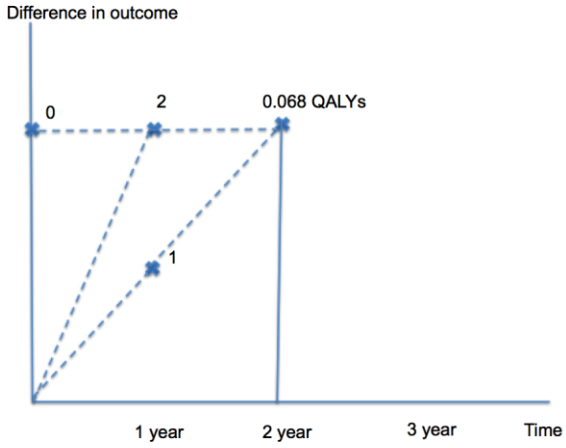
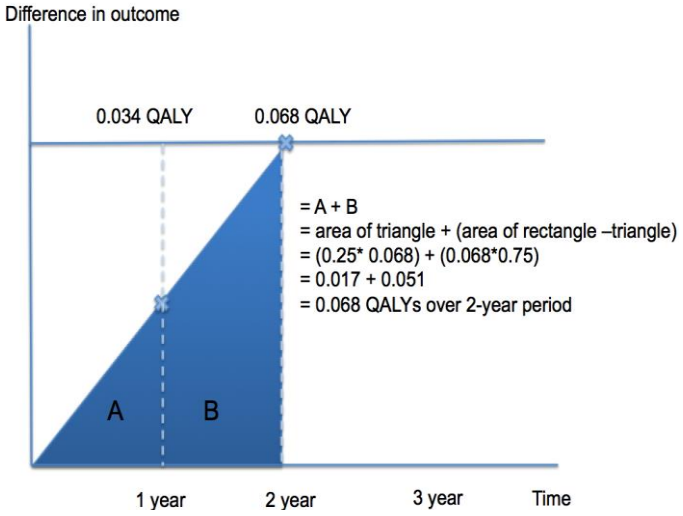
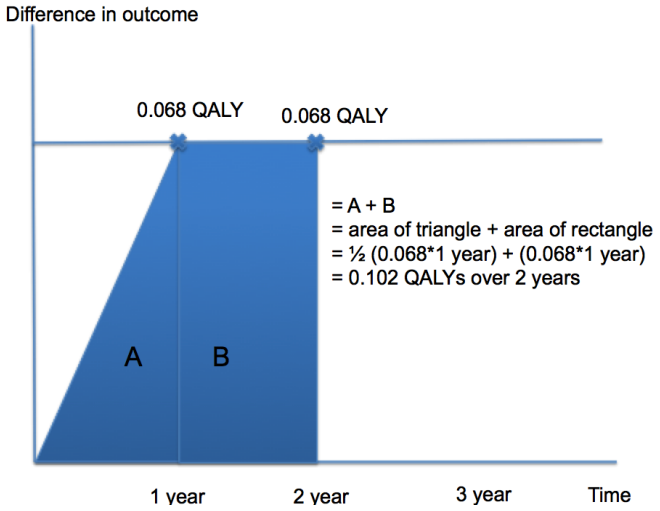


Figure 2 – Assumptions about QALYs gained

"QALY 1"



"QALY 2"



Uncertainty surrounding QALYs gained in the three-year period

There is also uncertainty about the appropriate time horizon for the analysis. Although the intervention was followed up over a three-year period, only resource use was measured in the third post-intervention year but QALY gains were not. However, arguments can be made for using a three-year time horizon if we assume that QALY gains would not have immediately disappeared post-intervention.

This hypothesis might find some support when exploring, first, the nature of the intervention itself and, second, making inferences based on patterns of resource use in the third year.

A. Inferences about QALY gains in the third year based on the nature of the intervention

While it is not possible to disentangle the effects of a multifaceted intervention, it is still worth exploring the key components of the intervention to inform the likelihood that some of the impacts could be sustained post-intervention.

The key components of the intervention are (Counsell 2007, p.2626): (i) annual in-home comprehensive geriatric assessment by the case managers, (ii) individualised care plan developed annually with assistance from an interdisciplinary geriatrics team, (iii) activation of protocols in relation to one of twelve geriatric conditions[8], (iv) case managers meeting with the patient's GP to review, modify, and prioritize care plan protocols and interdisciplinary team suggestions relating to patient care, (v) weekly interdisciplinary team meetings to review case managers' success in implementing protocols and problem solving barriers to implementation, (vi) ongoing case management (at least monthly patient contacts) supported by electronic medical record and providing coordination and continuity of care among all health professionals and sites of care.

Sustained impacts in the third year may be plausible if it is assumed that GPs gained new information about their patients through the new approach to assessment and care planning in the third year. It could also be argued that interventions provided through the 12 geriatric protocols might be 'investments' (advance care planning, medication management, chronic pain, hearing loss, visual impairment, malnutrition, caregiver burden).

However there are components of the intervention that would not be in place in the third year and these may have a considerable impact on QALY gains (but we can't be sure).

i. For instance, the contact with the nurse and social worker case managers may be important drivers of QALY gains. There is evidence from one study (identified in our review) indicating a statistically significant dose-response relationship between number of nurse and social worker contacts and reductions in acute care service utilisation and improvements in some patient outcomes (Sommers et al 2000, USA, –/+).[9] However,

[8] Advance care planning, health maintenance, medication management, difficulty walking/falls, chronic pain, urinary incontinence, depression, hearing loss, visual impairment, malnutrition, dementia, and caregiver burden

[9] Greater number of contacts was associated with lower hospital admissions (p=0.02), lower GP visits (p=0.003), better function (ADL and IADLs, p=0.005), better social activities count (p=0.02), and reduced symptoms (p=0.08).

this is based on a slightly different intervention model, a GP-based intervention with nurse and social worker collaboration.

ii. Weekly interdisciplinary team meetings may be key drivers in relation to actual problem solving of barriers to care plan implementation.

iii. New problems may arise and it is unclear whether without the intervention that a response to those problems would be handled in the same way.

B. Inferences about QALY gains in the third year based on patterns of resource use

Support for the hypothesis could be inferred from patterns of resource use in the third year.

In the third year, there was a non-significant reduction in acute care resource use (-28%, p=0.21).[10] It is possible that reduced use of acute care may be associated with sustained QALY gains. Relative to the control group, there was also a significant decrease in the intervention group's use of community healthcare services (-11%, p<0.001). However, it is not clear how changes in community health care services impacts on QALYs. [11]

C. Conclusions

<u>QALY gains in the third year</u>

Recognizing the uncertainty around sustained QALY gains in *the third year*, we adopt two different assumptions in the analysis. The first assumption is that *half* of the 0.068 QALY gains are sustained in the third year. This corresponds to an additional 0.051 QALYs. This is illustrated as point 3 in **Figure 3**. The second assumption is that QALY gains are *sustained* in the third year (an additional 0.068 QALYs). This is illustrated as point 4 in **Figure 3.**

<u>Total QALY gains over the 3-year period</u>

These assumptions build on the 2-year scenario. Therefore, the assumptions we use in our analysis for 3-year QALY gains are calculated using a lower and upper estimate (**Figure 4**). The lower estimate, "QALY 3", represents a total gain of 0.119 QALYs (the trajectory using points 1 and 3, the area shaded in green). The upper estimate, "QALY 4", represents a gain of 0.170 QALYs (the trajectory using points 2 and 4, the area shaded in blue and green) (Table 13**).**

However there was a very weak association in relation to nutrition and self-rated health (p=0.31 and p=0.27, respectively) and very little association with depression and medication count (p=0.58 and p=0.62, respectively).

[10] Percentages changes are based on changes in healthcare costs. Information was not provided in natural units.

[11] It was not possible compare the components and intensities in care packages across all three years because years 1 and 2 are consolidated into a 24-month average total cost, furthermore, information in the third year was provided as a composite score of 'community care services' rather than decomposed into specific areas (like primary, specialist, rehabilitative, etc).

Figure 3 – Assumptions about QALYs in the third year

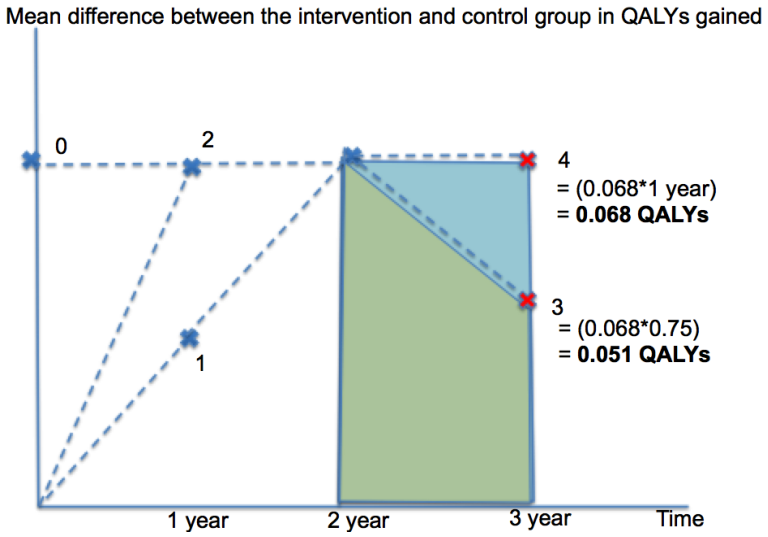


Figure 4 – Three-year time horizon: total QALYs gained

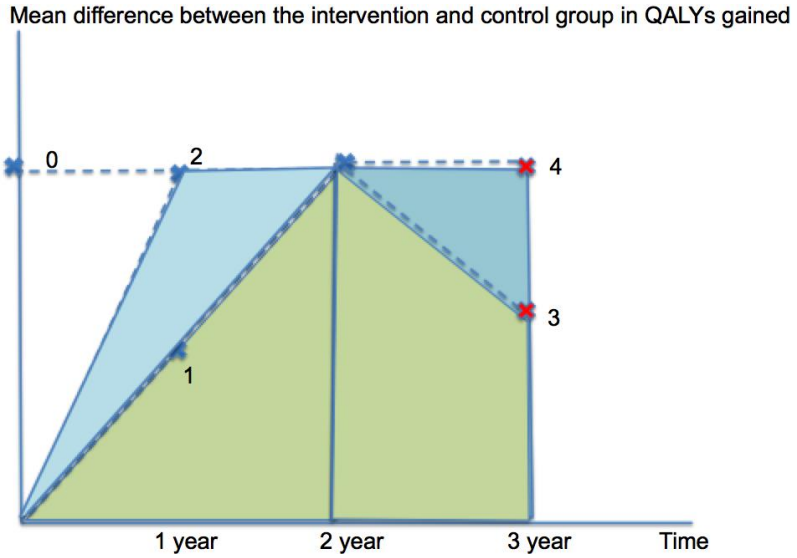


Table 13

QALY estimates used in the analysis for the two and three year periods

Two-year		**Three-year**			Third year
QALY 1	0.068 QALYs	QALY 3	0.119 QALYs	0.068 + 0.051 QALYs	0.051 QALYs
QALY 2	0.102 QALYs	QALY 4	0.170 QALYs	0.102 + 0.068 QALYs	0.068 QALYs

4 Results: the incremental cost per QALY

The results of the analysis are presented for the following eight scenarios, which reflect the:

- Two sets of English data used (IBSEN 2008 and Bardsley et al 2012)
- Two time-horizons (2 and 3 year), and
- Different assumptions about total QALYs gained over the two- and three-year periods

These scenarios help us understand under what circumstances the intervention could be cost-effective in the English context.

Table 14 presents the results of the cost-effectiveness analysis.

4.1 Results using cost-utility analysis

Using a two-year time horizon the intervention is not cost-effective at the £20,000 threshold but in the three-year time horizon it is cost-effective at the £20,000 threshold in most scenarios. This is illustrated in Table 14. The rows shaded in green indicate the scenarios where the intervention is cost-effective at £20,000 per QALY. The rows shaded in yellow indicate that the ICER is between the £20-£30,000 per QALY. The rows in red indicate scenarios where ICERs are above £30,000 per QALY, and therefore are unlikely to be a cost-effective use of resources from a clinical perspective.

Table 15 (IBSEN 2008) and

Table 16 (Bardsley et al 2012) report changes in healthcare service use in both natural and monetary units (from baseline to post-intervention) and presents the impact on net costs and the ICER.

The results of the sensitivity analyses are presented in the next section.

Table 14 – Cost-effectiveness scenarios using 8 different scenarios

ICER for the two-year time horizon			
IBSEN (2008)		Bardsley et al (2012)	
QALY 1	£50,334	QALY 1	£36,238
QALY 2	£33,556	QALY 2	£24,158

ICER for the three-year time horizon			
IBSEN (2008)		Bardsley et al (2012)	
QALY 3	£22,534	QALY 3	£10,427
QALY 4	£15,774	QALY 4	£7,299

103 **Table 15 Change in resource use based on IBSEN (2008)**

	Unit costs, 2012/13 prices	Intervention impact	Utilisation		Costs		
	PSSRU unit costs	Counsell et al (2007)	Baseline	New level	Baseline	New level	Change in cost
Acute care service use (per person)							
A&E visits							
Year 1	£37	-4%	0.71	0.68	£27	£25	£1
Year 2		-35%	0.71	0.46	£27	£17	£9
Year 3		-28%	0.71	0.52	£27	£19	£7
Hospital inpatient stay							
Year 1	£269	-12%	9.04	8.0	£2,435	£2,152	£284
Year 2		-44%	9.04	5.1	£2,435	£1,368	£1,067
Year 3		-28%	9.04	6.5	£2,435	£1,755	£680
Community healthcare (per person)							
GP visits (Primary care)							
24 months	£63	-1%	8.73	8.7	£550	£546	£4
Year 3		-11%	4.36	3.9	£275	£245	£30
Chiropodist visits (Specialty care)							
24 months	£38	8%	5.84	6.3	£222	£240	£17
Year 3		-11%	2.92	2.6	£111	£99	£12
Occupational therapist visits							
24 months	£56	269%	3.48	12.8	£195	£719	£524
Year 3		-11%	1.74	1.6	£97	£87	£10
Psychiatrist home visit							
24 months	£214	488%	0.14	0.8	£30	£177	£147
Year 3		-11%	0.07	0.1	£15	£13	£2
Two-year time horizon			**A&E**		£53	£43	£11
			Inpatient		£4,871	£3,519	£1,351
			Community		£997	£1,682	£685
			Total healthcare utilisation		£5,921	£5,244	£677
			Intervention cost				£4,100
			Net costs (healthcare - intervention costs)				£3,422
			ICER, QALY 1 (0.068 QALYs)				£50,327
			ICER, QALY 2 (0.102 QALYs)				£33,551
Three-year time horizon			**A&E**		£80	£62	£18
			Inpatient		£7,306	£5,275	£2,031
			Community		£1,496	£2,127	£631
			Total healthcare utilisation		£8,882	£7,464	£1,418
			Intervention cost				£4,100
			Net costs (healthcare - intervention costs)				£2,681
			ICER, QALY 3 (0.119 QALYs)				£22,530
			ICER, QALY 4 (0.170 QALYs)				£15,771

Table 16 Change in resource use based on Bardsley et al (2012)

	Unit costs, 2012/13 prices	Intervention impact	Utilisation		Costs		
	PSSRU unit costs	Counsell et al (2007)	Baseline	New level	Baseline	New level	Change in cost
Acute care service use (per person)							
A&E visits							
Year 1	£37	-4%	0.65	0.62	£24	£23	£1
Year 2		-35%	0.65	0.42	£24	£16	£9
Year 3		-28%	0.65	0.47	£24	£17	£7
Hospital inpatient stay							
Year 1	£269	-12%	15.5	13.7	£4,165	£3,679	£485
Year 2		-44%	15.5	8.7	£4,165	£2,339	£1,825
Year 3		-28%	15.5	11.1	£4,165	£3,002	£1,163
Community healthcare (per person)							
Data taken from IBSEN (2008)							
GP visits (Primary care)							
24 months	£63	-1%	8.73	8.7	£550	£546	£4
Year 3		-11%	4.36	3.9	£275	£245	£30
Chiropodist visits (Specialty care)							
24 months	£38	8%	5.84	6.3	£222	£240	£17
Year 3		-11%	2.92	2.6	£111	£99	£12
Occupational therapist visits							
24 months	£56	269%	3.48	12.8	£195	£719	£524
Year 3		-11%	1.74	1.6	£97	£87	£10
Data taken from Challis (2004)							
Psychiatrist home visit							
24 months	£214	488%	0.14	0.8	£30	£177	£147
Year 3		-11%	0.07	0.1	£15	£13	£2
Two-year time horizon			**A&E**		£49	£39	£10
			Inpatient		£8,329	£6,019	£2,311
			Community		£997	£1,682	£685
			Total healthcare utilisation		£9,375	£7,739	£1,636
			Intervention cost				£4,100
			Net costs (healthcare - intervention costs)				£2,464
			ICER, QALY 1 (0.068 QALYs)				£36,231
			ICER, QALY 2 (0.102 QALYs)				£24,154
Three-year time horizon			**A&E**		£73	£56	£16
			Inpatient		£12,494	£9,020	£3,474
			Community		£1,496	£2,127	£631
			Total healthcare utilisation		£14,063	£11,204	£2,859
			Intervention cost				£4,100
			Net costs (healthcare - intervention costs)				£1,240
			ICER, QALY 3 (0.119 QALYs)				£10,423
			ICER, QALY 4 (0.170 QALYs)				£7,296

4.2 Sensitivity analyses

Rationale for sensitivity analyses

In the methodology section (3) we discussed the uncertainties in our analysis. Performing threshold sensitivity analysis helps to address uncertainty in the analysis by testing the robustness of the results when key assumptions are changed. Sensitivity analysis can identify the parameters that have the greatest influence on the results.[12] Sensitive parameters are those that lead to large changes in the ICER as a result of small changes to the parameter's values. This is measured by exploring when sensitive parameters turn the ICER past the £20,000 and £30,000 per QALY thresholds.

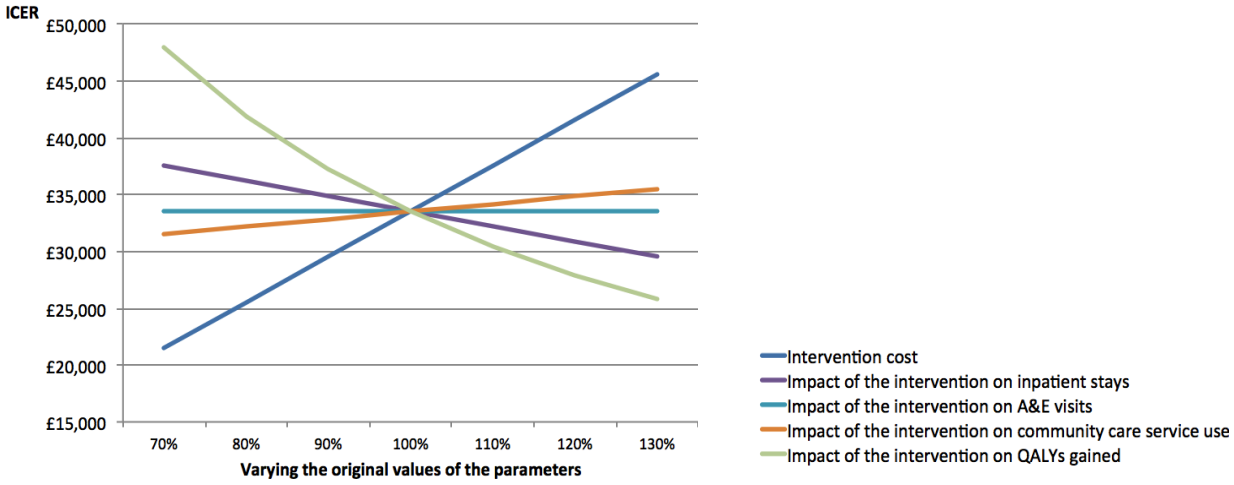
One-way sensitivity analysis: Which parameters have the most influence on the results?

The first step is to determine which parameters have more influence on the results than others. We find this out by varying the values of each parameter, one at a time, between -30% to +30%, while keeping the original values for all other parameters (the rationale for this range is that it is large enough to see the significance of each parameter on the results). We illustrate the results in Figure 5 using one of our eight scenarios; however, these are the same for the other seven scenarios. Very sensitive parameters include:

- The cost of the intervention
- Intervention's impact on QALYs gained
- Intervention's impact on changes in inpatient stays

Figure 5
Sensitivity of ICER to changes in the parameters' assumptions in 10% increments

IBSEN (2008) scenario with an assumption of 0.102 QALY gains over 2-years (as an example)



[12] One main factor influencing the sensitivity of the results is the difference in unit costs. The cost of an inpatient stay (£305) is significantly higher compared to the cost of an A&E visit (£42) or the costs of community care (£60 for a rehabilitation visit, £41 contact with specialist, £70 GP contact). Therefore, when assumptions about either the baseline level of inpatient stay or the impact of the intervention on the proportional change in the use of inpatient stay varies, the results are more sensitive relative to other parameters.

Three-way sensitivity analysis

Time horizon

We only conduct a sensitivity analysis on the three-year time horizon.

This is because most of the ICERs were above £30,000 per QALY in the two-year scenario. Therefore, any additional sensitivity analyses using more conservative assumptions will not add any new knowledge about the intervention's likely cost-effectiveness.

Rationale

We conduct a three-way sensitivity analysis only on the most sensitive parameters (as listed above: intervention costs, impact on QALYs gained and on inpatient stays). A three-way sensitivity analysis simultaneously changes all three parameters and checks the confidence that the intervention is likely to be cost-effective. This is measured by conducting sensitivity analysis from a range of -50% to +50%. These figures were chosen because they were sufficiently large to detect the points at which the ICER was no longer within the cost-effectiveness range.

Results, three-year time horizon

Table 17 summarizes the results and whether it was possible to undertake conservative changes in all three parameters and whether the ICER was still cost-effective at the £20,000 or £30,000 per QALY.

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Figure 7, using a spider graph, illustrates the maximum conservative changes at which the ICER can remain cost-effective at either the £20,000 or £30,000 per QALY threshold.

Table 17
Summary of the three-way sensitivity analysis

Two-year time horizon			
We do not conduct three-way sensitivity analysis on the two-year time horizon because most of the ICERs are above £30,000 per QALY and therefore will not add new knowledge.			
Three-year time horizon			
IBSEN (2008)	**ICER using original values**	**£20,000 /QALY** Is it possible to keep the ICER below £20,000 when all three parameters take on conservative assumptions?	**£30,000/QALY** Is it possible to keep the ICER below £30,000 when all three parameters take on conservative assumptions?
0.119 QALYs	£22,530	No	No
0.170 QALYs	£15,774	No	Yes
Bardsley (2012)			
0.119 QALYs	£10,423	Yes	Yes
0.170 QALYs	£7,296	Yes	Yes

IBSEN (2008)

ICER of £20,000

- When a total of 0.119 QALY gains are assumed, there is no conservative scenario that can occur in all three parameters to keep the ICER below £20,000. This is because the original values already result in an ICER of £22,530.
- When a total of 0.170 QALY gains are assumed, there is no conservative scenario that can occur in all three parameters to keep the ICER below £20,000. This is because the original values under the 0.170 QALY assumption is £15,774 and conservative changes can very quickly move the ICER past £20,000. However, there is a very small threshold of conservative changes but this occurs in only in two parameters simultaneously.
    - The threshold is a maximum 10% increase in the intervention's cost; no changes in the intervention's impact on QALY gains. A maximum of a 10% reduction in the intervention's impact on inpatient stays.

ICER of £30,000

- Assuming 0.119 QALY gains, there is no conservative scenario that can occur in all three parameters to keep the ICER below £30,000. However, there is a very small threshold of conservative changes, but again, only in two parameters where the ICER remains below £30,000.
    - The maximum threshold is a combination of a 10% increase in the intervention's cost coupled with a 10% reduction in the intervention's impact on QALYs gained and no changes in the intervention's impact on inpatient stays.
- If it is assumed that 0.170 QALYs are gained, there is a conservative scenario that can occur in all three parameters to keep the ICER below £30,000.
    - The maximum threshold is a combination of a 10% increase in the intervention's cost coupled with a 10% to 30% reduction in QALY gains and 20% to 50% reduction in the impact of the intervention on inpatient stays.

Bardsley et al (2012)

ICER of £20,000

- When a total of 0.119 QALYs are assumed, there is *a small threshold* of conservative changes in all three parameters where the ICER remains below £20,000. This is because the ICER using the original values is £10,423 and conservative changes can very quickly move the ICER past £20,000.
    - The threshold is a combination of a 10% increase in the intervention's cost; 10% reduction in the intervention's impact on QALY gains, and a 10% reduction in the intervention's impact on inpatient stays.

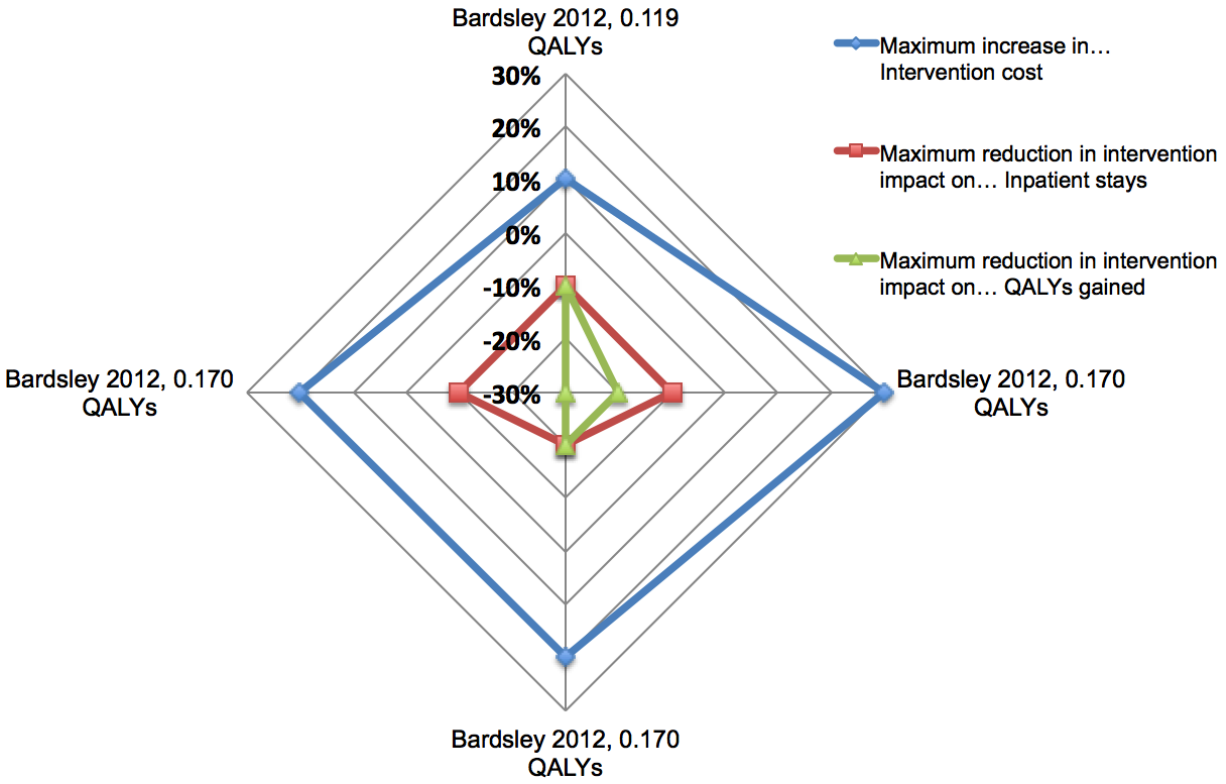
- When a total of 0.170 QALYs are assumed, there is *a wider threshold* of conservative changes in all three parameters where the ICER remains below £20,000. This is because the ICER using the original values is £7,296 and so there is slightly more room to accommodate conservative changes.
    - The threshold is a combination of a 20% to 30% increase (or less) in the intervention's cost, a 10% reduction in the intervention's impact on QALY gains, and a 10% to 20% reduction in the intervention's impact on inpatient stays.

ICER of £30,000

- When it is assumed that there are a total of 0.119 QALYs gained, there is *an even wider threshold* of conservative changes where the ICER remains below £30,000.
    - The threshold is a combination of a 20% to 30% increase in the intervention's cost, 10% to 30% reduction in the intervention's impact on QALY gains, and a 10% to 20% reduction in the intervention's impact on inpatient stays.
- When it is assumed that there are a total of 0.170 QALYs gained, there is still *an even wider threshold* of conservative changes where the ICER remains below £30,000.

The threshold is a combination of a 30% increase (or less) in the intervention's cost, a 10% to 40% reduction in the intervention's impact on QALY gains, and a 10% to 50% reduction in the intervention's impact on inpatient stays.

Figure 6
£20,000 per QALY - maximum conservative changes that are possible in all three parameters



108

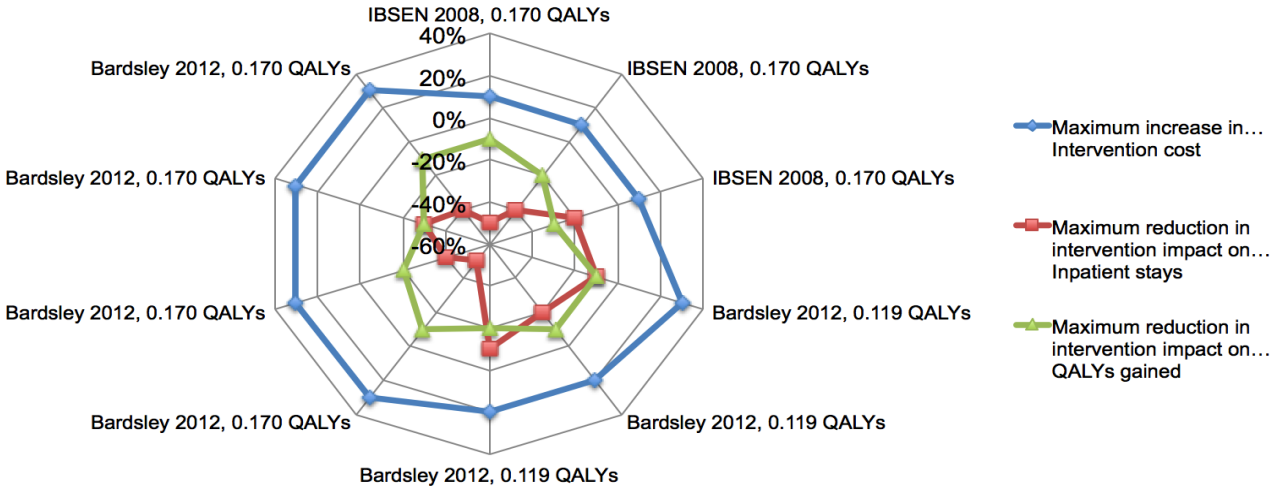
ICER = £20,000 per QALY	Maximum increase in… Intervention cost	Maximum reduction in intervention impact on… Inpatient stays	Maximum reduction in intervention impact on… QALYs gained
IBSEN 2008, 0.119 QALYs	*Not possible, already above £20,000 per QALY*		
IBSEN 2008, 0.170 QALYs	*Not possible to undertake conservative assumptions in all three parameters (only two parameters).*		
Bardsley 2012, 0.119 QALYs	+10%	-10%	-10%
Bardsley 2012, 0.170 QALYs	+30%	-10%	-20%
Bardsley 2012, 0.170 QALYs	+20%	-20%	-20%
Bardsley 2012, 0.170 QALYs	+20%	-10%	-30%

109

110

111 **Figure 7**

112 **£30,000 per QALY - maximum conservative changes that are possible in all three parameters**



ICER = £30,000 / QALY	Maximum increase in… Intervention cost	Maximum reduction in intervention impact on… Inpatient stays	Maximum reduction in intervention impact on… QALYs gained
IBSEN 2008, 0.170 QALYs	10%	-50%	-10%
IBSEN 2008, 0.170 QALYs	10%	-40%	-20%
IBSEN 2008, 0.170 QALYs	10%	-20%	-30%
Bardsley 2012, 0.119 QALYs	30%	-10%	-10%
Bardsley 2012, 0.119 QALYs	20%	-20%	-10%
Bardsley 2012, 0.119 QALYs	20%	-10%	-20%
Bardsley 2012, 0.170 QALYs	30%	-50%	-10%
Bardsley 2012, 0.170 QALYs	30%	-40%	-20%
Bardsley 2012, 0.170 QALYs	30%	-30%	-30%
Bardsley 2012, 0.170 QALYs	30%	-40%	-10%

5 Additional evidence on outcomes relevant to the cost-utility analysis

The results of the cost-utility analysis are based on one recent study but it is worthwhile to draw on evidence from the older additional studies identified. These additional studies are valuable in that they measured outcomes not captured in the Counsell (2007) study. Therefore, this knowledge can enhance our understanding of the potential impact of the intervention and the intervention's cost-effectiveness.

The impact of these interventions on the following health and functional outcomes are summarised below (**Table 18**). It is important to note that not all of the same outcomes were measured, and even then, measurement tools may have been different. The general finding is that across a range of outcomes, the impact is to improve or have no significant difference on mental health, general health, cognitive function, activities of daily living, function, mortality, and some service-level outcomes.

This is based on moderate evidence from two excellent quality non-UK studies: one from Canada (Beland 2006, ++/+) and one from the USA (Counsell et al 2007, ++/+), three moderate quality studies: two from the US (Boult 2001, +/+ and Toseland 1996 and 1997, +/+) and one from Italy (Bernabei 1998, +/+), and one poor quality study from Italy (Landi 1999, –/+) that integrating health and social care inputs into the assessment, care planning, and service delivery process can improve a range of health-related outcomes for older people with multiple long-term conditions who have some degree of limitations in basic or instrumental activities of daily living in comparison to individuals receiving potentially fragmented health and social care assessment and care planning and service delivery (or usual GP care). It is important to keep in mind that samples across studies were not homogeneous (varying levels of restriction in basic and instrumental activities of daily living) and reflect different institutional contexts.

Table 18 – Additional evidence on outcomes

Domain	**Mental health**			
Impact?	**Measurement tool**	**P-value**	**Study**	**Time horizon**
Improved	SF-36 mental health summary component	p=0.01	Counsell 2007	24 months
	Geriatric Depression Scale	p<0.05	Bernabei 1998	12 months
	Geriatric Depression Scale	p<0.01	Boult 2001	12, 18 months

Domain?	**General health**			
Impact?	**Measurement tool**	**P-value**	**Study**	**Time horizon**
No difference	SF-20	p=0.24	Toseland 1997	24 months

Domain	**Cognitive function**			
Impact?	**Measurement tool**	**P-value**	**Study**	**Time horizon**
Improved	Short portable mental status questionnaire	P<0.05	Bernabei 1998	12 months

Domain?	**Activities of daily living**			
Impact?	**Measurement tool**	**P-value**	**Study**	**Time horizon**

Improved	Basic activities of daily living	p<0.001	Bernabei 1998	12 months
	Instrumental activities of daily living	p<0.05	Bernabei 1998	12 months
No difference	Basic activities of daily living	p=0.61	Counsell 2007	24 months
	Instrumental activities of daily living	p=0.97	Counsell 2007	24 months
Domain?	**Function**			
Impact?	**Measurement tool**	**P-value**	**Study**	**Time horizon**
Improved	Sickness Impact Profile: Physical functioning	p<0.05	Boult 2001	6, 12, 18 months
	Bed disability days	p<0.05	Boult 2001	12, 18 months
	Restricted activity days	p<0.05	Boult 2001	12, 18 months
No difference	Functional independence measures	p > 0.05	Toseland 1997	24 months
Domain?	**Mortality**			
Impact?	**Additional information**	**P-value**	**Study**	**Time horizon**
Improved	Those reporting no pain on SF-20 subscale	p=0.051	Toseland 1997	24 months
No difference	Whole sample	NS	Counsell 2007	24 months
	Whole sample	NS	Boult 2001	18 months
	Whole sample	NS	Bernabei 1998	12 months

154

Domain?	**Service-level outcomes**			
Impact?	**Measurement tool**	**P-value**	**Study**	**Time horizon**
Improved	Reduced use of medications	p <0.05	Bernabei 1998	12 months
	Satisfaction	p=0.000	Toseland 1996	8 months
	Better process of care from health and social care professionals	p=0.000	Toseland 1996	8 months
	Better continuity of care from health and social care professionals	p=0.000	Toseland 1996	8 months

155

Domain?	**Carer outcomes**			
Impact?	**Measurement tool**	**P-value**	**Study**	**Time horizon**
Improved	Total caregiving burden (subjective and objective using Montgomery et al., 1985)	Not provided	Boult 2001, Weuve 2000	12 months

156

157

158

6 Discussion

1. **One limitation of the analysis is that Counsell et al (2007) did not measure individuals' use of community social care services, whether paid or voluntary** (for example, hours of home care support, use of adult day-care centres, or delivered meals). While we did draw on limited evidence from additional studies, the impact on social care services was mixed (Section 2.8). Therefore it is difficult to infer how the intervention might influence social care service use but we offer some hypotheses below.

   A. Counsell's study found no statistical differences on the intervention's impact on individuals' functional abilities, as measured by instrumental and basic activities of daily living at 2 years. However, evidence from additional studies finds either improvements or no differences in activities of daily living and different measures of functioning. Therefore we might infer that there is some potential for improvements in this area, although we cannot be certain.

   - The implication is that improvements or prevention of decline in functional abilities reduces or delays the need for increased social care support.

   B. Two intervention components have potential to influence social care service use. These were the involvement of the community services liaison as a part of the geriatric multidisciplinary team and the use of protocols in assessing and responding to caregiver burden. These components could lead to an increase of community care services, or improve informal carers ability to cope without increasing care provided.

      There is evidence from one older US study with a similar intervention model that, at 12 months follow-up, there was a smaller proportion of carers experiencing increases in caregiving burden (Intervention = 17% vs. Control = 39%, Risk ratio: 0.43, 95% confidence interval (0.21-0.92)) and smaller proportion initiating formal, paid home care (Intervention: 17% vs. Control: 42%, p=0.03)) (Weuve et al 2000, p.432). This association was still significant even after adjusting for potential confounders like caregiver travel time, help from other informal carers, the relationship between carer and the recipient, and the recipient's restricted activity days (Weuve et al 2000, p.433).

      The type of caregiver support offered in Weuve et al 2000 may be similar to that offered in Counsell et al (2007): caregivers received counselling and referrals to support groups and other community care services.

   - The implication from this study suggests there may be reduced private social care costs. However, local authority and private decisions to initiate additional social care services are influenced by different budget constraints; therefore it is unclear how this translates to the English PSS perspective.

2. **Counsell et al 2007 does not measure impacts on admissions to nursing or care homes, however, additional evidence finds no significant differences.**

We drew on moderate quality evidence from the additional studies regarding the impact of the intervention on admission to nursing or care homes. The finding was no differences between groups over a range of time horizons (12 to 24 months) (Section 2.8).

However, one older US study found that improvements in caregiver outcomes (via counselling and support) delayed admissions to nursing home placement (Mittelman, Ferris, Shulman, & Levin, 1996). However findings may have limited generalizability as that study focused on individuals with dementia and ours did not.

Using evidence from one English study (Challis et al 2004), carers in the intervention group had statistically significant reduction in caregiving burden (*Social Behaviour Assessment Score*, $p<0.03$) and there was a statistically significant reduction in the number of older people admitting to nursing homes at 6 months follow-up ($p=0.05$) but there were no differences in residential care home admissions. However, these individuals were at risk for admission to residential care and were considered to have substantial or critical social care needs. It is then also unclear whether that sample is generalizable to the sample used in our analysis.[13]

- The implication of these findings is that it is unlikely that there would be increased admissions to nursing or residential care.

3. **None of the additional studies included specific social care quality of life outcome indicators.**

However, given that all the effects on health status and health-related quality of life indicators were found to be either positive or not significantly different, it might be reasonable to expect that social-care-related quality of life would not be deteriorated as a consequence of the intervention.

4. **Another limitation is that most studies did not measure the impact on caregivers.**

Using evidence from Weuve et al (2000), it is possible that there were improvements in carer outcomes. Weuve et al (2000) found that the control group's total burden scores (a combination of objective and subjective measures) increased when care recipients' depressive symptoms increased, but this was not true for the intervention group ($p=0.068$) (Weuve et al 2000, p.434). This is interesting considering that there were no changes in total caregiving time (p.435).

[13] This intervention was targeted at improving social care planning through the addition of a health care assessment by a geriatrician or old age psychiatrist. However it is unclear whether, if at all, the intervention delivered any specific or standard service and support for carers.

Weuve et al (2000, p.434) also found that the intervention was trending towards a greater beneficial effect on carers with less experience and those carers who were less closely related to their care recipients (although this was not statistically significant).

Weuve et al (2000, p.434) point to other, older, US studies with similar intervention types (inpatient and outpatient geriatric evaluation and management) that show that these interventions were associated with statistically significant improvements in carers wellbeing (citing (Stuckey & Neundorfer, 1996); (Stull, Kosloski, & Kercher, 1994) or improvements on a single question on burden and a family strain index (Silliman, McGarvey, Raymond, & Fretwell, 1990) (Silverman, Musa, Martin, Lave, Adams, & Ricci, 1995).

- The implications of these studies suggest that there may be improvements to carers that have not been captured in our analysis. This would improve the intervention's cost-effectiveness.

7 Recommendations

1. While social care economic evaluation does not have an established outcome measure nor a threshold on which to determine whether interventions are cost-effective, the GDG concluded that the intervention is likely to be cost-effective at the £20,000 to £30,000 per QALY threshold based on the results of the sensitivity analysis and using evidence of improved outcomes identified in the cost-consequence analysis based on findings from additional studies. These studies found improvements or no differences in mental health, general health, activities of daily living, physical function, cognitive function, mortality, and carer outcomes.

   More specifically, whether or not the intervention is cost-effective depends to a large extent on the length of period considered, and in particular on whether the intervention would lead to improvements in quality of life beyond the period of the intervention. Whether or not this is realistic will depend on whether some residual gain could be expected post-intervention due to improvements in the design of the care package associated with the improved care management arrangements.

2. Further research in England should be sure to:

- For this particular intervention, measure the changes in the use of health & social care services for both individuals and their carers and measure private costs to carers, in terms of time spent caring, and the impact on carers' quality of life.
- For this particular intervention, measure outcomes that are meaningful to the individual.
    - Members of the guideline committee, in particular, comments from the service users and carers indicate that social isolation, social activities, and "living" were important outcomes.

- For this particular intervention, ensure a long enough follow-up period, covering some period of time beyond the intervention.
    - This will ensure that lagged effects of the intervention are captured, for example, how this influences carer outcomes and caregiving decisions and individuals' admissions to nursing or care homes.
- Conduct statistical analyses to understand:
    - Which types of carers are most likely to benefit from the intervention (experienced or inexperienced, close or distant relationships with care recipients, age of carer, mental health status of carer, etc.).

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9 Appendix: Statistical properties of the mapping function (SF-36 to EQ-5D).

The mapping function was developed using twelve studies covering a range of health conditions including asthma, chest pain, healthy older women, chronic obstructive pulmonary disease, menopausal women, irritable bowel syndrome, trauma, lower back pain, leg reconstruction, leg ulcers, osteoarthritis, and varicose veins (Ara & Brazier, 2008, p. 1132).

The models were developed using ordinary least squares regression models using patient level data. The authors checked the model for goodness of fit using standard techniques: variance explained, the magnitude of errors in predicted values, and the proportion of values within the minimal important difference of the EQ-5D (Ara & Brazier, 2008, p. 1131). The authors also check predictive ability using other datasets.

The authors report that (Ara & Brazier, 2008, p. 1131):

- the model explained more than 56% of the variance in EQ-5D scores and
- the mean predicted score was correct within two decimal places
- the absolute error for individual predicted values was 0.13
- mean errors (mean absolute errors) for:
    - within-sample subgroup mean EQ-5D scores ranged from 0.021 to 0.077 (0.045 to 0.083)
    - out-of-sample published data sets ranged from 0.048 to 0.099 (0.064 to 0.010)

The formula for mapping the eight dimensions of the SF-36 to the EQ-5D:

EQ-5D = 0.03256 + 0.0037 × Physical Function + 0.0011 × Social Function − 0.00024 × Role Physical + 0.00024 × Role Emotional + 0.00256 × Mental Health − 0.00063 × Vitality + 0.00286 × Bodily Pain + 0.00052 × General Health

10 Appendix: Details of the full cost approach used to estimate the unit cost of a full-time equivalent health or social care professional involved in the intervention

Care professionals in **bold** are as described in Counsell et al (2007, 2009) while care professionals in brackets ( ) are our assumptions about English-equivalent care professionals.

FTE cost per year, 2012/13 prices	**Case managers**		**Physiotherapist** (NHS community physiotherapist)	**Pharmacist** (Community pharmacist)	**Community organizer** (Social worker assistant)	**Geriatrician** (Medical consultant)	****Mental health social worker** (Approved mental health social worker)
	Nurse specialist (specialist community nurse)	**Social worker** (Lead social worker)					
Wages	£31,943	£39,171	£23,474	£38,610	£21,851	£87,060	£38,829
Oncost, (employers' national insurance and pension contribution on behalf of employees)	£7,818	£12,178	£5,464	£9,671	£6,324	£23,141	£10,662
Qualifications (related to training)	£10,514	£25,626	£5,587	£8,858	Not reported	£72,197	£20,744
Overheads direct	£7,677	£14,891	£5,588	£9,323	£8,171	£21,279	£13,482
Overheads indirect	£16,688	£8,216	£12,125	£20,263	£4,508	£46,251	£7,439
Capital overheads	£3,687	£2,552	£4,338	£3,937	£2,452	£4,891	£2,011
Total annual cost	£78,327	£102,634	£56,576	£90,662	£43,306	£254,819	£93,167 x 0.5% HSCIC pay inflation rate = £93,629
Source: PSSRU unit cost report	2014, p.190	2014, p.205	2014, p.179	2014, p.184	2014, p.208	2014, p.257	Unit cost (2010, p.175) Inflation (2014, p.263)

Notes

**Mental health social worker: Unit costs for the mental health social worker were only available from the 2010 edition of the PSSRU unit costs (p.175). The HSCIC pay inflation rate was applied at 0.5%, using 2009/10 as the index year, to inflate to 2012/13 prices (PSSRU unit cost report, 2014, p.263). An approved mental health social worker is defined as someone "with responsibility for assessing someone's needs, care and treatment under the Mental Health Act 1983 (MHA). The ASWs plays a key role in deciding whether someone with mental health problems can be cared for in the community, or whether they should be admitted to hospital." (PSSRU unit cost 2010, p.175).

FTE cost per year, 2012/13 prices	**Administrative assistant** (Administrative & clerical staff, GP office)	**Practice manager** (Practice manager)
Wages & oncosts	£27,026*	£57,260**
Practice expenses ***		
Direct care staff	*Excluded*	*Excluded*
Office and general business	£9,970	£9,970
Premises	£14,005	£14,005
Other	£16,616	£16,616
Car and travel	*Excluded*	*Excluded*
Capital costs	£13,217	£9,970
Total annual cost	**£80,834**	**£111,068**
Source: PSSRU unit cost report	2014, p.194	2014, p.194 and p.277

Notes

*Administrative assistant wages and oncosts were calculated using GP practice costs of administrative and clerical staff (PSSRU unit costs 2014, p.194). The PSSRU unit cost reports that a GP practice uses 1.3FTE administrative and clerical staff, costing £35,134 per year, which includes salary and oncosts. As we needed information on 1FTE, we divided £35,134 by 1.3 to obtain estimates for our purpose. Using this information, 1FTE is £27,026 per year.

**Practice manager wages and oncosts could not be identified for GP practices. We assumed practice manager costs using estimates from a transition service for children transferring into adult services. We estimated the FTE cost per year to be £57,260 using the information provided. Information provided indicated that 0.05FTE practice manager cost £2,863 (PSSRU unit costs, 2014, p.277).

***Practice expenses were used to estimate overheads and capital costs associated with the administrative assistant and practice manager. These costs are taken from an office-based GP (PSSRU unit costs, 2014, p.194). We excluded the costs of direct care staff and car & travel as these related to the GP. However we assumed that applicable costs included: office and general business, premises, 'other', and capital costs.

11 Appendix: Details on the full cost approach used to estimate unit costs of healthcare utilisation

<table>
<tr><th>2012/13 prices
Cost per contact</th><th>Healthcare resource</th><th>Face-to-face
(Cost per hour)</th><th>Average intensity
(Face-to-face contact)</th><th>Indirect cost
per hour</th><th>Ratio of indirect to
face-to-face activity</th></tr>
<tr><td>£269</td><td>Average cost per inpatient bed day</td><td colspan="4" rowspan="2">We did not estimate the full cost approach due to lack of information. These are based on NHS reference costs, which are charges data.</td></tr>
<tr><td>£37</td><td>Average A&E cost</td></tr>
<tr><td>£38</td><td>Chiropodist visit</td><td colspan="4">PSSRU unit costs (Curtis 2010, p.156). No information provided on direct and indirect costs. Estimates are based on the NHS reference cost for a mean average cost per contact (but no information is given for the mean duration of a contact).</td></tr>
<tr><td rowspan="2">£214</td><td rowspan="2">Psychiatrist home visit
(Clinical psychologist)</td><td>£138</td><td>1 hour</td><td>£61</td><td>1.25:1</td></tr>
<tr><td colspan="4">PSSRU unit costs (Curtis, 2014, p.183)</td></tr>
<tr><td colspan="6">Calculation: £214 = (£138 * 1 hour) + (£61 * (1.25 * 1 hour))</td></tr>
<tr><td colspan="6">Comments and source of information used in calculations: PSSRU unit costs (2014, p.183)

<u>Face to face cost per hour:</u> Unit cost per hour of face-to-face contact

<u>Average intensity of face-to-face contact:</u> No information was available on the average duration of a psychiatrist home visit. Assumed to be 60 minutes.

<u>Indirect cost per hour:</u> No information provided on the unit cost of indirect activities, assumed hourly wage based on annual salary

<u>Ratio of indirect to face-to-face activity</u>: Total ratio of face-to-face activity with all other activity</td></tr>
</table>

2012/13 prices Cost per contact	Healthcare resource	Face-to-face (Cost per hour)	Average intensity (Face-to-face contact)	Indirect cost per hour	Ratio of indirect to face-to-face activity
£63	**Primary care (GP visit)**	PSSRU unit costs (Curtis 2014, p.195) Estimated as an average of GP home & clinic visits (see below). £63 = (£66 + £60) / 2			
£66	**Home visit**	£234	11.4 / 60 minutes	£117	0.99:1
Calculation: £66 = (£234 * (11.4/60 minutes)) + (£117 * (0.99 * (11.4/60 minutes))					
£60	**Surgery visit**	£234	11.7 / 60 minutes	£117	0.61:1
Calculation: £60 = (£234 * (11.7/60 minutes)) + (£117 * (0.61 * (11.7/60 minutes))					

Face to face cost per hour: Per hour of patient contact, excludes travel time (PSSRU 2014, p.195)

Average intensity of face-to-face contact: Average duration of home visit estimated at 11.4 minutes. Average duration of a surgery visit estimated at 11.7 minutes (PSSRU unit costs, 2014, p.194).

Indirect cost per hour: No unit cost is provided for indirect contact per hour. We assume unit cost is 1/2 of face-to-face cost.

Ratio of indirect to face-to-face activity:

- *Ratio of indirect time related to home visit* is not available in the 2014 edition of PSSRU unit costs (p.194). However, estimates are available from 2013 edition (p.190). Which is estimated at 1:0.99 (includes home and clinic visits and travel time).
- *Ratio of indirect time related to surgery visit* (PSSRU, 2014, p.194)

Healthcare resource	2012/13 prices Cost per contact	Face-to-face (Cost per hour)	Average intensity (Face-to-face contact)	Indirect cost per hour	Ratio of indirect to face-to-face activity
Occupational Therapist Contact	**£56**	Estimated as an average of Local Authority and NHS provided (home and clinic) (See below) £56 = (£82 + £63.70 + 22.30) / 3			
Local authority provided at home (cost per contact)	**£82**	£82.40	(40 / 60 minutes)	£42.20	0.96:1.0
Calculation: £82 = (£82.40 * (40/60 minutes)) + (£42.20 * (0.96 * (40/60 minutes)) Face to face cost per hour: No information was provided in the most recent (2014) edition of the PSSRU unit costs. The earliest edition with information came from the PSSRU unit costs from 2010 (p.177). Unit costs from 2009/10 was £82 per hour of face-to-face contact, and prices inflated to 2012/13 using the PSS pay inflator for adult services, all sectors (PSSRU unit costs, 2014, p.265). Inflation estimated at 0.5%, resulting in 2012/13 prices of £82.40 per hour of face-to-face contact. Average intensity of face-to-face contact: Estimated at 40 minutes (PSSRU unit costs, 2010, p.177) Indirect cost per hour: No information provided for unit cost of indirect time associated with face-to-face contact. We assume a general unit cost per hour derived from annual salary (£42/hour using 2009/10 prices, which includes the full cost approach and cost of training) (PSSRU unit costs, 2010, p.177). 2009/10 prices are inflated to 2012/13 using the PSS pay inflator for adult services, all sectors (PSSRU unit costs, 2014, p.265). Inflation estimated at 0.5%, resulting in 2012/13 prices of £42.20 per hour. Ratio of indirect to face-to-face activity: (PSSRU unit costs, 2010, p. 177)					
NHS provided at home (Cost per contact)	**£63.70**	£44.40	60 minutes	£26.40	0.73:1.0
Calculation: £63.7 = (£44.40 * (60/60 minutes)) + (£26.40 * (0.73 * (60/60 minutes)) Face to face cost per hour: No information was provided in the most recent (2014) edition of the PSSRU unit costs. The earliest edition with information came from the PSSRU unit costs from 2010 (p.152). Unit cost of per hour of client contact (including cost of qualifications), NHS provided, estimated at £42 per hour at 2009/10 prices (PSSRU unit costs, 2010, p.152). These were inflated to 2012/13 using the HSCIC pay index (PSSRU unit costs, 2014, p.263). Inflation estimated at 5.7%, resulting in 2012/13 prices of £44.40 per hour of face-to-face contact. Average intensity of face-to-face contact: Estimated at 60 minutes (PSSRU unit costs, 2010, p.152) Indirect cost per hour: No information provided for unit cost of indirect time associated with face-to-face contact. We assume a general unit					

cost per hour derived from annual salary (£25/hour using 2009/10 prices, which includes the full cost approach and cost of training) (PSSRU unit costs, 2010, p.152). 2009/10 prices are inflated to 2012/13 using the HSCIC pay index (PSSRU unit costs, 2014, p.263). Inflation estimated at 5.7%, resulting in 2012/13 prices of £26.40 per hour.

Ratio of indirect to face-to-face activity: (PSSRU unit costs, 2010, p.152).

NHS provided in clinic (Cost per contact)	**£22.30**	£35.90	(30 / 60 minutes)	£26.40	0.33:1.0

Calculation: £22.3 = (£35.90 * (30/60 minutes)) + (£26.40 * (0.33 * (30/60 minutes))

Face to face cost per hour: No information was provided in the most recent (2014) edition of the PSSRU unit costs. The earliest edition with information came from the PSSRU unit costs from 2010 (p.152).

Unit cost of per hour of client contact (including cost of qualifications), NHS provided, estimated at £34 per hour at 2009/10 prices (PSSRU unit costs, 2010, p.152). These were inflated to 2012/13 using the HSCIC pay index (PSSRU unit costs, 2014, p.263). Inflation estimated at 5.7%, resulting in 2012/13 prices of £35.90 per hour of face-to-face contact.

Average intensity of face-to-face contact: Estimated at 30 minutes (PSSRU unit costs, 2010, p.152)

Indirect cost per hour: No information provided for unit cost of indirect time associated with face-to-face contact. We assume a general unit cost per hour derived from annual salary (£25/hour using 2009/10 prices, which includes the full cost approach and cost of training) (PSSRU unit costs, 2010, p.152). 2009/10 prices are inflated to 2012/13 using the HSCIC pay index (PSSRU unit costs, 2014, p.263). Inflation estimated at 5.7%, resulting in 2012/13 prices of £26.40 per hour.

Ratio of indirect to face-to-face activity: (PSSRU unit costs, 2010, p.152).

12 Appendix – Comparability of English samples to Counsell et al (2007)

Study, Sample size	Age, Sex	Hospital Admission Rates	Measures of Functional Dependency, ADL + IADL, scores	Mean chronic conditions	Self-rated health	Living alone & informal care	Depression	Cognitive impairments
IBSEN 2008 N=316	**Mean Age** = 80 years **Minimum age** = 65 **Female**= 67%	**(3 months prior)** 0.18 per person	**Barthel index** (1-3) scale 6-item ADL **ADL** Bathing, feeding, toileting, dressing, grooming, transferring – Matching Counsell 6/6 ADLs **ADL score=** 8.8 **IADL =** not enough comparability to Counsell et al (2007) for scores to be meaningful	Not measured	**How is your health?** 1= very good 5 = very bad **Mean score**: 3.1	**Living alone** = 51% **Informal carer** = 54%	**Have you been recently feeling unhappy and depressed?** Excludes "don't know & not applicable" 1 = not at all 2 = no more than usual 3 = rather more than usual 4 = much more than usual **Mean score**: 2	15% diagnosed 30% with evidence of cognitive impairment
Bardsley et al 2012 N=2,118 with high home care service use	**Mean age =** 81.5 years **Minimum age** = 75 **Female**= 61%	**12 months,** 0.91 per person	**Not available**					
Counsell et al 2007 *N=226 I=114 C=112 *Subgroup with high level of hospital admissions	**Mean Age** =72 years **Minimum age** = 65 **Female**= 62-67%	**(6 months prior)** I=0.8, C=0.6 admissions per person **12 months post-intervention** I=0.7, C=0.7 admissions per person	**Assets & Health Dynamics of the Oldest-Old (AHEAD)** 6-item ADL, 7-item ADL, (0-3 scale) **ADL score**, I = 2.6, C= 1.9 **IADL score**, I = 3.8, C= 3.5 **% with 1+ ADL restrictions,** (49-46%) **% with 1+ IADL restrictions,** (30-23%)	3.5 to 3.7 (SD = 1.5)	**Overall health status fair or poor** **Mean** = 80% (standard deviation not known)	<u>Information is not available for the subgroup, the information below applies to the whole sample of both individuals with relatively low and high use hospital services</u> **Living alone** = 44% **Carer helping at home** = 25%	**Depressed/ sad** = 26% **Patient health questionnaire-9** **Depression case =** 11% (Score 10+ = 11%)	**Dementia** (MMSE 5+) = 2%