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1 Economic evaluation of integrated new technologies for health and
2 social care: suggestions for policy makers, users and evaluators.

3

4 John Wildman^{a*}, Peter McMeekin^b, Eleanor Grieve^c and Andrew Briggs^c

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7 ^a Economics, 5 Barrack Road, Newcastle University Business School, Newcastle University, Newcastle
8 Upon Tyne,

9 *corresponding author: email: john.wildman@ncl.ac.uk

10

11 ^b Health and Life Sciences, Northumbria University, Newcastle Upon Tyne

12 ^c Institute of Health and Wellbeing, University of Glasgow, Glasgow, Scotland

13

Abstract

14 With an ageing population there is a move towards the use of assisted living technologies (ALTs) to
15 provide social care and health care services, and to improve service processes. These technologies
16 are at the forefront of the integration of health and social care. However, economic evaluations of
17 ALTs, and indeed economic evaluations of any interventions providing both health benefits and
18 benefits beyond health are complex. This paper considers the challenges faced by evaluators and
19 presents a method of economic evaluation for use with interventions where traditional methods
20 may not be suitable for informing funders and decision makers. We propose a method, combining
21 economic evaluation techniques, that can accommodate health outcomes and outcomes beyond
22 health through the use of a common numeraire. Such economic evaluations can benefit both the
23 public and private sector, firstly by ensuring the efficient allocation of resources. And secondly, by
24 providing information for individuals who, in the market for ALTs, face consumption decisions that
25 are infrequent and for which there may be no other sources of information. We consider these
26 issues in the welfarist, extra-welfarist and capabilities framework, which we link to attributes in an
27 individual production model. This approach allows for the valuation of the health component of any
28 such intervention and the valuation of key social care attributes and processes. Finally, we present a

1 set of considerations for evaluators highlighting the key issues that need to be considered in this
2 type of economic evaluation.

3 **Keywords:** Assisted Living Technologies; Economic Evaluation; Multi-dimensional outcomes;
4 Attributes; Capabilities; Health and Social Care

5

6

7 **1 Introduction**

8 In the face of an increasingly dependent population there is a need to find solutions to the
9 associated increases in health and social care costs. The OECD projects that the proportion of
10 individuals over 80 will increase from 4% to 10% by 2050 (Colombo et al., 2011), with the projection
11 that health care spending will rise from 6.7% of GDP in 2007 to 13% by 2060 for the 27 European
12 Union (including Norway) countries (Appleby, 2013).

13 Technology, in the form of assisted living technologies (ALTs), has become a focus for health systems
14 and researchers as a potential solution to increasing costs. ALTs cover interventions such as
15 telehealth, telecare and technology items. They can be home and environmental modifications that
16 may promote independence and safety, and so improve wellbeing and reduce the demand for
17 health and social care services. Such interventions are aimed at older and potentially vulnerable
18 younger populations.

19 ALTs may be provided by the market or by the public sector. However, there have been concerns
20 regarding the ability of the market to provide scalable ALTs to consumers (Li et al., 2014). Further, it
21 is believed that perceptions of the effectiveness of ALTs are mixed (de Leonibus et al., 2013). For the
22 time being it may be preferable for ALTs to be provided by the public sector in which case the
23 benefits, and more pertinently, the cost-benefit of ALT interventions need to be demonstrated. This
24 is important for ensuring that public money is spent efficiently. Furthermore, robust evaluation of

1 ALTs may help to provide information for individuals in the private market, helping it to grow by
2 overcoming the problems surrounding the perceptions of the effectiveness of ALTs.

3 Evaluating ALTs is challenging. Graybill et al. (2014) find that economic evaluations of ALTs are rare,
4 and those that have been conducted are often of poor quality. One area where rigorous evaluations
5 have been conducted is the 'Whole Systems Demonstrator' project (Henderson et al., 2013,
6 Steventon et al. 2013), a large randomised controlled trial of telehealth and telecare. However, the
7 cost-effectiveness results were largely inconclusive.

8 The problem for evaluations may not be the way they are conducted so much as the way current
9 methods are applied. This paper addresses the issue of whether the standard evaluation methods
10 used in health care are suitable when considering ALTs and indeed any intervention where there are
11 multiple outcomes, including processes, that may extend beyond health. The key contribution of this
12 paper is the development of an approach to evaluation that combines current methods in order to
13 value health outcomes and outcomes beyond health alongside one another. The approach retains
14 the CUA basis of valuing health that has been widely used and accepted in the economic evaluation
15 of health care interventions (Drummond et al. 2005). We suggest the use of qualitative and
16 quantitative elements that combine cost-utility (CUA) for valuing health with cost-benefit analysis
17 (CBA) for valuing outcomes and processes beyond health. We also suggest that robust evaluations
18 can benefit both the private sector and the public sector and may help to overcome the problems
19 that currently affect the private market.

20 This approach has several innovative elements: firstly, we combine existing methods from economic
21 evaluation while maintaining the extra-welfarist approach to valuing health outcomes. Secondly, we
22 show how it is possible to link economic theory regarding attributes to a capabilities approach,
23 allowing the new method to encompass wider elements of capabilities than has already been
24 achieved. Thirdly, our process would allow individual attributes to be valued, revealing which
25 elements are important in services providing a range of outcomes and how they are traded-off

1 against each other. Finally, the approach is highly flexible because the use of a consistent numeraire
2 (either monetary or health) means that programmes can be compared even if the underlying
3 attributes differ.

4

5

6 **2 Assisted Living Technologies**

7 ALTs can benefit individuals in need across the whole age range. Generally, ALTs fall into two
8 categories: *Home and Environmental Modifications*, technologies installed to promote independence
9 and mobility and to mediate the risk of injury; and *Telemedicine*, technologies that provide remote
10 communication between people in their home and healthcare, social care or security professionals
11 (Graybill et al., 2014).

12 Demonstrating value for money is important for any intervention that requires public funding and
13 there may be good reasons for publicly funding ALTs even though they may fall outside the
14 traditional remit of health care systems (Li et al., 2014). Firstly, the market for ALTs is not well
15 developed because ALTs are in their infancy. Secondly, the market may be affected by the presence
16 of large public sector health and social care providers that may crowd-out private providers.

17 Individuals may have an expectation, in systems that rely on social insurance or taxation, that
18 technologies providing health and social care should be provided by public funds. Thirdly, the
19 provision and market for ALTs may not be trusted due to consumers having little experience of
20 interacting in such a market. Indeed such markets have been highlighted as potential areas for
21 scams, hindering market development (<http://www.bbc.co.uk/news/business-15097985>). Finally, for
22 markets to work it is important for consumers to have information. Due to the novelty of many ALTs
23 there may be little information regarding their quality and efficacy as interventions. A recent report
24 on the market for ALTs did find a public perception that ALTs may not be effective (de Leonibus et

1 al., 2013). In fact many individuals go to (traditionally public sector) health care and social care
2 professionals in order to obtain information regarding effectiveness. These information gaps mean
3 that individuals may not be willing to pay for ALTs that they would otherwise purchase had full
4 information been available.

5 The evaluation of ALTs may provide a benefit to the private market if evaluation becomes a source
6 of information that highlights the efficacy of ALTs. Evaluations would build a body of evidence
7 regarding which interventions are value for money. This may filter into the private market, which, as
8 it develops, may reduce the need for public provision. However, public provision may always be
9 necessary due to equity concerns, although we will not cover these in this paper.

10

11 **3. Economic evaluations**

12 The concern is whether methods of economic evaluation that are commonly applied in health care -
13 cost-effectiveness analysis (CEA) and CUA - are appropriate for new technologies where there are
14 multiple outcomes, including process value, that extend beyond health. While CEA and cost-
15 consequence analysis (CCA) are useful forms of evaluation they may not be appropriate, either
16 because they are only partial economic evaluations or because they are restricted in the measures of
17 outcomes and focus on issues of technical efficiency. Our focus is on broader approaches such as
18 CBA or CUA.

19

20 **3.1 CBA and welfarism**

21 Economics approaches evaluation through the paradigm of welfare economics - benefits are
22 restricted to those accruing to the individual (in terms of utility gains). The welfarist approach

1 applies CBA, comparing the discounted future streams of incremental programme benefits with the
2 incremental programme costs to measure the net social benefits (Drummond et al., 2005).
3 CBA considers issues of allocative efficiency across and within sectors and may be suitable when the
4 outcomes are varied and process, such as the method of delivery (eg whether at home or at a
5 provider), may also be of value. However, CBA can be difficult to undertake as the values can be
6 confounded by ability-to-pay (Donaldson, 1999), and in the case of social care and health care
7 interventions, confounded by potentially increasing expectations of the role of the state in their
8 provision (Ham et al., 2012). Furthermore, in practical application, it seems that traditional CBA-
9 based welfare economic analysis has not been widely accepted as the evaluative method of choice in
10 the health care setting.

11

12 **3.2 CUA and 'extra-welfarism'**

13 In rejecting the traditional welfarist approach to health care evaluation, the predominant evaluative
14 technique to emerge is the 'extra-welfarist' approach, which focuses on the benefits from
15 fundamental goods and their distribution and underpins most of the economic evaluations in health
16 (Culyer, 1989, Hurley, 2014). According to Coast et al. (2008b) extra-welfarism grew from the work
17 of Sen (1980, 2002) focusing on functionings and capability – the ability of individuals to function.
18 Sen has suggested functionings such as 'moving' or 'being in good health' and it is the focus on the
19 latter and the ability for an individual to be in good health that has led to the development of extra-
20 welfarism. This notion of extra-welfarism is quite narrow (Coast et al., 2008b) and meant that in
21 economic evaluations of health interventions the fundamental good is health. This has led to a focus
22 on using quality adjusted life years (QALYs) as the main currency of outcome measurement (for an
23 excellent discussion of the welfarism, extra-welfarism and capabilities see Coast et al., 2008b). This

1 approach, using QALYs in combination with the cost-utility analysis method, specifically does not
2 place value on benefits outside of health gains.

3 In order to capture benefits beyond health an alternative approach to the method we are suggesting
4 would be to move away from a health focused version of 'extra-welfarism' and develop a broader
5 utility measure to use in CUA, such as the 'capability-QALY' proposed by Cookson (2005), the 'super-
6 QALY' as described by Buxton (2008), or the WELBY (wellbeing adjusted life years) (Brazier and
7 Tsuchiya, 2015). A super-QALY measure would require knowledge of what people value that might
8 be affected by the intervention and a means to capture those effects. Similar problems would be
9 raised by the use of the WELBY, which would also risk removing much of the focus from health.

10

11 **4. The challenges of conducting economic evaluations on ALTs**

12 ALTs present many challenges for the traditional economic evaluation approaches. These challenges
13 may explain why cost-effectiveness studies have struggled to make the case for ALTs in the past.

14 **4.1 The outcomes of ALTs**

15 Using CUA methods with QALYs is the core economic evaluation tool used to investigate value for
16 money in health care. However, focusing on health benefits from the 'extra-welfarist' position is
17 challenged by the possibility of multiple outcomes (Birch and Donaldson, 2003). For ALTs there are
18 outcomes that may be important for health, for social care and for process - improving health and
19 social care may partly revolve around service delivery rather than solely on outcomes. The focus on
20 health and QALYs seems inappropriate in this context and broader measures of outcomes are
21 required. Sen's (1980) notion of capabilities, which is already gaining ground in the area of health
22 (Coast et al., 2008a, Coast et al, 2008c), could provide a way forward.

1 As social care can be a mechanism to support people to improve their opportunities and life
2 chances, the capabilities approach may offer an insight into how the benefits of social care
3 technologies might be identified and quantified. However, the individual nature of capabilities
4 raises difficulties when it comes to technologies not purchased by individuals. Nussbaum
5 attempted to identify ten key capabilities that should be supported by all democracies, some of
6 which could be affected by social care (Nussbaum, 2011). The general nature of Nussbaum's
7 capabilities, for example: "Life. Being able to live to the end of a human life of normal length; not
8 dying prematurely, or before one's life is so reduced as to be not worth living."; are neither easy to
9 establish small marginal effect on nor easily valued. If capabilities were identified that were specific
10 enough to social care interventions, when those freedoms are financially constrained, it is unclear
11 what would be valued in any evaluation: the freedom itself or compensation for the inability or
12 inopportunity to be availed of the freedom. Also, unlike health related utility that, when combined
13 with mortality, produces QALYs for which there is a societal value associated, as yet there is no
14 evidence to understand what society might deem appropriate to pay for any increase in capability.
15 In particular, the notion of 'capability maximisation' as an objective has recently been challenged in
16 favour of focusing on the concept of 'sufficient' (Mitchell et al, 2015).

17 Two potential ways forward would be, firstly, to expand the utility basis of QALYs to take account of
18 capabilities (and process). However, this would require knowledge of which elements of utility were
19 included in any measure (similar arguments have been raised regarding the use of bolt-ons to the
20 EQ-5D, see Brazier and Tsuchiya (2015)). Even if the utility elements could be identified and a utility
21 score developed, individuals would be valuing an overall utility score (in the same way that
22 willingness-to-pay (WTP) of overall programmes provides a single monetary valuation of the
23 benefits). This would provide no information on how the individual elements that comprised the
24 score were valued. It would also require the development of a new threshold level to determine cost
25 effectiveness.

1 A second approach would be to use an instrument. One instrument designed to estimate the effect
2 of interventions targeting older people is ICECAP-O (Grewal et al., 2006), where Attachment (love
3 and friendship), Security (thinking about the future without concern), Role (doing things that make
4 you feel valued), Enjoyment (enjoyment and pleasure) and Control (independence) are the
5 functions.

6 Given the diverse nature of social care interventions, a generic instrument would not necessarily be
7 appropriate for any given technology. Furthermore, given the diversity of social care it may be that
8 even condition specific instruments would not be sensitive enough to be of benefit to evaluators.

9 What is required is a way of conceptualising attributes (that might include capabilities) so they can
10 be valued and combined with health benefits. We suggest that it is possible to link capabilities to
11 attributes through a household production framework based on the work of Lancaster (1966).

12 **4.2 ALTs and attributes**

13 In Lancaster's model, individuals use inputs to produce fundamental outputs or more broadly utility.
14 For example, individuals purchase goods and services that provide health attributes and, through a
15 consumption technology, use these inputs to produce health. It is possible to think of capabilities as
16 outputs from this production process, in which case individuals will consume goods and services that
17 provide attributes that can used to produce capabilities. For example, a key capability may be 'bodily
18 integrity' and individuals would consume goods and services that would provide the attribute 'bodily
19 integrity'. Lancaster's theoretical model allows us to align the attributes of goods with capabilities.

20 If we think of goods as sets of attributes it is possible to see how evaluating ALTs becomes
21 problematic. If we are considering interventions that provide a range of outcomes, and where
22 process may be of value, then it is possible that individuals are willing to trade-off these different
23 attributes against each other. Health care contains attributes of social care and social care contains
24 attributes of health care. They can be substituted for one another, whereas social care attributes

1 may enhance health care attributes meaning that they are also complements (Wildman and
2 McMeekin, 2014).

3 Individuals do not value the services 'health care' or 'social care' care but the attributes that
4 comprise 'health care' and 'social care'. For example, the process through which the health care or
5 the social care is provided is a valued attribute. In this case it is useful to be able to value attributes
6 individually. It is also possible that these attributes may be valued differently; for example, process
7 attributes may be valued more highly than health attributes. In this scenario it would not be
8 possible, or would be complex, to use any measure that results in an overall score, such as the QALY,
9 a broader measure like the 'capability-QALY', the 'super-QALY', a WELBY or an instrument such as
10 the Social Care Related Quality of Life (Netten et al., 2012) that covers elements such as 'control over
11 daily life" or "Dignity". With any such approach, the way that domains are incorporated into an
12 overall metric and valued can be methodologically complex and problematic, and often overlooks
13 substitution effects or trade-offs that individuals are want to make. This problem is also true for CBA
14 approaches where the overall intervention is valued using a single WTP value - there is no way to
15 reveal the valuation of the individual attributes that make up the intervention on offer.

16 **4.3 ALT Perspectives**

17 One of the key decisions when undertaking economic evaluation is the perspective: which costs and
18 benefits should be accounted for in the analysis? While it is beyond the scope of this paper to
19 discuss all of the issues relating to perspectives, it is important to note some of the challenges that
20 economic evaluations of ALTs (and other interventions) face. Costs are often considered at the
21 service level but with interventions where costs may be met by different sectors such an approach
22 can be problematic. In many publicly provided health and social care systems the budgets are
23 separate and there is an incentive for the health care and the social care provider to try to shift costs
24 from their budgets. With health care and social care acting as substitutes it is possible that
25 individuals use health care services when they should use social care services. For example, if an ALT

1 promotes independence, perhaps by aiding mobility, this clearly provides a social care benefit.
2 However, the benefits that arise from cost savings may be largely felt in the health care sector, not
3 only in terms of reduced falls but also by shortening the length of stay in hospital by increasing
4 mobility. Regardless of these problems we believe that the service level is appropriate and below we
5 outline a cost sharing method based on where benefits accrue.

6

7 Benefits are usually considered from a social perspective and, in a CUA framework, focus on QALYs.
8 One advantage of the CBA/WTP approach is the ability to incorporate non-health benefits and other
9 potential externalities that may arise from any intervention (externalities may be incorporated by
10 individuals valuing them in their own WTP; for example if an intervention means that care can take
11 place at home then the externality of not requiring someone to take the individual to receive care
12 may be included in the WTP value). Such an approach means that individual valuation may partly
13 take account of preferences of others, such as carers or family members.

14 With dependent populations, and individuals who may struggle to make decisions in their best
15 interests, perhaps due to cognitive decline, there are many potential beneficiaries (Al Janabi et al,
16 2016). The treated individual may not be the sole beneficiary from the use of ALTs. Others including
17 public sector bodies, charities, immediate family and carers and more distant families, may also
18 benefit and may be making decisions on behalf of the treated. In the presence of many beneficiaries,
19 and moving away from health as the sole benefit to multi-dimensional benefits that include process,
20 it is valid to ask whose valuations of benefits should be included.

21

22 So whose values should count? And should all the identified attributes be included for valuation? It
23 has been suggested that the distinction between patient and public is a false one (Dolan, 1999) while
24 some, such as Gandjour (2010) suggest that nothing beyond the patient's valuations has a

1 theoretical basis. However, such valuations may be problematic due to issues of adaptation (Brazier
2 et al., 2005). Furthermore, for ALTs individual users may be vulnerable, suffer from cognitive decline
3 and are often poor. In such cases valuations that are based on WTP may be particularly affected by
4 ability-to-pay.

5

6

7 It may be preferable that, like the EQ-5D which is based on population-based preferences, the values
8 assigned to attributes should reflect those of the wider population and not just those of the
9 individuals receiving care, their families and associated professionals. If ALTs are to be funded from
10 general taxation then it is right that their benefits should be valued by the wider population. If they
11 are paid for by individuals and their families who obtain benefits, the case for population based
12 valuations is weaker (Gold et al., 1996). This is where the market has clear advantages over public
13 provision. Revealed preference - where the actions of individuals demonstrate their preferences -
14 would demonstrate consumer and family valuations. However, until a wider market has become
15 established this is not currently possible.

16 Given the issues outlined above, especially the issues regarding the potential ability-to-pay bias we
17 recommend the use of population values for the attributes. This is especially important since health
18 states are also being valued at the population level.

19

20 **4.4 Comparators**

21 Finding the correct comparator for any ALT is a challenge due to their complex nature. In any
22 economic evaluation it is good practice to compare a new technology with other alternatives. As
23 Wildman and McMeekin (2014) argue, there are issues when evaluating social care technologies that

1 arise from social care's relationship with health care. In some circumstances it might be necessary to
2 compare a new social care intervention with another social care intervention, whilst at other times a
3 health care technology might be the most appropriate comparator.

4

5

6

7 **5. Valuing outcomes beyond health care**

8 We have highlighted many challenges facing the economic evaluation of ALTs and in this section we
9 outline a new approach to evaluation that overcomes many of these challenges. Many of the
10 problems raised also occur in other areas of economic evaluation and our method could be widely
11 applied to economic evaluations where outcomes beyond health are valued.

12 Our method combines existing evaluation frameworks and a summary is presented in Figure 1. The
13 key feature of this approach is the use of monetary values as a common numeraire across the
14 valuation of attributes/capabilities and the valuation of health. In this way each attribute can be
15 valued, allowing us to identify trade-offs and heterogeneity in valuation and, by using monetary
16 values, providing a mechanism through which social care outcomes can be compared across
17 programs. The health element can be valued in monetary terms through the use of the threshold
18 value that is applied by NICE or via other WTP based approaches. This demonstrates the steps that
19 can be used to evaluate ALTs and other interventions that may have multiple outcomes. It is worth
20 noting that this same threshold could be used to convert monetary values of outcomes and process
21 beyond health into their net-health equivalents (the equivalence between a monetary and health
22 representations of net-benefits is well accepted (Stinnett and Mullahy, 1998)). This may offer some
23 advantages to understanding the trade-offs between the attributes beyond health and health itself.

1

2

3 **5.1 Perspective, comparator and attributes**

4 Choosing the perspective and the attributes to be valued needs to be considered simultaneously
5 because the sets of attributes may vary according to perspective. The attributes of importance may
6 be different if we are considering an intervention from a decision makers' perspective compared to
7 an individual perspective, or family/carer perspective.

8 We suggest that important attributes could be determined by the decision maker or funder (it may
9 be the case that there are important attributes that are valued by the funder). An alternative
10 approach would be to undertake analysis that could identify a range of views and start to bring
11 together important attributes as identified by different populations. These could be populations of
12 decision makers, health and social care professionals, individuals using ALTs or family and carers.

13 One potentially useful method would be Q-methodology. This is a powerful mixed-methods
14 approach that can be used to elicit and group views using factor analysis. An example of applying
15 this method to the public's views on resource allocation can be found in Baker et al. (2014).

16 Practically, it may not be possible to undertake such an analysis for each new intervention -
17 economic evaluations are only one input into a decision making process and it is important that they
18 themselves are value for money. However, this practical difficulty applies to alternative approaches,
19 even the use of the 'super-QALY' would require considerable analysis to understand which elements
20 of utility should be included. Furthermore, as a new approach there are bound to be learning effects
21 and it may be the case that as more analysis is undertaken researchers iterate towards a set of
22 important attributes.

23 As in any economic evaluation, it is important to select the relevant comparator. If funding becomes
24 increasingly integrated then health evaluations, which use health measures or QALYs as their

1 outcome, will need to be compared to evaluations of social care, where QALYs are unlikely to be the
2 most appropriate outcome. In order to obtain comparability between the valuations of benefits,
3 both elements will need to be measured on the same scale. We suggest that the best approach is to
4 measure both sets of benefits in terms of monetary valuations. However, the final decision on the
5 comparator lies with the researcher.

6 With perspective, the method we are proposing is flexible since the measurement of benefits from
7 health attributes and social care attributes are in the same currency - namely money.

8 **5.2 Valuing social care attributes**

9 Representative samples from the population should be used to value the attributes using WTP
10 methods. There are a number of reasons justifying this position. Firstly, while many countries
11 maintain a right to health care funded by the state and there are QALY thresholds in place, beyond
12 health care there are generally no such frameworks. This is true for any capabilities approach where
13 there is no clear agreement on what should comprise a list of capabilities. In this situation there is
14 neither an agreed threshold value, nor is there, unlike the QALY framework, a clear metric to apply a
15 threshold to. Secondly, obtaining valuations from the population would demonstrate wider WTP for
16 ALTs (or other technologies) that may eventually filter into the private market. Thirdly, the
17 valuations would allow for externalities to be accommodated and, at least in part, account for
18 benefits that accrue to other individuals - such as families or carers. Furthermore, these externalities
19 may stem from both the health care and the social care portion and so incorporate some of the
20 wider benefits arising from health care.

21 Contingent valuation (CV) approaches (a method of hypothetically valuing outcomes 'contingent' on
22 a market existing) or discrete choice experiment (DCE) methods could be applied. The DCE approach,
23 which elicits preferences across alternatives using a range of scenarios, seems particularly promising
24 since this would enable a first step towards understanding how attributes from social care could be

1 traded-off against one another. In fact, if the health care elements are also included in this valuation
2 exercise then it would be possible to see how individuals made trade-offs between health care and
3 social care, or to investigate the complementarities.

4 There are methodological challenges to be faced in valuation. How does one design a DCE that
5 ensures orthogonality (no correlation) in order to value attributes? Which would be the most
6 appropriate valuation methods; for example, in a DCE should best-worst scaling (Flynn et al., 2007)
7 be used? Another challenge that arises is that of scope, where the sum of the WTP does not equal
8 the total WTP (Drummond et al., 2005). It may be possible to use CV, where individuals are asked to
9 provide values contingent on the existence of a hypothetical market, to value the whole programme
10 but that would not provide information of the valuations of each of the attributes.

11

12 **5.3 Combining health benefits**

13 As stated above, our key development is measuring the health and social care benefits using the
14 same numeraire, in this case money. Our approach has three main elements: firstly, identify the
15 attributes that underpin the intervention, secondly, obtain monetary values for these attributes
16 using a DCE approach and thirdly, value the health benefit, in money, using either threshold (or
17 revealed decision making) approach, or using WTP based approaches.

18 Once researchers have valued social care and process attributes from an intervention then it is
19 important to combine these with health benefits. There are two ways to approach this problem. The
20 first is to use CBA to value the health portion of any intervention. The outcomes of the CBA would be
21 in monetary terms and could easily be combined with the valuations of the attributes from the DCE.
22 However, this approach would be moving away from the 'extra-welfarist' underpinnings of CUA.

23 A second avenue would be to use CUA. However, this presents a problem of how to combine
24 valuations in terms of QALYs with the monetary valuations of the attributes. There are two

1 approaches that are available and the approach chosen will depend on whether the evaluator is a
2 searcher or surveyor of the value of a QALY (Baker et al., 2011). A searcher (researchers using
3 threshold values from decision making bodies) could apply the QALY threshold value as used by NICE
4 - conventionally accepted to be around £20,000 - £30,000 per QALY (McCabe et al., 2008). The
5 surveyor (a more welfarist CBA approach) could use the WTP for a QALY based on values from
6 studies such as Donaldson et al. (2011) that obtained values of QALY ranging from £10,000 to
7 £70,000.

8 In the case where health is evaluated through CUA methods, the net monetary benefit of the health
9 element of any intervention could be derived by multiplying the number of QALYs with the
10 monetary value of a QALY, whether that is derived directly from a threshold value or from values
11 revealed from actual decision making (Claxton et al., 2015) to give health benefits measured in
12 monetary units. These values could then be combined with the attribute values, giving a
13 combination of the CBA and CUA approaches. Standard decision rules, such as ranking interventions
14 on the basis of benefit-cost ratios, could then be applied.

15 This technique also has the added advantage of addressing (some of) the issues in moving resources
16 between health and social care budgets. By measuring benefits in the same units it would be
17 possible to determine the proportion of benefits deriving from the health and social care outcomes.

18 In this case it would then be possible to apportion costs on the basis of similar proportions. So, for
19 example, if 60% of the benefits accrued from health then 60% of costs could then be attributed
20 towards health.

21 The combining of two principal existing economic evaluation techniques into one single framework
22 presents a novel approach to current methods as an immediate and practical solution for evaluating
23 health and social care interventions with outcomes that are necessarily going beyond health. By
24 continuing to capture the impact upon health in terms of a CUA, this is a natural evolution in
25 evaluation methods that enables wider outcomes to be captured and presented alongside health

1 outcomes — and importantly, the use of CUA maintains the fundamental focus on health for the
2 health portion of the evaluation.

3

4 **Discussion**

5 This paper presents a method for evaluating interventions where the outcomes may be disparate
6 and process may be valued. This is especially timely with the increasing focus on the integration of
7 health and social care budgets and the interest in preference based methods and cross sector
8 evaluations (Brazier and Tsuchiya, 2015) and where cross sector transfers may occur (Claxton et al.,
9 2010). The basis of the new method is the integration of evaluation methodologies and the
10 inclusion of attributes as a key element of benefit valuation. This approach allows us to value
11 interventions that have social care benefits, process benefits and health benefits. It can also be
12 expanded to include social or business benefits depending on the perspective of the evaluation.

13 As a first step in the evaluation process, other attributes (beyond health) that are considered
14 relevant and important to the beneficiaries and/or decision-maker need to be identified; i.e. the
15 identification of attributes against which the impact of intervention should be evaluated. With any
16 new method, identifying key attributes will take time and, while an extensive list of attributes may
17 be identified, the attributes used do not necessarily have to be identical across interventions. We
18 propose that by eliciting views to estimate the value placed on wider gains produced by new social
19 care technologies, and combining this with standard health economic methods, a more robust
20 approach could be applied to evaluate interventions reflective of a more integrated health system.
21 This is innovative as it combines current methods associated with both technical and allocative
22 efficiency and would assist decision-makers to allocate resources more efficiently across health and
23 social care budgets. Furthermore, by providing valuations of the benefits of ALTs, evaluations will

1 also provide information for the private market, giving consumers more information regarding the
2 efficacy of ALTs.

3 However, there are key methodological challenges that still need to be overcome. Firstly, it would be
4 helpful if there were an already agreed set of attributes. It may not be feasible to derive the
5 attributes and evaluate them with each intervention and each evaluation. If an appropriate set of
6 attributes and their values could be derived then these could be applied to each evaluation.

7 A second challenge regards the perspective of studies. Where the benefits (and costs) of social care
8 interventions accrue is a difficult matter for evaluators to decide. Such issues are complicated
9 further because social care is often aimed at vulnerable individuals where decision making may be
10 impaired, and where externalities of care - eg the benefits of safety in the home and independence -
11 may be felt by health systems and society as a whole. Furthermore, if there is an increasing drive for
12 the development of a thriving private market in ALTs, then how much should the business
13 perspective also be included in the evaluation? These issues mean that the selected attributes may
14 be different depending on the perspective taken.

15 A third challenge, stemming from the point above, is how to resolve the valuations placed on
16 attributes when the stakeholders involved have different preferences across attributes. We currently
17 suggest using representative samples from the population to value attributes; however it is possible
18 that the methods could be developed further to try and account for the many different views held in
19 the population. If, for example, a person in receipt of care values dignity above all, yet their family
20 members value peace of mind most, how are these different valuations to be reconciled if decisions
21 regarding a technology are made at the family level? There may be a role for methods such as
22 Analytical Hierarchical Processes (Ghodsypour and O'Brien, 1998) that seek to value by consensus by
23 arriving at valuations where the individual discrepancies from the group valuation are minimised.

1 A fourth challenge (that stems from the three already outlined above) is the choice of comparator.
2 While choosing comparators is vital, there is no clear guidance of how to proceed. The advantage of
3 our approach is that since all valuations can be considered in the numeraire of 'money' then the
4 outcomes of interventions do not necessarily have to be identical across trials. For example, while it
5 would be hoped that the lists of attributes valued are similar, they do not need to be identical;
6 comparisons can still occur since the outcomes have a monetary valuation. As more of these types of
7 economic evaluation were conducted the choice of comparator should become clearer.

8 A fifth challenge arises from the valuations of QALYs. Donaldson et al. (2011) have shown that the
9 value society places on a QALY can vary from £10,000 to £70,000 depending of the severity of the
10 condition that the treatment addresses. Whether health and social care should be valued by setting
11 a threshold to maximise output from an exogenously-set health budget or whether it should reflect
12 the value the public put on health and social care, is a broader debate that is beyond the current
13 scope of this paper.

14 The sixth challenge is the decision making process. What would the decision rule be for the
15 interventions evaluated, and who would be the decision maker? Would this role stay within the
16 remit of NICE or should the decision maker include wider representatives from social care? We
17 suggest that the current approach to decision making is maintained. Economic evaluations are an
18 input into the decision making process and our method allows decision makers to be more informed.
19 It is not a decision tool in its own right. This view is largely pragmatic, since NICE has the experience
20 as such a decision maker and a wider discussion of how to integrate health and social care decision
21 making is required.

22 A final challenge concerns aligning the equity elements to the method outlined above. Much of the
23 capabilities literature has focussed on equity and challenges utility based maximisation frameworks
24 (Coast et al. 2008c, Mitchell et al., 2015). Equity issues could be incorporated through the valuation

1 of attributes and social valuations of QALYs (Lancsar et al., 2011) or through the decision making
2 processes. These are issues that are still unresolved in much of the economic evaluation literature.

3 **Conclusion and suggestions**

4 This paper considers the issues relating to the economic evaluation of interventions such as ALTs
5 that may provide social care benefits, health care benefits and process benefits, all of which are
6 valued by the end user and, potentially, also by families, carers and society more broadly.

7 An ageing population and an increasing number of people with complex health needs requiring
8 integrated care, together with continued pressure on health and social care budgets, mean that the
9 need to ensure that resources are allocated in the most efficient way is increasingly important
10 (Mason et al., 2014). Techniques for evaluating health care technologies have been established.
11 However, social care technologies present a set of challenges beyond those typically encountered
12 when conducting economic evaluations of health care technologies.

13 A mixed methods approach that uses qualitative methods to identify the attributes of social care
14 technologies that individuals value and values these attributes using quantitative techniques would
15 allow cost-utility and cost-benefit analyses, to be carried out together. This would be a significant
16 step in an area that has so far been without the tools available to decision makers in healthcare. The
17 downsides of the approach we propose result from its complexity. It means that research would
18 need to be undertaken to establish which attributes were relevant to a particular technology.
19 However, while it might not be possible or desirable to develop a generic instrument and a universal
20 set of values, as the evidence base grew the opportunities to use data from previous economic
21 evaluations would increase. Ultimately, the decision about whether to adopt a methodology such as
22 we propose depends on whether complexity and cost outweigh the uncertainty around the social
23 care technology and the financial consequences of adopting an inefficient technology ahead of a
24 better alternative.

1 There are many challenges still to be addressed but we believe that we have started to clarify
2 economic evaluations of ALTs. Many of our arguments echo those expounded in Coast et al. (2008a)
3 although our application is broader than health interventions and covers interventions that are at
4 the forefront of integrating health and social care.

5 In conclusion we raise considerations for researchers conducting economics evaluations outcomes
6 are complex and processes are also potentially of value.

7 1. What is the perspective of the economic evaluation? Who are the main beneficiaries -
8 patients/consumers, carers, health and social care systems, businesses, etc?

9 2. Select the attributes of the intervention using Q-methodology. We hope that further research can
10 identify key attributes; however, it may be that for each economic evaluation attributes can be
11 identified by researchers or funders, or that qualitative methods can be used of obtain key attributes
12 from individuals and family members.

13 3. Will the health attribute(s) be separated from the social care and the process attributes?

14 4. How will valuation occur? If health is a separate attribute will it be valued through CUA or CBA? If
15 the former, what value of a QALY will be assigned? Will a DCE be used for the other attributes?

16

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Figure 1: Evaluation Guide

