EEPRU

Economic Evaluation of Health and Social Care Interventions Policy Research Unit

RESEARCH REPORT

Estimating the "Wider Societal Impacts" of health conditions and treatments

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Estimating the "Wider Societal Impacts" of health conditions and treatments

Background

Health interventions provide benefits to patients which are commonly measured in Quality-Adjusted Life Years (QALYs – the universal unit or currency of health). However they may also have other economic impacts, on other individuals and the rest of society – for instance in enabling a patient to return to work, and therefore contribute more to tax revenues (and require less benefits), or in changing a patient's utilisation of resources such as residential social care, or informal care provided by their family.

These impacts of treatments beyond health have previously been termed "Wider Societal Impacts" (WSIs). This paper proposes a definition of WSIs as the patient's net production – their contribution or production of resources, net of their consumption or utilisation of resources– and sets out a systematic approach to measuring net production based on routinely available data.

Finally it provides initial results of the estimation of the amount of net production generated by treatments in different disease areas, and in the marginal activity of the NHS.

Definition of "Wider Societal Impacts" as the patient's net contribution to society

The approach described is founded on the principle that any resources a patient contributes or produces, net of resources they utilise or consume, are available for others in society to use and benefit from. Similarly, if a patient utilises or consumes resources in excess of the resources they contribute or produce, then those resources must inevitably be provided by society, and are not available for others to consume and benefit from. If a treatment changes the production or consumption of resources by a patient, then it will change the amount of resources available for others to benefit from.

For example, suppose a patient with a particular condition produced **£1500** worth of resources per month – through their labour, paid or unpaid. If they consumed **£1000** of resources per month, for instance in the normal goods and services used in everyday life, but possibly also by needing social care, or informal care by family – then, in this perspective, they would be judged to provide net production worth **£500** per month.

Suppose that a treatment improves the patient's health, such that they now contribute **£1600** worth of resource per month. This increased amount might reflect the fact that they are able to work more. They may also utilise fewer resources, perhaps because they require less care by their family. Suppose they now consume resources worth **£900** per month, giving net production of **£700** per month. This

would imply that the effect of the treatment was to increase the patient's net production by **£200** per month. If the duration of the treatment's effect was 5 months, the total impact on net production – and the value of the benefits realised by society beyond the patient themselves – would be **£1000**.

Elements of net resource contribution

For convenience of analysis, the production and consumption of resources by the patient are divided into sub-elements.

For *production* these are

Paid production – that is, labour provided for a salary or other payment. (Note that this is the only element of net production that contributes directly to GDP).

Unpaid production – including domestic work, child care and volunteering

For *consumption* these are

Formal care – social care paid for by the patient, their family or Government

Informal care – including care provided by family and friends

Personal paid consumption – including goods and services used in everyday life, such as housing, food, clothes, travel and entertainment

Personal unpaid consumption –utilisation of unpaid production, as above

Government consumption – using services provided directly by Government, including education and health services (but excluding those directly related to the condition in question)

It is important to note that this categorisation is intended to be substantially complete. While there may be practical reasons why the categories of production and consumption defined above do not capture certain exceptional impacts – for instance "external" or direct effects on others through crime – it is considered that this definition of net production encompasses, in principle, all general economic impacts of patients and their treatments.

Estimating net resource contribution for patients in different health states

DH, in collaboration with external experts, has developed a mechanism by which each element of net production – and therefore the total amount of net production – can be estimated for a patient, given their

Age

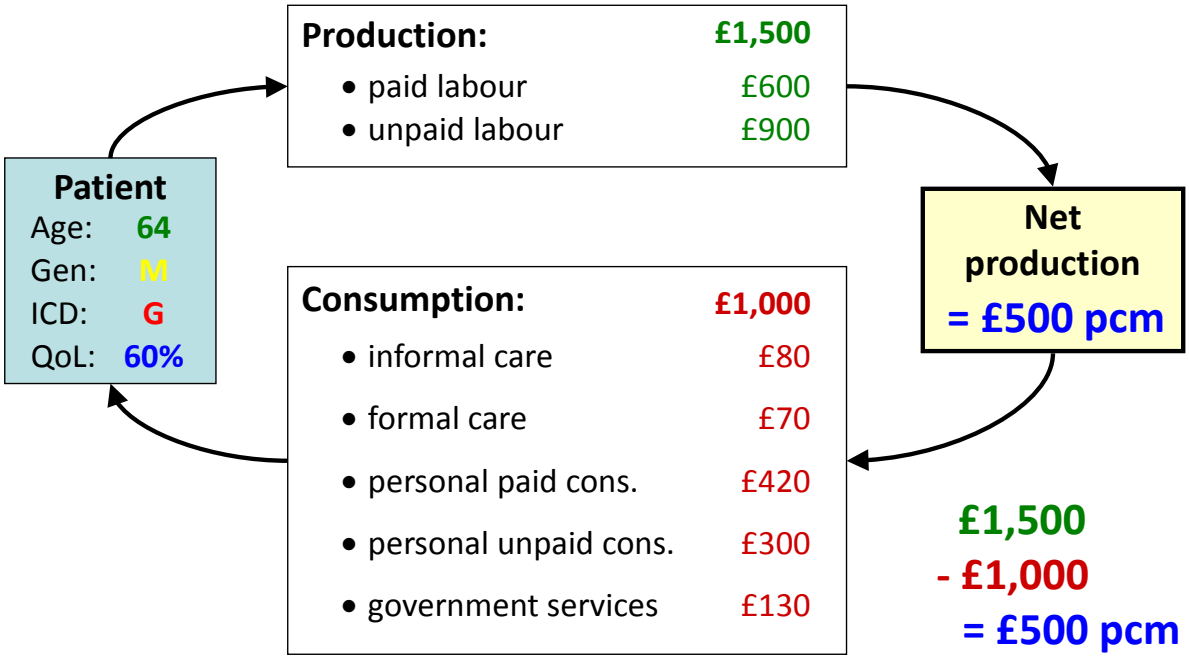
Gender

Type of health condition - defined according to the International Classification of Disease (ICD)

Quality of Life (QoL) *score* – on the standard EQ5D scale in which 100% represents full health, and 0% is considered equivalent to death

For a given patient, the net production calculation gives an estimate of the resource impact of the patient in each element of production and consumption.

So, for example, a **male** patient aged **64** with migraine (ICD = **G**) and QoL of **60%** might be estimated to generate **£500** worth of net production per month (illustrative figures). This sum may be composed of the elements of production and consumption, as set out below.



The calculations for each element are generated using data and modelling from a variety of sources – some existing datasets, as well as analysis that has been specifically carried out or commissioned to support the development of this approach. It has been extensively reviewed by external academic collaborators, and in a series of expert workshops. Details of this analysis, and the data used, are available on request.

Estimating Wider Societal Impacts of health interventions

The mechanism described above allows the net production rate (eg in £ pcm) for a single patient to be estimated, given only the four inputs of age, gender, ICD and QoL. In principle it is straightforward to use this calculation to estimate the net production impact of a treatment – by comparing the progression of patients' diseases over time with the treatment and its comparator, and calculating the change in net production in the same way as quality of life (QoL) profiles over time are used to calculate incremental QALY gains.

However there are practical difficulties in applying the net production calculation to treatments or interventions with patient populations that vary across the inputs of age, gender and QoL. In particular, net production is highly non-linear with respect to age.

To address this issue, a *reference calculation* has been developed which provides an estimate of the net production impact of typical treatments in all disease areas

across the NHS. This calculation uses reference estimates which include all the information required to calculate the net production (expressed per QALY of health gain) provided by typical treatments in each of 1281 diseases (ICDs). Given knowledge of the indicated ICD, this dataset can therefore be used to calculate (or look up) the estimated net production per QALY of health gain for that ICD.

The accuracy of the above estimate will depend on the degree to which the reference estimates are representative of the actual treatment population (as well as the accuracy of the models estimating the individual elements of net production).

WSI estimates by disease area

The table below shows the estimated £ net production generated per QALY in a selection of diseases[1]. WSIs are also shown in £net production per £ of spending, assuming a marginal cost-effectiveness of £15,000 / QALY for treatments in all conditions.

Code	Disease	£WSI / QALY	£WSI / £NHS
F03	Dementia	40,068	2.67
M05	Rheumatoid arthritis	37,745	2.52
E11	Diabetes	30,969	2.06
M81	Osteoporosis	23,483	1.57
F30	Depression	22,826	1.52
F20	Schizophrenia	19,625	1.31
G35	Multiple sclerosis	18,573	1.24
L40	Psoriasis	17,884	1.19
G20	Parkinson's disease	16,950	1.13
J45	Asthma	16,267	1.08
G40	Epilepsy	16,031	1.07
displ	***(average displaced QALY)***	**13,925**	**0.93**
C53	Cervical cancer	11,248	0.75
E66	Obesity	8,524	0.57
C50	Breast cancer	8,072	0.54
I64	Stroke	-1,350	-0.09
C18	Colon cancer	-2,262	-0.15
C61	Prostate cancer	-5,178	-0.35
C64	Kidney cancer	-7,249	-0.48
I21	Acute myocardial infarction	-8,223	-0.55
I26	Embolisms, fibrillation, thrombosis	-10,705	-0.71
J10	Influenza	-14,982	-1.00
C90	Myeloma	-17,249	-1.15
C92	Myeloid leukaemia	-18,108	-1.21
C22	Liver cancer	-25,867	-1.72
C34	Lung cancer	-29,135	-1.94
C25	Pancreatic cancer	-46,141	-3.08

[1] Based on analytical model of January 2015. The input data and calculation methodology are under continual review to improve their accuracy and robustness – so results may vary in current versions of the calculation.

Disease areas vary significantly in the value of net production they are estimated to provide per QALY of health gain. The most significant determinant of variation between disease areas is the extent to which treatments improve quality of life, or extend life. Improving *quality of life* is typically associated with increases in production and decreases in consumption – so an increase in net production overall. However *extending life* typically increases consumption. In conditions such as cancer, where quality of life is low and life has to be extended for long periods to gain 1 QALY, the impact of increased consumption – with little associated increased production – can imply large negative net production impacts per QALY gained.

WSI estimate for rheumatoid arthritis

The results above show aggregated estimates of net production impacts for a selection of disease areas. However detailed results are available which show the components of the impact of net production for treatments in specific disease areas.

The table below shows the detailed results for *rheumatoid arthritis*.

	£WSI per QALY gained
Total production	**26,849**
Paid production	11,276
Unpaid production	15,573
Total consumption	**-10,896**
Residential care	-1,765
Informal care	-13,157
Private paid consumption	1,492
Private unpaid consumption	1,946
(Childcare consumption)	0
Govt consumption	588
Net production (prod - cons)	**37,745**

The net production impacts of a typical treatment for *rheumatoid arthritis* are disaggregated into the elements of production and consumption.

For example, a treatment which provides 1 QALY to the population of patients suffering with rheumatoid arthritis is estimated to result in **£11,276** of additional paid production. The total net production impacts is estimated to be **£37,745** per QALY of health gain.

As discussed above, treatments which improve QoL tend to have greater (more positive) net production impacts than those which improve LoL – as they tend to increase production, and decrease consumption. *Rheumatoid arthritis* is a good example of a condition where treatments tend to increase QoL – and the above results are based on estimates that **96%** of QALY gains from treating this condition come through QoL improvement, rather than LoL extension (data not shown). This is the main explanation for the high estimated net production impact of treatments for *rheumatoid arthritis.*

WSI of spending at the margin in the NHS

The set of reference estimates described above also contains information on the distribution of the marginal QALY (or £ of spending) across the 1284 disease areas, and across each age and gender bin. This allows an estimate to be made of the net production impact associated with the notional QALY (or £) at the margin in the NHS – that is, the net production impact of treatments that are provided or withdrawn if funds are allocated to or from central NHS funding.

The table below shows the results of this analysis, disaggregated into the elements of net production – and also into the components of marginal activity that provide improvements in quality of life, or length of life.

	£WSI per QALY gained
Total production	**22,701**
Paid production	9,398
Unpaid production	13,303
Total consumption	**8,776**
Residential care	-249
Informal care	-2,612
Private paid consumption	4,384
Private unpaid consumption	5,164
(Childcare consumption)	41
Govt consumption	2,047
Net production (prod - cons)	**13,925**

For example, the marginal activity in the NHS is estimated to provide a total of **£9,398** of *paid production* per QALY. It is worth noting that this element of net production contributes directly to GDP. As it is estimated to cost £15,000 to provide a QALY at the margin in the NHS, this implies that each £1 spent at the margin generates **63p** in direct contribution to GDP through reduced sickness absence (£9,398 / £15,000).

The total net production impact of activity at the margin is estimated to be **£13,925** per QALY gained or displaced. This implies that each £1 spent at the margin in the NHS budget provides **93p** of additional net production.

Methodology for estimating the Net Production / Wider Societal Impact of treatments

Introduction

1. Health treatments can have consequent impacts beyond the health of the patient who receives them. These impacts, sometimes referred to as "Wider Societal Impacts", include the benefits of patients returning to work, as well as carrying out unpaid activities such as child-care, domestic work and volunteering. Treatments can also have wider effects by changing patients' use of formal and informal social care and other resources.

2. This paper documents a methodology for estimating the wider impacts consequent on health treatments – that is, the impacts beyond the health effects on the patient.

Defining Wider Societal Impacts in terms of net production by the patient

3. Wider Societal Impacts are here defined as impacts on the net production of the patient.

4. A patient's net production is the amount of resources the patient produces, net of the amount they consume. Any excess resources produced by an individual, beyond their consumption, must be available for consumption by others – representing a benefit to the rest of society. Conversely, any resources an individual consumes in excess of the resources they produce cannot be available for use by others – representing a cost on the rest of society.

5. If a treatment changes either the patient's production or consumption of resources, it will change the amount available for the rest of society to consume, and affect the consumption and welfare of others.

6. It is important to note that the widest possible definition of resource production and consumption is used – encompassing unpaid activities such as parental child care and domestic work, as well as paid labour and consumption associated with a financial transaction.

7. For convenience of measurement, production and consumption are sub-divided into elements:

Net production = production
= paid production
+ unpaid production
– consumption
= formal care consumption
+ informal care consumption
+ private paid consumption
+ private unpaid consumption
+ government consumption

8. These elements may be further divided into sub-elements, as set out in the detailed explanation of the calculation below.

Calculating the net production impact of treatments - overview

9. This document describes a mechanism for calculating the net production generated by a *patient* in a given health state, using data that is routinely available from sources such as clinical trials and Health Technology Assessments. The impact of a *treatment* can then be measured by comparing the estimated net production of the patient who receives it with and without the treatment.

10. It is important to note that any net production impact would be *additional* to the value of the health provided to the patient, normally measured in Quality-Adjusted Life Years (QALYs).

Calculating net production for a given patient

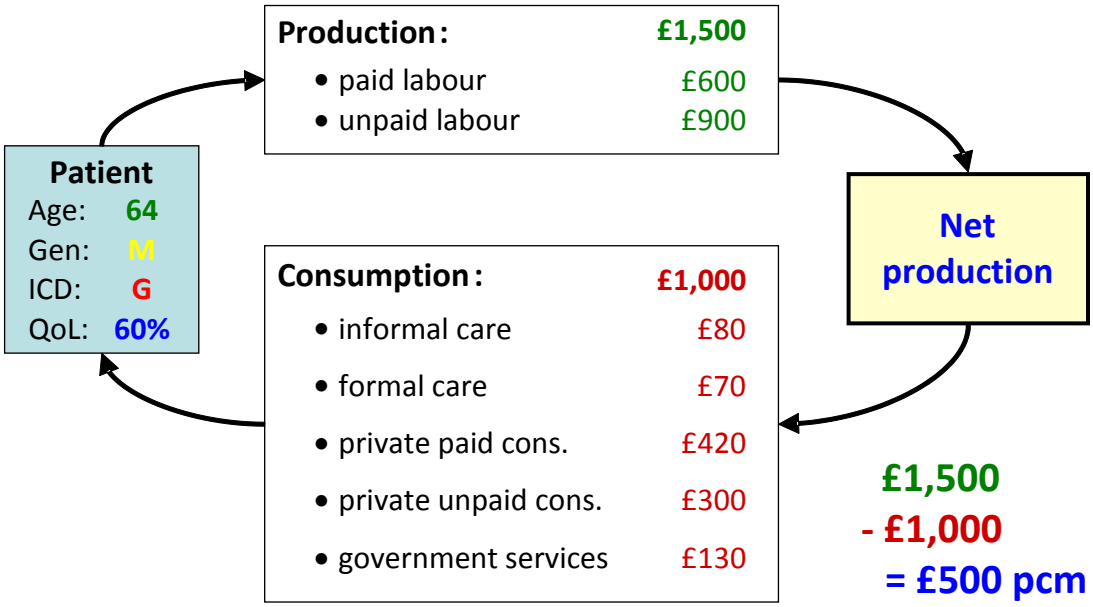
11. In this approach, the value of a patient's production and consumption, in each of the elements shown above, may be calculated as a function of:

- the patient's age [A]
- the patient's gender [G]
- the type of condition suffered by the patient - using the International Classification of Disease (ICD) [I]
- the patient's health-related quality of life – on a scale in which 100% corresponds to full health, and 0% corresponds to a state equivalent to death, such as the EQ5D scale [Q]

12. The calculation described in this document yields the £ value for each of the elements of production and consumption, using as inputs the patient's age, gender, ICD and quality of life (QoL).

13. For example, a male patient aged 64 with migraine (ICD = G) and QoL of 60% might be estimated, using the calculation described in this document, to

generate £500 worth of net production per month (illustrative figures). This is net figure may be composed of the elements of production and consumption, as set out below.



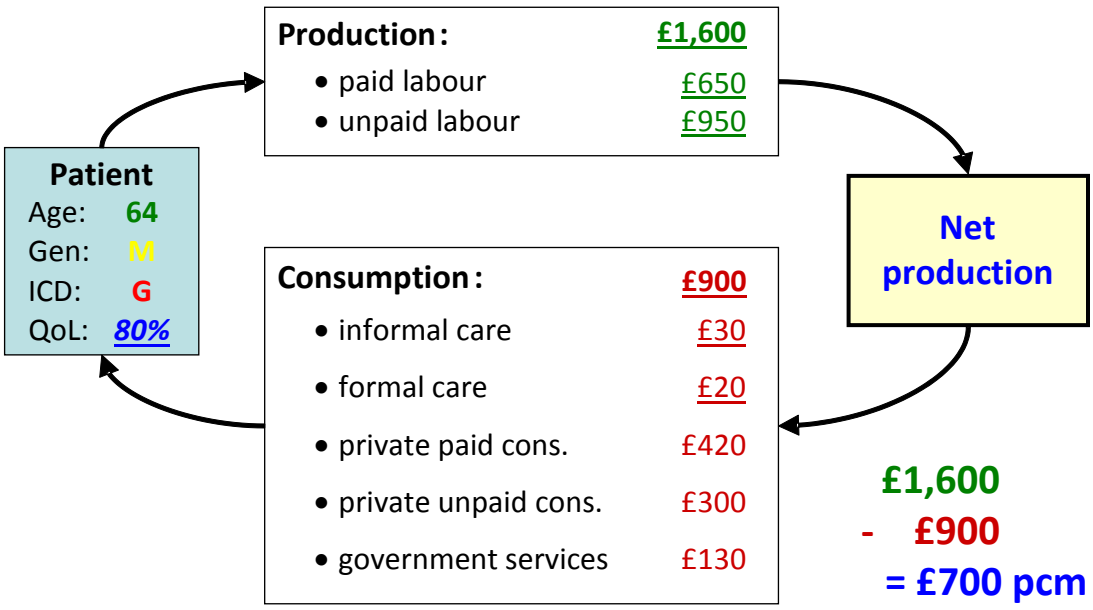
14. The Annexes describe the calculation of each element in more detail.

Estimating the net production impact of a treatment

15. The calculation set out here yields the estimated rate of net production for a patient, given their age, gender, ICD and QoL. However when estimating the net production *impact* of a treatment or intervention, it is necessary to compare the net production provided by the affected patient with and without the treatment or intervention.

16. For example, if an intervention improved the QoL of the patient in the above example from 60% to 80%, this would yield a different estimate of their net production. In particular, the patient's provision of paid and unpaid labour would be expected to increase. Their consumption, for example of formal and informal care, might be expected to decrease.

17. The diagram shows, using illustrative figures, the possible result of an improvement of QoL from 60% to 80% in this example.



18. In this example, the patient's production has increased from £1,500 pcm to £1,600 pcm, while their consumption has decreased from £1,000 pcm to £900 pcm. Their net production has therefore increased from £500 pcm to £700 pcm. A treatment which increases the QoL of a patient, as shown in the example, would therefore be estimated to generate an additional £200 pcm in net production.

Calculating impacts over time to estimate the overall impact on net production

19. The example above shows the effect of moving from 60% to 80% QoL. However, as when calculating health impacts in QALYs, the total effect over time must be considered in order to estimate the total impact of the treatment.

20. For example, if a treatment for a patient with the above characteristics were to increase their QoL from 60% to 80% for a period of 6 months, this would correspond with a total net production impact of £1,200.

21. Note that the calculation of net production impacts can be directly associated with health impacts measured in QALYs. In this example, the patient would have gained 0.1 QALYs (20% health gain over 0.5 years), as well as £1,200 worth of net production.

22. Health treatments can affect length of life as well as quality of life. The net production associated with an increase in length of life is simply the rate of net production multiplied by the time by which life is extended. For example, if the life of the patient in the above example (80% QoL) was extended by 3 months, this would correspond with an increase in net production worth £6,400 (£1,600 pcm * 4 months).

23. Finally, it is important to note that some patients may generate negative net production, if their consumption exceeds their production. This may be especially true of very ill patients who are unable to provide paid or unpaid

labour, but who still consume resources – notably informal and formal care. Extending the life of such patients inevitably implies an increase in resource consumption, which imposes costs on others in society.

24. Further detail on the calculation of treatment impacts on net production is presented in Annex N.

Production (or contribution to society's resources)

25. This section provides an overview of the calculation of a patient's production, given their age, gender, ICD and QoL. For detailed explanation of the calculations, see Annexes A and B.

26. A patient's production is the sum of:

- **Paid production** through labour provided in employment
- **Unpaid production**, for example in domestic work, childcare or volunteering

27. These elements are calculated separately, as described below.

Paid production from employment

28. The value of paid production for a patient is calculated by

- estimating their *productivity* – the proportion of possible working time they spend actually working, given their age and QoL.
- applying this to the patient's *average monthly wage* (if in work) given their age and gender, uplifted for the costs associated with their employment (*oncosts*)
- the value of paid labour pcm is then

*paid labour = productivity * wage * oncosts*

29. Estimates of *productivity* as a function of age and QoL are made using analysis by the School of Health and Related research (ScHARR) using the Understanding Society dataset.

30. Monthly gross *wages*, by age and gender, are calculated using data from the Annual Survey of Hours and Earnings (ASHE). *Oncosts* are estimated using Eurostat 2012 data.

31. See Annex A for further details of the calculation and data sources.

Note: this methodology currently omits measurement of "presenteeism" effects – that is, the possibility that ill patients might attend work but achieve a lower level of productivity.

Unpaid production

32. Unpaid production is the work a patient does which is valued by others but for which they are not paid.

33. It is estimated in three sub-elements:

- General unpaid production – including domestic work
- Unpaid sickness care production
- Unpaid childcare production

34. Each sub-element is calculated as follows:

Hours provided pcm at full health value per hour * sick rate*

35. The following describes how *Hours provided pcm at full health* is calculated for each sub-element of unpaid production. For further details of the calculation see Annexes B-D.

36. Each sub-element is estimated using data from the Time Use Survey (TUS).

- General unpaid production is estimated by observing the average time spent on activities in the TUS classified as general unpaid production by people of different age and gender. (See Annex B)
- Unpaid sickness care production provided by the patient (eg for family members who are unwell) is estimated by calculating the probability that a person with a given age and gender is a carer, using data in the TUS, and multiplying this by an estimate of the average time spent on care by a carer, using data from the Survey of Carers in Households (2009). (See Annex C).
- Unpaid childcare production by the patient is estimated by calculating the probability that a person of a given age and gender will be in a household with one or more children requiring care, and the proportion of that care likely to be provided by the patient. Only time that may otherwise be spent working is included in the estimate of the patient's provision of childcare. (See Annex D).

37. The *value per hour* is the defined as the opportunity cost of the patient's time – estimated as the average net wage of people in work.

38. The s*ick rate* is an estimate of how much the patient works as a proportion of the amount of the time they would work in full health. It is calculated as the productivity of a patient given their age and QoL, divided by the productivity of a patient at that age, but in full health – where productivity is calculated using the methodology described above for paid labour.

Consumption (or utilisation of resources)

39. This section presents the approach developed for estimating each element of a patient's consumption.

Formal care consumption

40. This element of consumption includes care provided to the patient (except treatment for their health condition) that is paid for – either by the patient or their family, or by Government. It is divided into two components:

    - Residential care, for example provided in nursing homes
    - Non-residential care, such as "home help". As explained below, this is considered to be encompassed in the patient's *consumption of unpaid production*, and is therefore not included in estimates of the patient's formal care consumption, to avoid double counting

41. The **probability of needing residential care** is estimated as a function of the patient's age and QoL, and multiplied by the **average care cost** of residential care. Condition-specific multipliers are then applied to patients with dementia and stroke, to reflect the increased likelihood that they will need care. See Annex E for further details.

Probability of needing care

42. Estimates of the **probability of needing care** are provided by the School of Health and Related Research (ScHARR). This uses data from the Adult Social Care Survey (ASCS), the GP Patient Survey (GPPS) and the Personal Social Services Research Unit (PSSRU) to estimate the distributions of patients receiving care, or not receiving care, across different ages and QoL levels. This enables calculation of the probability that a patient with a given age or QoL is receiving care.

Cost of care

43. Estimates of the **average monthly cost** of residential care are made using the ASCS, which measures Government spending on care provision. An adjustment is made to reflect the average private contributions to costs of care.

Condition-specific multipliers for dementia and stroke

44. Finally, an adjustment is made to reflect the apparent disproportionate need for care by patients with dementia and stroke. Analysis commissioned from PSSRU is used to calculate multipliers for the estimated care costs for these two conditions.

Avoiding double-counting with *consumption of unpaid production*

45. The patient's need for activities categorised as *unpaid production*, such as washing and domestic work, is measured separately as their *consumption of*

unpaid production (see below). There is evidently a possibility of double-counting with this measure and consumption of formal care.

46. To address this potential for double counting, patients in *residential care* are assumed to have no additional consumption of unpaid production – that is, all their needs for care and domestic activities are considered to be met by the services in their residential home.

47. Some patients receive *non residential care*, normally funded by local authorities. The activities of non-residential care include cooking, washing and dressing, and assistance with other functions that healthy patients are able to carry out for themselves. To avoid double counting, it is proposed that each patient is considered to have the same need for these activities, and that these are measured in the *consumption of unpaid production*. From this perspective it does not matter if their needs are met with non-residential social care or through some other means – they are already included in the measure of *consumption of unpaid production*. Therefore no separate calculation of non residential care consumption is included.

Informal care consumption – care provided by family or friends

48. Patients who are unwell may often require care by family members or friends.

49. A patient's need for this type of informal care is measured using a study by ScHARR which estimates the **number of days of informal care** patients need as a function of their age, gender, QoL and type of health condition. An estimate is then made of the number of **hours of care required per day**. Finally, the amount of time the patient needs care for is **valued** using the opportunity cost of the providers' time – calculated as the average hourly net wage of people in work.

50. To avoid double-counting with *consumption of unpaid production*, explained below, consumption of informal care is restricted to the need for "passive" presence of a carer. The need for active care, for instance in washing and cleaning, is considered to be encompassed in the *consumption of unpaid production*.

51. It is assumed that patients who are in residential care do not need informal care.

52. See Annex F for further details.

Private paid consumption

53. This element includes the goods and services that are purchased for consumption in the course of normal life – such as food, clothing, accommodation, travel, communications and entertainment.

54. It is important to note that the approach taken in measuring net production means that consumption of resources by the patient is measured *directly* – and

it is immaterial how that consumption is funded. For example, an individual's spending on clothes is measured directly, regardless of whether they were purchased with funds earned through their own labour, or provided in a transfer from Government or a family member. The overall calculation of net production shows the total amount of such transfers to or from a patient, by comparing their production with their consumption.

55. Private paid consumption is estimated using data on average household expenditure from the Living Costs and Food Survey (LCFS), adjusted to reflect the average household size (using data from the Labour Force Survey), to give average individual expenditure.

56. An adjustment is then made to reflect variation in private paid consumption with age, using data from a study of private consumption in Sweden (Ekman & Mattias, 2002).

57. It is assumed that patients who are in residential care do not have additional private consumption – and that all their consumption is included in their costs of care.

58. Finally, it should be noted that this approach assumes the value of the consumption to the patient is reflected in the value of their QALYs.

59. See Annex G for further details.

Consumption of unpaid production

60. As described in the measurement of production, it is important to reflect the fact that individuals provide many services of value but which are not paid for – such as domestic work in the home. It must therefore also be true that individuals benefit from such services, whether provided by themselves or others, and that their use of these services constitutes an element of their consumption of resources which would otherwise benefit another member of society.

61. The average consumption of unpaid production is calculated by first using the Time Use Survey to estimate the average amount of unpaid *production* per person. It is then assumed that all individuals use the same amount of these services, and therefore that all individuals consume the average unpaid production per person – regardless of their age, gender or health state.

62. It is assumed that patients who are in residential care do not consume private unpaid consumption – and that all their needs for domestic work and personal care are included in the costs of their residential care.

63. Finally, this analysis makes the assumption that consumption of informal childcare *by a patient* (i.e. a child) does not have a cost. This is based on the premise that parents, overall, choose to have children and gain enjoyment from providing their childcare.

64. See Annex H for further details.

Consumption of Government services

65. Individuals use services provided directly by Government, and these also form part of their consumption of resources.

66. However there are some aspects of Government spending which do not depend on the number of people who benefit from them. These are known as "public goods" with the property of "non-rival" consumption. These elements of Government spending are excluded from estimates of consumption.

67. Elements of Government spending that relate to transfers of funds, rather than spending on provision of services, are also excluded to avoid double counting with estimates of individuals' private paid consumption. Similarly spending on provision of social care is excluded, as it is measured elsewhere. However costs of healthcare *unrelated* to the condition the patient suffers from at the time of the analysis are included – to reflect the fact that patients may go on to suffer other illnesses which impose costs on the health budget.

68. Estimates of Government expenditure per capita are taken from the Public Expenditure Statistical Analysis 2013 (PESA). Adjustments are made to exclude the elements identified above.

69. As for private paid consumption, a further adjustment is made to reflect variation in patterns of use of Government services by age. The categories of Government spending for which age is most important are education and health spending. Estimates of the relative use of these two services by different age groups are made using a variety of data sources (see Annex J). Consumption is assumed to be constant across age groups for all other Government services. Consumption of Government services is also assumed to be constant for different levels of health (when spending on the condition itself is excluded).

Note on Annexes

70. The Annexes that follow describe in greater detail the calculations used to estimate the net production of patients, given their age, gender, ICD and QoL. However some of the calculations are based on analysis that is too detailed to be presented in this document. Nevertheless it is intended that sufficient information is provided to enable the calculations to be replicated, using intermediate data at an appropriate level of detail.

71. For example, while the analysis of the Time Use Survey used to generate the estimates of general unpaid production provided by individuals given their age and gender is too detailed for inclusion here, a table is provided with the results of that analysis, showing the average time spent per day on activities classed as unpaid production, in order to enable the calculation to be re-created.

72. The coefficients of estimated models are presented, in order to enable their results to be replicated – even though the analysis underlying these estimates is beyond the scope of this document. The detailed analysis underlying these models is expected to be published in due course.

73. Queries about the derivation and use of the calculations in these Annexes, as well as errata or suggestions for improvement should be directed to Gavin Roberts or Donald Franklin.

Annex A: Paid Production

Definition

74. Paid production is defined as the value of labour provided by the patient through paid employment.

Rationale

75. The labour provided by patients in their paid employment generates resources that will be consumed by some member of society.

76. Note that in this approach to measuring net production the individual's production and consumption are measured directly, and the overall net production calculated by comparing the two. Therefore it is not necessary to know if the individual consumed their own production (i.e. funded their consumption with their earned income). For example, if an individual earned £1,000 through their paid labour, and used this to fund consumption of £1,000 worth of goods, these would be calculated separately and compared – to give the correct estimate of net produciton of £0.

Approach

77. Paid production is estimated by

- Estimating the *productivity* of the patient – the amount of possible working time they actually spend working – given their age and QoL, using a model based on data from the Understanding Society dataset
- Multiplying this by their gross *wages* if in work, which is estimated using the Annual Survey of Hours and Employment
- Applying an uplift ("*on costs"*) to reflect the overhead costs of their employment

Illustrative example

78. Consider a 55 year old woman with a QoL of 70%. (Figures are illustrative, for simplicity of explanation). If:

- They are estimated to have a *productivity* rate of 50% (that is, on average people with these characteristics spend 50% of normal working time in paid employment)
- The average gross monthly *wage* for a 55 year old woman in work is £2,000
- The overhead costs of their employment ("*on costs*") are 15% of their wage

79. Then their estimated paid production will be (50%*£2,000*(1+15%) =) **£1,015**.

Methodology

Productivity

80. This is defined as the proportion of normal working time the patient actually spends working in paid employment. It is estimated as a function of the patient's age and QoL.

81. The output of this estimate is a measure of the proportion of working time spent actually working. Note that this encompasses all possible reasons for not working, including unemployment, retirement, not being of working age, as well as ill health. This effectively allows the impacts of factors such as retirement and unemployment to be automatically reflected in the estimate of paid production as a function of age and QoL.

82. Estimation of productivity as a function of age and QoL uses a model developed by ScHARR, based on the Understanding Society dataset. This dataset includes information on the respondents' productivity (questions below), and their health (measured using the SF12 instrument), as well as their age and gender.

Data used for estimating productivity as a function of age and quality of life

83. Data were used from Wave 1 of Understanding Society, which covers the years 2009 and 2010 inclusive. The full dataset contains information on 50,994 respondents. Respondents were excluded from this analysis if they were proxy respondents (n = 3,262), aged 65 years or older (n = 8,609) or if they had missing SF12 data (n = 238).

Assessing respondents' productivity

84. Respondents were defined as being productive if they answered 'Yes' to the question: "*Did you do paid work last week*?". Fourteen respondents did not answer this question, and so were also excluded. The resulting dataset used in this analysis had information on 38,871 respondents.

85. Productivity was therefore represented as a binary variable, reflecting the provision of paid labour in the previous week.

Assessing respondents' quality of life

86. Understanding Society includes the SF12 health measurement instrument, which is mapped to the EQ-5D QoL scale in the model developed. SF12 includes elements for physical capability (PCS) and mental capability (MCS).

Estimating productivity as a function of age and quality of life

87. The ScHARR study used logistic regression to estimate productivity as a function of age and QoL. The results of this regression model are used to calculate productivity as a function of age and QoL, as explained below.

88. A two-stage calculation is used. First, the *PCS* and *MCS* elements of SF-12 are calculated as functions of the respondent's age and EQ-5D score (QoL).

89. Then the productivity of the patient is calculated as a function of their age, and *PCS* and *MCS* scores.

Calculating PCS and MCS as a function of age and QoL

90. The variables *PCS* and *MCS* are calculated as linear functions of age and EQ5D score:

$$PCS \text{ or } MCS = \beta_0 + \beta * Age/10 + \beta * EQ5D\ index + \varepsilon$$

91. The coefficients (β) of the equation are as follows:

Variable	**Coefficient** (PCS)	**Coefficient** (MCS)
Age/10	-1.0443	1.0383
EQ-5D index	25.918	5.0122
Constant, β_0	31.0231	32.5459

Calculating productivity as a function of PCS and MCS

92. Productivity is calculated as a logistic function, $L(p)$ of MCS, PCS and age:

$$L(p) = \beta_0 + \beta * Age/10 + \beta * (Age/10)^2 + \beta * Gender + \beta * PCS + \beta * PCS^2 + \beta * MCS + \beta * MCS^2 + \varepsilon$$

93. The coefficients of the equation (β) are as follows:

Variable	**Coefficient**
Age/10	2.95
$(Age/10)^2$	-0.35
PCS/10	1.37
$(PCS/10)^2$	-0.09
MCS/10	1.19
$(MCS/10)^2$	-0.09
Constant, β_0	-13.2

94. Productivity is calculated as:

$$productivity = \frac{\exp L(p)}{1 + \exp L(p)}$$

Example calculation of productivity rate

95. Consider a 50 year old with QoL of 0.8.

96. The PCS and MCSs scores are first estimated as follows:

PCS(50,0.8) = 31.02 + (-1.04*[5/10]) + (25.9*0.8) = **46.5**

MCS(50,0.8) = 32.55 + (1.04*[5/10]) + (5.01*0.8) = **41.7**

97. The logistic function of productivity is estimated as:

$$\boldsymbol{L(p)} = -13.2 + (2.95*[50/10]) + (-0.35*[5/10]^2) + (1.19*[41.7/10]) + (-0.09*[41.7/10]^2) + (1.37*[46.5/10]) + (-0.09*[46.5/10]^2) = \mathbf{0.626}$$

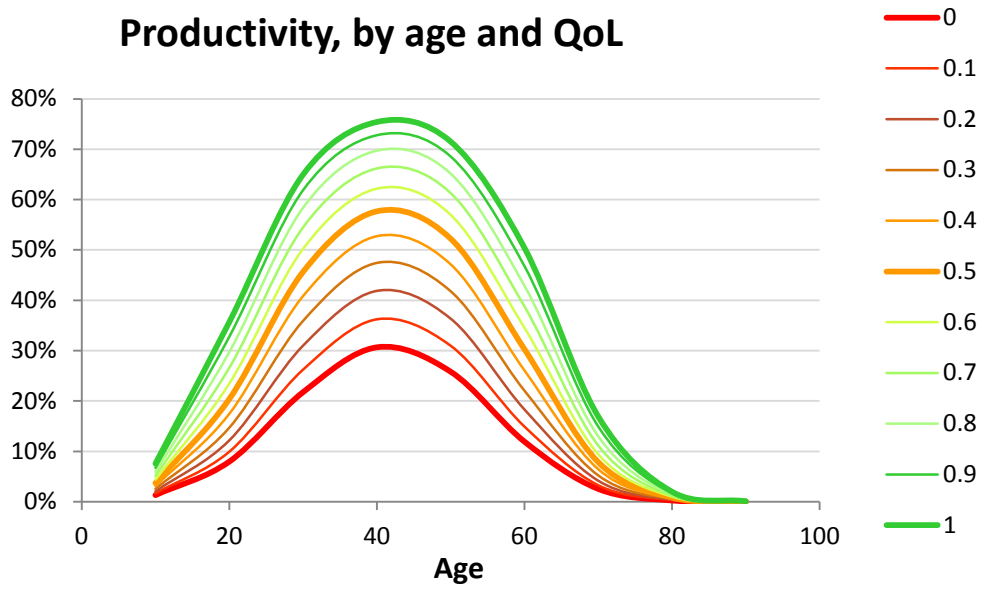
98. Productivity is then calculated as

$$\textit{productivity} = \exp(0.626) / (1+ \exp(0.626)) = 0.652$$

99. A 50 year old with QoL of 0.8 would therefore be estimated to have a productivity rate of **65.2%**.

Results of productivity estimate as a function of age and QoL

100. The results are shown graphically below.



Gross wages, by age and gender, with and adjustment for on-costs

101. The Annual Survey of Hours and Earnings (ASHE)[2] provides data on the average hourly wage, by age and gender:

Mean hourly wage 2011, £

Age	*Male*	*Female*
18-21	7.55	7.12
22-29	11.44	11.14
30-39	16.68	14.61
40-49	18.68	14.14
50-59	17.97	13.58
60+	14.98	11.71

102. It also provides the average hours worked per week, for those in work:

Hours worked / week if in work

Age	*Male*	*Female*
16-17	14.1	10.3
18-21	35.0	22.5
22-29	37.5	36.2
30-39	37.5	35.0
40-49	37.9	32.5
50-59	37.5	32.5
60+	37.0	22.3

103. This data is used to calculate the average weekly wage for individuals if in work. Note that this approach to calculating the weekly wage is aligned with the estimate of productivity made using the Understanding Society data, which asks respondents whether they or not worked in the previous week.

104. For example, a 25 year old woman would be estimated to provide **36.2 hours** of paid work, at a wage of **£14.61** – and therefore have a weekly wage of **£529**.

105. An uplift is then applied to reflect the "*on costs*" (overhead expenses associated with employment). *On costs* are estimated at 16.4%, on the basis that wage costs represent 85.9% of total labour costs according to Eurostat[3].

Wages lost, given a patient's quality of life

106. This approach models the impact of illness as affecting only productivity – i.e. the amount of time spent working. It is possible that it might also affect wage rates – i.e. the amount of value generated for a given time spent working. For example, some patients with a long term illness might change jobs and accept a

[2] http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-235202

[3] Note, the latest versions of calculations use, instead, an estimate of **30%** for on-costs (source: BIS). The examples in this documentation have *not* been updated with this figure, as of 16/12/2014.

lower wage as a result. However a study of the relationship between income and health[4], using the Longitudinal BHPS found that going from 'Excellent' health to 'Good or Poor' health decreases the hourly wage in the population by 1.3%. Since this effect is relatively small, this analysis assumes that wages do not change with health, and the only effect of illness is on productivity as defined above.

Outstanding Issues

Source data for estimating sickness absence as a function of QoL

107. A more detailed and focussed study of the relationship between sickness absence and QoL, which is expected to enable greater accuracy and resolution of the estimates is due to be available in 2014.

108. The US dataset has two limitations which reduce its accuracy in representing the impact of health on productivity. These should both be resolved when the more detailed study above is available. However it is important to note that inaccuracies resulting from these two limitations are likely to be offsetting, to some extent. No further mitigation is therefore currently used.

- The US questionnaire records whether respondents carried out paid employment in the previous week. If they answer *yes*, then they are deemed to have been "productive" for that week. However it is possible that respondents might answer *yes* even though they were in paid employment, and not affected by their health, but were nevertheless not working for example due to holiday. This would have the effect of under-estimating the productivity of respondents, especially when in relatively good health.

- The US survey only asks if a respondent was working for the *whole* of the previous week. If a respondent was absent for less than a full week, it would not be recorded. The effect of this limitation would be to over-estimate the productivity of respondents – again most significantly when they are in relatively good health, consistent with taking a few days in sickness absence.

Presenteeism

109. The methodology described estimates the impact of ill health on production through absence from work. However it is possible that patients who are ill may still attend work, but achieve lower levels of productivity – a phenomenon known as "presenteeism". Impacts on productivity through presenteeism are not currently captured in this methodology.

[4] Contoyannis, P. & N. Rice (2001) *The impact of health on wages: evidence from the British Household Panel survey*. Empirical economics, 26, 599-622 cited in Epstein, D. Claxton, K. Sculpher, M. Rice, N. *Estimates of the relationship between health and income*, Draft 2: 7 December 2011(Unpublished)

Addendum: using productivity estimates to calculate a "sick rate"

110. Estimates of unpaid production (Annex B) use the analysis for paid production to calculate impacts due to changes in health state. To do this a "*sick rate*" is calculated from the productivity analysis above. The *sick rate* is calculated as the ratio of the patient's estimated productivity, given their age and QoL, to their productivity at full health, given their age.

111. For example, if 50 year olds with QoL 0.7 had productivity rates of 40%, while 50 year olds at full health had productivity rates of 50%, then the sick rate for 50 year olds with QoL of 0.7 would be calculated to be 80% (=40%/50%).

112. Estimated full health productivity rates are shown below.

Full health productivity rates, by age

Age	*Prod.*
1	1%
2	1%
3	1%
4	2%
5	2%
6	3%
7	4%
8	5%
9	6%
10	8%
11	9%
12	11%
13	14%
14	16%
15	19%
16	22%
17	25%
18	29%
19	32%
20	36%
21	39%
22	43%
23	46%
24	49%
25	53%
26	55%
27	58%
28	61%
29	63%
30	65%
31	67%
32	68%
33	70%
34	71%

Age	*Prod.*
35	72%
36	73%
37	74%
38	75%
39	75%
40	75%
41	76%
42	76%
43	76%
44	75%
45	75%
46	75%
47	74%
48	73%
49	73%
50	72%
51	70%
52	69%
53	67%
54	66%
55	64%
56	61%
57	59%
58	56%
59	53%
60	50%
61	47%
62	44%
63	40%
64	37%
65	33%
66	30%
67	26%
68	23%

Age	*Prod.*
69	20%
70	17%
71	14%
72	12%
73	10%
74	8%
75	7%
76	5%
77	4%
78	3%
79	3%
80	2%
81	2%
82	1%
83	1%
84	1%
85	0%
86	0%
87	0%
88	0%
89	0%
90	0%
91	0%
92	0%
93	0%
94	0%
95	0%
96	0%
97	0%
98	0%
99	0%
100	0%

Annex B: General Unpaid Production

Definition

113. *General unpaid production* is defined as the active work patients do that benefits others but for which they are not paid (excluding "passive" child care and informal sickness care which are estimated separately). It largely comprises domestic work, but also activities such as volunteering.

114. Note that *general unpaid production* is one of three sub-elements of unpaid production – the others being *unpaid sickness care production* and *unpaid childcare production*, which are described in subsequent Annexes.

Rationale

115. The inclusion of unpaid work ensures that individuals' full contribution to society is reflected in estimates of their net production, even though those contributions may not be directly compensated with a financial transaction. Failure to include unpaid work would underestimate the contributions and economic output of many patients – particularly women and older patients who are less likely to be in paid labour.

Approach

116. The approach to estimating the value of *general unpaid production* provided by a patient, given their age, gender and health condition is summarised as follows:

- Estimate average *hours of general unpaid labour* provided by patients <u>at full health</u>, given their age and gender
- Multiply by the *value of an hour* of the patient's time
- Adjust for the estimated "*sick rate*", given the patient's age, gender, quality of life and health condition.

Illustrative example

117. Consider a 55 year old woman a QoL of 70%. (Figures are illustrative, for simplicity of explanation). If:

- the average 55 year old woman in full health is estimated to spend **25 hours pcm** providing general unpaid labour, and
- each hour is valued at **£10**; and
- 55 year old women with QoL of 70% have a sick rate of **80%**, then
- the estimated value of the patient's unpaid labour is (25 h pcm * £10 / h * 80% =) **£200 pcm**.

Methodology

Estimate average general unpaid labour hours provided by patients at full health, given their age and gender

118. Hours of general unpaid labour at full health, given an individual's age and gender, are estimated using the Time Use Survey[5] (TUS). This survey asks respondents to record their activity for 10 minute episodes over a 24h period. Activities are classified according to whether they are considerd to correspond with unpaid labour. Classification is based on the "third person criterion", as described in Miranda, V (2011)[6], which defines unpaid labour as activity that one could potentially pay someone else to do, for example, cooking, cleaning and gardening. It also includes personal care such as washing, and "active" care provided to other adults or children. See Annex M for the detailed classification used.

119. For each 10 minute period, respondents to the TUS record their main activity and secondary activity. Where these differ it is assumed that respondents spent **6** minutes on the main activity, **4** minutes on the secondary activity.

120. Respondents not at full health were excluded on the basis of positive responses to question Q34b in the TUS - "*Have you CUT BACK on the things you do because of illness or injury?*".

121. This data therefore provides the time spent on general unpaid labour for each age and gender group, allowing the average time to be calculated for each group. Respondents are weighted in order to make their contribution to the average unpaid labour representative of the UK population (see TUS for details). The results, in *hours per month* of general unpaid labour provided are shown in the table below.

[5] UK Time Use Survey (2000) Available from: http://www.esds.ac.uk/findingData/snDescription.asp?sn=4504

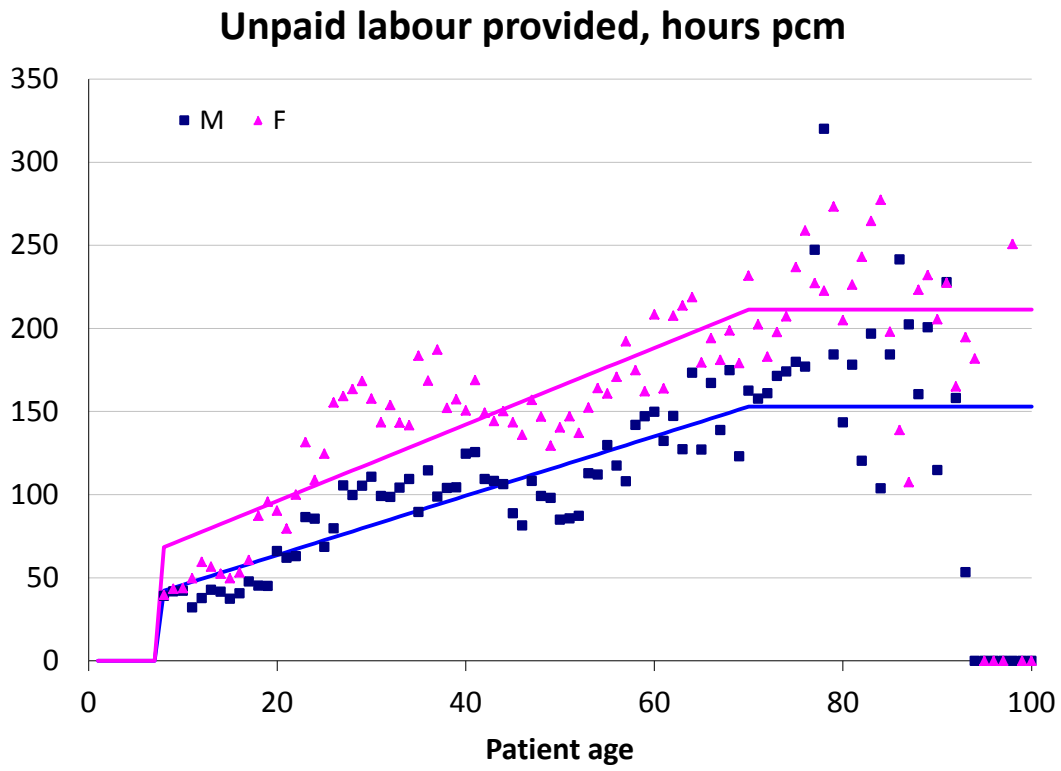
[6] Miranda, V. (2011), "Cooking, Caring and Volunteering: Unpaid Work Around the World", OECD Social, Employment and Migration Working Papers, No. 116 Available from: www.oecd.org/berlin/47258230.pdf

Hours per month of general unpaid production in full health (from TUS)

Age	*Male*	*Female*
1	-	-
2	-	-
3	-	-
4	-	-
5	-	-
6	-	-
7	-	-
8	39	40
9	42	43
10	42	44
11	32	50
12	38	59
13	43	57
14	42	52
15	37	50
16	41	53
17	48	61
18	45	87
19	45	96
20	66	90
21	62	80
22	63	100
23	87	131
24	85	109
25	68	125
26	80	155
27	106	159
28	100	164
29	105	168
30	111	158
31	99	144
32	99	154
33	104	143
34	109	142
35	89	183
36	115	168
37	99	187
38	104	152
39	104	157
40	125	151
41	125	169
42	109	149
43	108	144
44	106	150
45	89	144
46	81	136
47	108	157
48	99	147
49	98	129
50	85	140

Age	*Male*	*Female*
51	86	147
52	87	137
53	113	152
54	112	164
55	130	161
56	117	171
57	108	192
58	142	175
59	147	162
60	150	208
61	132	164
62	147	208
63	127	214
64	173	219
65	127	180
66	167	194
67	139	181
68	175	199
69	123	179
70	162	232
71	158	202
72	161	183
73	171	198
74	174	207
75	180	237
76	177	259
77	247	227
78	320	223
79	184	273
80	144	205
81	178	226
82	120	243
83	197	265
84	104	277
85	184	198
86	241	139
87	202	107
88	160	223
89	201	232
90	115	205
91	228	227
92	158	165
93	53	195
94	-	182
95	-	-
96	-	-
97	-	-
98	-	251
99	-	-
100	-	-

122. The results are shown graphically below.



123. The data for older age groups shows a breakdown of the trend after age 70, as the sample sizes for each of these subgroups diminishes. When calculating the value of unpaid labour in estimating net production it is therefore assumed that the amount of time spent on unpaid production for healthy respondents is constant from the ages of 70-100 – as shown by the flattened trend line.

Estimation of general unpaid production as a linear function of age

124. When calculating the hours of general unpaid production per month, the trend-lines in the above graph are used. The equations describing this line, for male and female patients respectively, are

Hours pcm general unpaid production (m) = **27.92** *+ (***1.79** ** patient age)*

Hours pcm general unpaid production (f) = **50.03** *+ (***2.30**** patient age)*

125. A cut-off of 70 years is applied, as shown in the graph above. This means the amount of unpaid production cannot exceed the amount for a 70 year old.

126. For example, a 50 year old woman (in full health) would be estimated to provide (50.03 + (2.30*50) =) **165 h pcm** of general unpaid production.

The value of an hour of the patient's time

127. The value of time for the provider of unpaid labour is calculated using the estimated opportunity cost of time – calculated as the unweighted average *net* wage of employees, **£9.24**.

128. This is calculated using average weekly gross wage for from the Annual Survey of Hours and Earnings (ASHE), adjusted to subtract direct income taxes and National Insurance Contributions, and divided by the hours worked (also ASHE).

129. For example, a 50 year old woman in full health is estimated to provide 165 h pcm of general unpaid labour (as above). This corresponds with a value of general unpaid labour of (165 * 9.24 =) **£1,527 pcm**.

Adjust for the *sick rate* calculated using productivity estimates

130. The "*sick rate*" for unpaid production is calculated using the observed productivity effects calculated for paid production. See paragraph 110 for details of the calculation of the sick rate. This approach effectively assumes that provision of unpaid labour is affected by health in the same way as participation in paid employment.

131. For example, consider a 50 year old woman with QoL of 0.8.

- A 50 year old woman in full health would be estimated to provide general unpaid labour worth **£1,527 pcm** (paragraph 129)
- As shown in the calculation of paid production, a 50 year old with QoL of 0.8 is estimated to have a productivity rate of **65%** (see paragraph 99)
- A 50 year old in full health is estimated to have a productivity rate of **72%** (see table, paragraph 112)
- The *sick rate* for a 50 year old with QoL of 0.8 is therefore estimated to be (65% / 72% =) **90%**
- A 50 year old woman with QoL of 0.8 is therefore estimated to provide general unpaid production worth (£1,527*90% =) **£1,374 pcm**.

Annex C: Unpaid Sickness Care Production

Definition

132. Unpaid sickness care production is defined as the value of time the *patient* spends in caring for a friend or relative who is unwell.

133. The measure of unpaid sickness care production includes only "passive" care, requiring only that the carer is present, and able to respond to care needs if they arise. Active provision of care is included in the measure of general unpaid production.

Rationale

134. Unpaid or informal sickness care provided by the patient is valued by society, even though it is not paid for in a financial transaction.

Approach

135. The general approach to estimating unpaid sickness care provided by a patient is:

- Estimate the probability that a patient is a carer, given their age and gender, using data identifying respondents as carers in the Time Use Survey.
- Estimate the average hours of care pcm provided by carers, using data from the Survey of Carers in Households.
- Apply the value of an hour of care using the same value as for general unpaid production, to give the value of care provided pcm.

136. This gives the value of care provided, given an individual's age and gender, if the individual is in full health. The final step is to

- Adjust this value using the *sick rate* calculated in the analysis of paid production, to give the value of care provided given the patient's QoL.

Illustrative example

137. Consider a 55 year old woman a QoL of 70%. (Figures are illustrative, for simplicity of explanation). If:

- There is an estimated **20%** probability that the average 55 year old woman in full health is a carer, and
- The average carer provides **125 h pcm** of care, and
- each hour is valued at **£10**; and
- 55 year olds with QoL of 70% have a *sick rate* of **80%**, then

- the estimated value of the sickness care provided by the patient is (20% * 125 h pcm * £10 / h * 80% =) **£200 pcm**.

Methodology

Estimate the probability of being a carer, given age and gender

138. Care provision for an individual of a given age and gender is calculated by first estimating the probability that the individual provides any sickness care to a friend or relative, given their age and gender, using the TUS.

139. The TUS contains a variable ("PROVCARE") which records whether a respondent is a carer for a friend or relative. This is used to calculate the proportion of respondents of a given age and gender who are carers. The results are shown in the table below.

Proportion of TUS respondents that are carers

Age	*Male*	*Female*
1	0%	0%
2	0%	0%
3	0%	0%
4	0%	0%
5	0%	0%
6	0%	0%
7	0%	0%
8	4%	6%
9	7%	6%
10	5%	12%
11	12%	7%
12	11%	10%
13	16%	12%
14	15%	11%
15	10%	6%
16	5%	8%
17	4%	11%
18	7%	6%
19	3%	4%
20	5%	5%
21	4%	8%
22	7%	10%
23	5%	8%
24	7%	10%
25	12%	10%
26	9%	5%
27	6%	7%
28	4%	9%
29	9%	11%
30	7%	14%
31	8%	14%
32	6%	15%
33	4%	10%
34	7%	10%

Age	*Male*	*Female*
35	15%	14%
36	8%	13%
37	10%	12%
38	14%	14%
39	11%	15%
40	10%	12%
41	4%	19%
42	11%	15%
43	16%	18%
44	16%	16%
45	19%	22%
46	7%	30%
47	12%	16%
48	15%	25%
49	14%	26%
50	21%	17%
51	12%	31%
52	24%	32%
53	24%	24%
54	17%	25%
55	16%	28%
56	20%	15%
57	18%	33%
58	19%	23%
59	27%	24%
60	19%	28%
61	29%	22%
62	17%	30%
63	13%	18%
64	20%	16%
65	17%	11%
66	15%	24%
67	15%	21%
68	32%	26%

Age	*Male*	*Female*
69	15%	18%
70	15%	19%
71	16%	20%
72	8%	26%
73	13%	18%
74	21%	16%
75	15%	14%
76	7%	12%
77	27%	9%
78	15%	17%
79	22%	8%
80	11%	11%
81	6%	19%
82	19%	0%
83	0%	11%
84	12%	18%
85	14%	0%
86	19%	4%
87	20%	9%
88	19%	13%
89	0%	0%
90	0%	0%
91	0%	0%
92	0%	19%
93	0%	0%
94	0%	0%
95	-	-
96	-	-
97	-	-
98	-	-
99	-	-
100	-	-

Apply the estimated hours pcm of care provided, if a carer

140. Data from the Survey of Carers in Households is used to estimate of the number of hours pcm that a carer provides (averaged over all ages and genders). This is estimated at **125 hpcm**.

141. This is calculated as the weighted average of the hours of care pcm provided by carers who live with the person they care for (207 h pcm, 37% of carers) and those who care for someone they don't live with (77h pcm, 63% of carers).

Value of an hour of care

142. Care provision is valued at **£9.24 per hour**, as described in paragraph 127.

Adjust for the *sick rate* calculated using productivity estimates

143. The "sick rate" for unpaid production is calculated using the observed productivity effects calculated for paid production. See paragraph 110 for details of the calculation of the sick rate. This approach effectively assumes that provision of unpaid labour is affected by health in the same way as participation in paid employment.

Annex D: Unpaid Childcare production

Definition

144. Unpaid child care provision is defined as the amount of time the patient normally spends in caring for a child. Only "passive" provision of child care is included in this element of production – as active provision of care activities is included in general unpaid production.

Rationale

145. Unpaid or informal sickness care provided by the patient is valued by society, even though it is not paid for in a financial transaction.

Approach

146. As with unpaid sickness care, patients may provide care to children simply by being with the child. This type of "passive" care is not captured in the Time Use Survey as a recorded activity.

147. The approach to estimating the amount of childcare provided by a patient is as follows:

- Estimate the probability that the patient is in a household with a child needing care (either with a youngest child of pre-school age, or of school age, as they are deemed to have different care needs)
- Estimate the proportion of the child's care that is provided by the patient
- Estimate the amount of childcare time required by a child of pre-school age or school age
- Apply the value of an hour of care using the same value as for general unpaid production, to give the value of care provided pcm.

148. This gives the value of childcare provided, given an individual's age and gender, if the individual is in full health. The final step is to

- Adjust this value using the the *sick rate* calculated in the analysis of paid production, to give the value of care provided given the patient's QoL.

Illustrative example

149. Consider a 55 year old woman QoL of 70%. (Figures are illustrative, for simplicity of explanation). If:

- There is an estimated **2%** probability that the average 55 year old woman is in a household with a youngest child of pre-school age

- There is an estimated **5%** probability they are in a household with a youngest child of school age
- A pre-school child requires on average **200 h pcm** of informal childcare
- A school age child requires on average **50 h pcm** of informal childcare
- 55 year old women are estimate to provide **80%** of the care for children in their household
- Each hour is valued at **£10**
- 55 year old women with QoL of 70% have a *sick rate* of **80%**

150. Then

- the estimated value of care provided by the patient to a pre-school child is (2% * 80% * 200 h pcm) * £10 / h * [1-20%] = **£25.6 pcm**.
- the estimated value of the child care provided by the patient to a school age child is (5% * 80% * 50 h pcm) * £10 / h * 80% = **£16 pcm**.

151. And

- the total value of childcare provided is (£25.6 + 26 =) **£41.6 pcm**.

Methodology

152. The care provided for school age and pre-school age children are estimated separately, to reflect the fact that they are likely to have different care requirements.

153. The analysis is based on an estimate of the probability that the individual has a *youngest* child of either pre-school or school age, and calculates the care provided in terms of the needs of the *youngest child only*. This entails the assumption that any additional older children impose no additional care needs.

Estimating the probability that an individual shares a household with a child of pre-school or school age

Source of data on youngest children in a patient's household

154. The Time Use Survey records the age of the youngest child in the household for each respondent to the survey, as well as the respondent's age and gender.

Accounting for youngest children who are siblings of the patient

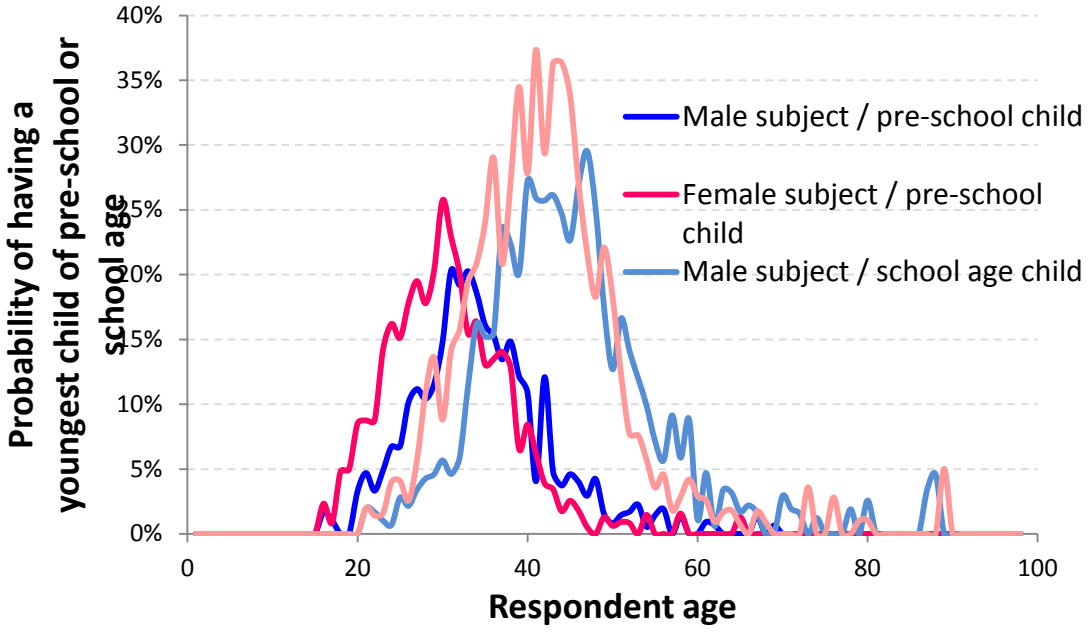
155. Some respondents might have siblings who are recorded as the youngest children in their households. While it is possible that children may themselves care for younger siblings, this situation is likely to be relatively uncommon. This analysis makes the simplifying assumption that a respondent only cares for a youngest child in their household if that child is at least 15 years younger than the respondent.

Results: Probability that a person shares a household with a pre-school or school age non-sibling child

	Pre school		School age	
Age	**Male**	**Female**	**Male**	**Female**
1	0%	0%	0%	0%
2	0%	0%	0%	0%
3	0%	0%	0%	0%
4	0%	0%	0%	0%
5	0%	0%	0%	0%
6	0%	0%	0%	0%
7	0%	0%	0%	0%
8	0%	0%	0%	0%
9	0%	0%	0%	0%
10	0%	0%	0%	0%
11	0%	0%	0%	0%
12	0%	0%	0%	0%
13	0%	0%	0%	0%
14	0%	0%	0%	0%
15	0%	0%	0%	0%
16	2%	2%	0%	0%
17	1%	1%	0%	0%
18	0%	5%	0%	0%
19	0%	5%	0%	0%
20	3%	9%	0%	0%
21	5%	9%	2%	2%
22	3%	9%	2%	1%
23	5%	14%	1%	2%
24	7%	16%	1%	4%
25	7%	15%	3%	4%
26	10%	18%	2%	3%
27	11%	20%	3%	6%
28	10%	18%	4%	11%
29	12%	20%	5%	14%
30	15%	26%	6%	9%
31	20%	23%	5%	14%
32	19%	20%	6%	16%
33	20%	15%	11%	19%
34	19%	16%	16%	21%
35	16%	13%	15%	24%
36	15%	13%	15%	29%
37	13%	14%	24%	21%
38	15%	13%	22%	27%
39	12%	7%	20%	34%
40	11%	8%	27%	28%
41	4%	6%	26%	37%
42	12%	4%	26%	29%
43	5%	3%	26%	36%
44	4%	2%	25%	36%
45	5%	3%	23%	34%
46	4%	2%	27%	27%
47	3%	1%	30%	22%
48	4%	0%	25%	18%
49	2%	1%	17%	22%
50	1%	1%	13%	18%

	Pre school		School age	
Age	**Male**	**Female**	**Male**	**Female**
51	1%	1%	17%	12%
52	2%	1%	14%	8%
53	2%	0%	12%	8%
54	1%	1%	10%	6%
55	1%	0%	7%	4%
56	2%	0%	6%	5%
57	0%	0%	9%	2%
58	1%	2%	6%	3%
59	0%	0%	9%	4%
60	0%	0%	1%	3%
61	1%	0%	5%	3%
62	1%	0%	1%	1%
63	0%	0%	3%	2%
64	0%	0%	3%	2%
65	0%	1%	2%	1%
66	0%	0%	2%	0%
67	1%	0%	2%	2%
68	0%	0%	0%	1%
69	1%	0%	0%	0%
70	0%	0%	3%	0%
71	0%	0%	2%	0%
72	0%	0%	2%	0%
73	0%	0%	0%	4%
74	0%	0%	1%	0%
75	0%	0%	0%	0%
76	0%	0%	0%	3%
77	0%	0%	0%	0%
78	0%	0%	2%	0%
79	0%	0%	0%	1%
80	0%	0%	3%	1%
81	0%	0%	0%	0%
82	0%	0%	0%	0%
83	0%	0%	0%	0%
84	0%	0%	0%	0%
85	0%	0%	0%	0%
86	0%	0%	0%	0%
87	0%	0%	3%	0%
88	0%	0%	5%	0%
89	0%	0%	0%	5%
90	0%	0%	0%	0%
91	0%	0%	0%	0%
92	0%	0%	0%	0%
93	0%	0%	0%	0%
94	0%	0%	0%	0%
95	0%	0%	0%	0%
96	0%	0%	0%	0%
97	0%	0%	0%	0%
98	0%	0%	0%	0%
99	0%	0%	0%	0%
100	0%	0%	0%	0%

156. These results are also shown in the graph below.



157. For example, the results indicate that for a 26 year old man there is a 10% probability of being in a household with a pre-school aged non-sibling youngest child, and a 2% probability of being in a household with a school aged non-sibling youngest child.

Adjustment for probability that the patient is the provider of childcare in the household

158. The calculation above provides an estimate of the likelihood that an individual shares a household with a non-sibling youngest child of pre-school or school age. However care responsibilities may not be equally divided between men and women. Therefore an adjustment is made to reflect the likely proportion of a child's care provided by the individual, depending on their gender.

159. The Time Use Survey TUS indicates that women provide **68%** of *active* childcare in families, while men provide **32%**. These proportions are used as multipliers to calculate the amount of effective care a patient provides to children needing care in their households.

160. For example, as shown above a 26 year old man has a 10% probability of being in a household with a pre-school aged non-sibling child. The man would be expected to provide, on average, 32% of the care needs of a pre-school aged child. Overall this implies that the average 25 year old man provides **3.2%** of a pre-school child's care needs. The provision of care for school age children is additional to this – and note that double counting has been eliminated, as only the youngest child in a household is considered.

Calculating the parental childcare time required by a child

161. The calculation above estimates the *proportion* of a child's parental care requirement provided by an individual given their age and gender. To calculate the *amount* of parental childcare required by a child requires an estimate of the number of hours per week a child requires parental care.

162. It is assumed that all children requires 12h of care of some kind per day – or **360 h pcm**. This may be provided in part outside of the household – for example by a nursery or school. It is assumed that the remainder of the child's care needs are met within the household.

*Hours of parental care required by **pre-school children***

163. Estimates from OECD suggest that that **49%** of pre-school aged children are enrolled in formal care. It is assumed that children in formal care receive 5 hours of care per day, on 20 working days per month. This equates to 49 potential working hours per month in which parents would *not* have to provide informal childcare.

164. Therefore the amount of potential working time in which parental informal care would be required for a pre-school child is (360 – 49 =) **311 h cpm**.

*Hours of parental care required by **school age children***

165. It is assumed that all school age children attend school for 6 h per day, on 20 working days per month. This equates to 120 potential working hours per month in which parents would *not* have to provide informal childcare.

166. Therefore the amount of potential working time in which parental informal care would be required for a school age child is (360 – 120 =) **240 h cpm**.

Value an hour of care

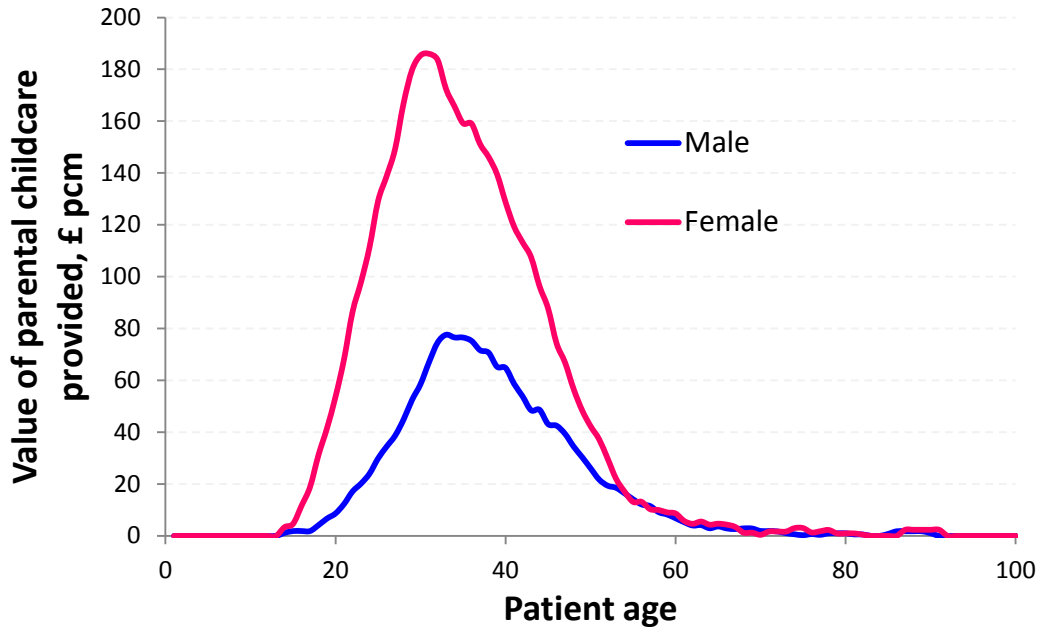
167. Care provision is valued at **£9.24 per hour**, as described in paragraph 127.

Adjustment for the *sick rate* calculated using productivity estimates

168. The "sick rate" for unpaid production is calculated using the observed productivity effects calculated for paid production. See paragraph 110 for details of the calculation of the sick rate. This approach effectively assumes that provision of unpaid labour is affected by health in the same way as participation in paid employment.

Results

169. The following graph summarises the average value of unpaid childcare provided by individuals of different ages and genders (by implication at full health). Data have been smoothed using a 5 year moving average.



Annex E: Formal Care Consumption

Definition

170. Consumption of formally-provided residential care, paid for by the individual, their friends or family or the state. This excludes non-residential care and health care in NHS settings.

Rationale

171. Provision of formal care to a patient consumes resources which would otherwise be put to some other use – for example in providing formal care to some other individual who may benefit from it.

Approach

172. Consumption of residential care is calculated using the following approach.

- Estimate the probability that a patient with a given age and QoL receives care
- Multiply this by the cost of care pcm

173. The above calculation is used for the majority of conditions. However patients with *dementia* and *stroke* are found to have significantly higher social care costs, for a given age and QoL, than other conditions. Condition-specific multipliers are therefore applied to reflect higher costs of care for patients with these conditions.

Illustrative example

174. Consider a 75 year old woman with stroke, and a QoL of 70%. (Figures are illustrative, for simplicity of explanation). If:

- There is an estimated **5%** probability that the average 75 year old woman with QoL of 70% receives residential social care
- The condition-specific multiplier for *stroke* is 2.
- The cost of residential social care is **£2,000 pcm**.

175. Then the estimated cost of social care for this patient is (5% * 2 * £2,000 pcm =) **£200 pcm**.

Methodology

Estimating the probability of using social care

176. ScHARR have provided estimates of the probability of a patient receiving residential social care, given their age and QoL.

177. These estimates are made using data from the Adult Social Care Survey which show the distribution of care users across age and QoL. This is compared to the distribution of the general population across age and QoL (estimated using the GP Patient Survey), to give an estimate of the proportion of individuals with a given age and QoL who are in care.

178. The table below shows the estimated probability of being in residential social care, by age and QoL.

	Patient Age			
QoL	*18-34*	*35-54*	*55-74*	*75+*
<0.2	1%	1%	2%	29%
0.2-0.6	1%	1%	2%	14%
0.6-1	0%	0%	0%	3%

179. To represent these results in a continous function, for calculating the care need of a given patient, a simple regression is used to estimating the probability of residential care need as a function of age and QoL. It is apparent that the probability of being in residential care is close to zero for patients below 75 years. Therefore the need for care is estimated as a linear function of QoL, and it is assumed that only patients over 75 years old need care.

$$\textit{Prob. of using residential care} = \beta_0 + \beta * QoL$$

180. The coefficients (β) of the equation are as follows:

Variable	**Coefficient**
QoL (EQ5D)	-0.325
Constant, β_0	0.283

181. For example, an 80 year old with QoL of 0.5 will be estimated to have a probability of needing residential social care of (0.283 * [-0.325*0.5] =) **12%**.

Estimating the costs of care

182. Data from the Adult Social Care Survey suggests that the average annual cost to local authorities for a residential care user is **£23,120** (monthly cost is £1,927).

183. For residential care, evidence from PSSRU suggests that private expenditure contributes an additional **77%** of gross state expenditure.

184. Note that, in principle, state-funded care impacts are included in the current NICE reference case. This would imply that only the private expenditure costs should be used when calculating the consumption impact of treatments – that is, **£1,484 pcm** for residential care.

185. Where appraisal of an intervention does not include state-funded care impacts, the full costs of care should be used – that is, **£3,410 pcm** for residential care.

186. Continuing the example above, an 80 year old patient with QoL of 0.7 will be estimated to have residential social care costs of (12% * £3,410 =) **£412 pcm**.

Adjustment to reflect greater costs of patients with dementia and stroke

187. The above analysis assumes that care needs depend only on the age and QoL of a patient, and are the same across all types of condition. However it is likely that some conditions are associated with greater than average care costs for a given age and QoL.

188. A literature review conducted by the Personal and Social Services Research Unit (PSSRU) found that two conditions were associated with systematically higher levels of care use: dementia and stroke. The literature review was also used to generate estimates of the average care costs associated with each of these conditions.

189. The estimates of average care costs for dementia and stroke patients are used to derive multipliers which are applied to the calculation of formal care use above for patients with these two conditions.

190. This is done by comparing the observed costs for dementia and stroke patients with the costs that would be expected if these populations had the care needs of average patients across all conditions, given their age and QoL. The ratio of observed costs for dementia and stroke patients to the costs that would be expected if they had average care needs gives the condition-specific multiplier that is then used to calculate care needs in this conditions.

191. Condition-specific multipliers are estimated as follows:

- Calculate the average annual cost of care for people with dementia or stroke (PSSRU analysis).
    - *For patients aged 65+ with dementia, the average annual cost of care is **£16,886**.*[7]
    - *For patients aged 65+ with stroke, the average annual cost of care is **£5,670**.*

[7] PSSRU provided estimates of cost of care by age. A weighted average has been taken, to simplify the analysis.

- Observe the distribution of dementia and stroke populations across age and QoL
    - *The GP patient survey and the Global Burden of Disease dataset are used to approximate the most plausible distributions*
- Calculate the care costs that would be expected for the populations of dementia and stroke conditions, *if* they had the care needs of average patients across all conditions.
    - *The ScHARR analysis includes estimates of the average costs of residential care for patients with all conditions, by age and QoL.*
    - *These can be used to calculate the expected costs of care for patients with the age and QoL distribution of dementia and stroke populations* if *they had average care needs*
    - *The patient population with dementia would have expected care costs of **£2,008 pa**., if they had average care needs*
    - *The patient population with stroke would have expected care costs of **£965 pa**., if they if they had average care needs*
- Calculate the ratio of the actual costs for dementia and stroke patients to the costs that would be expected if they had average care needs
    - *Care costs for dementia patients are £16,886 pa. If the dementia population had average care needs, the costs would be £2,008 p.a. Patients with dementia are therefore estimated to have (16,886 / 2,008 =) **8.41x** greater care costs than average patients with the same age and QoL*
    - *Care costs for stroke patients are £5,670 pa. If the stroke population had average care needs, the costs would be £965 p.a. Patients with stroke are therefore estimated to have (5,670 / 965 =) **5.88x** greater care costs than average patients with the same age and QoL*

192. For example, as shown above, an 80 year old patient with QoL is estimated to have a costs of £412 pcm. If the condition for which they are being treated is stroke, then their care costs are estimated as (£412 * 5.88 =) **£2,423** pcm.

193. Patients receiving residential care are assumed not to use other types of consumption, such as informal care. To ensure these element of consumption are calculated appropriately, condition-specific multipliers are applied to the probability of a patient needing residential care (and, for these purposes, assumed not to exceed 100%).

Use of non-residential social care

194. All individuals have a need for activities of unpaid production such as cleaning, cooking and washing. The patient's need for these activities is measured in their *consumption of unpaid production* (Annex G). It seems likely that there may be significant overlap between this element of consumption and the need for non-residential care. This implies there may be double counting of consumption of these activities if the two elements are estimated separately.

195. As all individuals consume unpaid production, not just those receiving non-residential care, the proposed approach to this issue is to assume all patients consume the same amount of unpaid production – and regard provision of non-residential care as a "transfer", which indicates that their need for these activities is not met by their own production. This entails excluding estimates of non-residential care use from the calculation of consumption.

Annex F: Informal Care Consumption

Definition

196. Informal care consumption includes unpaid care required by the patient as a result of ill health – for example, including care provided by family and friends.

197. The measurement of informal care consumption in this approach is limited to the need for "passive" care – that is, someone "just being there" in order to ensure the patient's needs are being met. The patient's need for active care such as cooking, washing or cleaning is measured separately as *consumption of unpaid production* (Annex H).

Rationale

198. The need for informal care places a burden on those who provide it.

Approach

199. The general approach to estimating a patient's requirement for informal care is as follows:

- Estimate days of informal care required, given a patient's age, gender, QoL and health condition, using a model developed by ScHARR
- Multiply by hours of care needed per day, given a patient's QoL
- Multiply by the average value of an hour of informal care

200. A different approach is used for adults and children, as explained below.

Methodology

Days of informal care used, given a patient's age, gender, QoL and health condition

201. A study carried out by the School of Health and Related Research (ScHARR) used data from the Health Outcomes Data Repository (HODaR) to estimated days of informal care used as a function of the patient's age, gender, QoL and health condition.

Dataset used

202. HODaR is a dataset collated by Cardiff Research Consortium (Currie *et al.*, 2005). The data is collected from a prospective survey of inpatients at Cardiff and Vale NHS Hospitals Trust. The survey includes information on the number of days of informal care needed by the respondent in the preceding 6 weeks. Since it is linked to routine hospital health data, it also includes socio-demographic, health related quality of life and international classification of disease (ICD) data. It does not survey people in residential care (and this analysis assumes that care home residents receive zero informal care).

Estimation of informal care need as a function of age, gender, ICD and QoL

203. The expected number of days of informal care required in a **6 week period** preceding the administration of the survey is estimated using the following model:

$$E = \left(1 - \frac{e^{\mathbf{z}_i'\gamma}}{1 + e^{\mathbf{z}_i'\gamma}}\right) e^{\mathbf{x}_i'\beta}$$

204. Where: $\boldsymbol{x_i}$ and $\boldsymbol{z_i}$ are vectors of input variables; β and γ are corresponding vectors of coefficients. These are shown in the following tables.

205. For $\boldsymbol{x_i}\beta$:

Variable (x_i)	**Coefficient (β)**
EQ-5D score	-0.857
Age	0.021
Female (1/0)	-0.024
ICD = H (1/0)	-0.241
ICD = K (1/0)	-0.215
ICD = L (1/0)	-0.135
ICD = N (1/0)	-0.231
ICD = O (1/0)	-0.565
ICD = R (1/0)	-0.192
ICD = S (1/0)	0.195
Constant, β_0	2.704

206. For $\boldsymbol{z_i}\gamma$:

Variable (z_i)	**Coefficient (γ)**
EQ-5D score	4.173
Age	0.046
Female (1/0)	-0.548
Constant, β_0	-3.572

207. This equation can therefore be used to calculate the expected days of informal care required for any patient, given their age, gender, ICD and QoL (EQ5D score).

Hours of care provided per day

208. The calculation above estimates the number of days of informal care required by a patient, given their age, gender, ICD and QoL. However it is unlikely that a full day of care is required in all circumstances. It seems likely that the hours of care needed per day would depend on the severity of the patient's condition.

209. Data is not currently available to allow a direct estimate of the hours of care required per day that would be consistent with the estimate of the number of days of care required. Therefore this analysis uses an informed assumption about the relationship between the patient's QoL and the intensity of their care requirement, as described below.

Hours of care provided per day of care

210. It is assumed that the minimum and maximum hours per day of care required by a patient are 1 and 6 respectively (informed by the Survey of Carers in Households).

211. Variation in care need between these extremes is then calculated using *the fraction of a month for which the patient is estimated to require care*. So

- if a patient is estimated to require care for the entire month (100%), they are deemed likely to have a high care need, and are considered to require the maximum of 6 hours per day of care;
- if a patient requires care for half of the month (15 days, or 50%), they are considered to require an intermediate level of 4.5 hours per day of care (the mid-point between 1 and 6 hours).

212. In general, the hours of care per day is calculated as follows:

$$h^{AGIQ} = 1 + 5\left(\frac{d^{AGIQ}}{30}\right)$$

213. Where:

- h^{AGIQ} is the hours of care per day, given the patient's age, gender, ICD and QoL
- d^{AGIQ} is the estimated days of care required per month, given the patient's age, gender, ICD and QoL
- The number 30 in the denominator represents the maximum number of days of care required per month.

214. Note that the maximum possible hours per day is therefore 6 (where the ratio in brackets equals 1), and the minimum possible hourse per day is 1 (where the ratio in brackets equals zero).

Calculating total hours of care per month

215. To calculate the total hours of care per month for a given patient, the **days of care needed per month** are estimated using the model of days of care need above (paragraph 203).

216. This is then used to calculate the **hours of care required per day**, as above (paragraph 212).

217. The **hours of care per month** is the product of these two values.

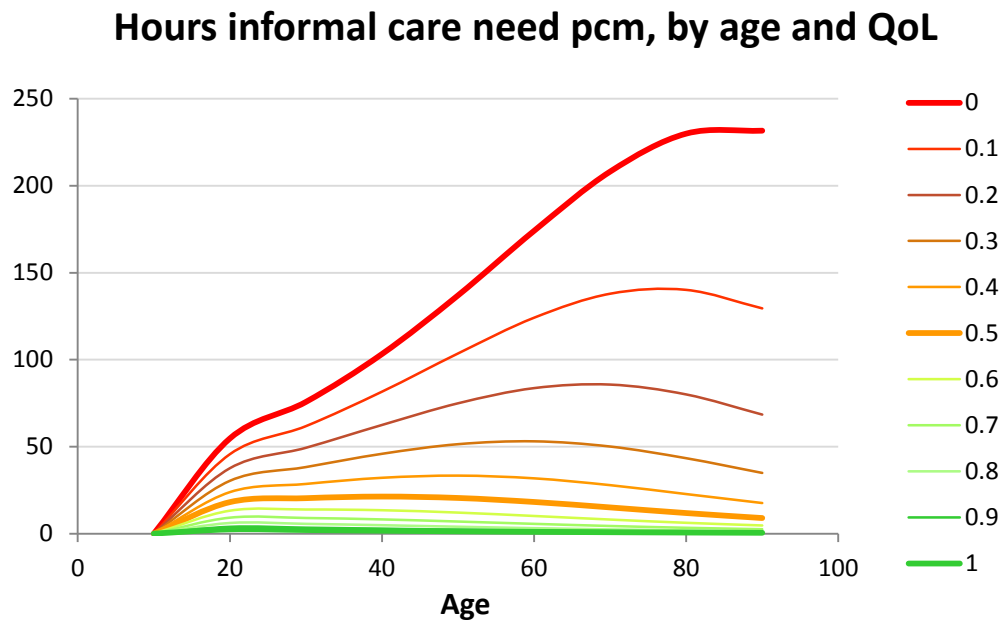
Example calculation of total hours of care per month

218. Consider a 66 year old woman with renal failure (ICD = G) and QoL of 0.6.

- They would be estimated to need **3.9 days pcm** of informal care, on average (using the model of days of care needed, above).
- Their hours of care needed per day is 1 + 5*(3.9/30) = **1.65 h per day**
- Their total informal care need is (3.9*1.65 =) **6.5 h pcm**.

Results

219. The following graph shows the estimated hours of informal care pcm as a function of age and QoL (assuming female, ICD G – and without the further adjustments described below).



Adjusting for the probability that the patient is in residential formal care

220. Patients who are in residential care, such as a nursing home, are assumed not to require informal care. To reflect this, the estimate of informal care need is reduced by the probability that the patient is in residential care (as calculated in Annex E)

221. For example:

- If the patient in the above example, who was estimated to require 6.5 h pcm of informal care, was estimated to have a probability of 10% of being in residential care, the adjusted estimate of informal care need would be (6.5 * [100%-10%] =) **5.8 h pcm.**

The average value of an hour of informal care

222. Care provision is valued at **£9.24 per hour**, as described in paragraph 127.

Valuing the cost of informal care for sick children

223. As described in Annex I, it may be argued that parents gain enjoyment from providing informal childcare – and that time spent by parents with children therefore ought not to be regarded as a net cost to the parents.

224. Attributing a cost to the parent of caring for a child implies that extension of the life of the child would impose a burden on the parent, in terms of the material cost of the time devoted to care, that they would prefer not to bear. This seems implausible. This analysis therefore assumes that informal care provided to sick children has zero net cost.

225. It may be noted that the arguments above, in respect of informal care provided to children, may also be made in respect of informal care provided to adult relatives. However the current analysis makes the assumption that carers for adults do not gain direct utility that offsets the burden to them of providing the care.

Annex G: Private Paid Consumption

Definition

226. Private paid consumption includes the use of goods and services that are paid for privately – including housing, clothing, transport, food, communications and entertainment. It excludes goods and services that are provided directly by Government.

Rationale

227. Consumption of resources by the patient implies a reduction in the resources available for others in society to benefit from. This includes the consumption of privately-purchased goods and services. To measure the patient's net production therefore requires inclusion of private consumption.

228. Note that in this approach to measuring net production it is not necessary to consider whether goods and services are paid for by the patient from their income, or funded by transfers to the patient – for example through welfare payments, or payments from family members. If the patient's total production and consumption are estimated directly – in terms of the resources actually produced and consumed – then the difference between these amounts is the net amount of *all* transfers to and from the patient.

229. For example, suppose a patient's private consumption in a period was £1,000. If this was funded entirely from their own paid labour, which was itself £1,000, then their estimated net production would be zero (ignoring other elements), as production and consumption are matched, and there is no transfer to or from the rest of society. However if a patient provided no paid labour, and their £1,000 of consumption was funded entirely by transfers from Government or family, then their estimated net production would be -£1,000. The total amount of transfers to and from the patient is shown by their estimated net production.

230. The value of the consumption to the patient is assumed to be included in the measurement of their QALYs.

Approach

231. The approach to measuring private paid consumption per patient is summarised as follows:

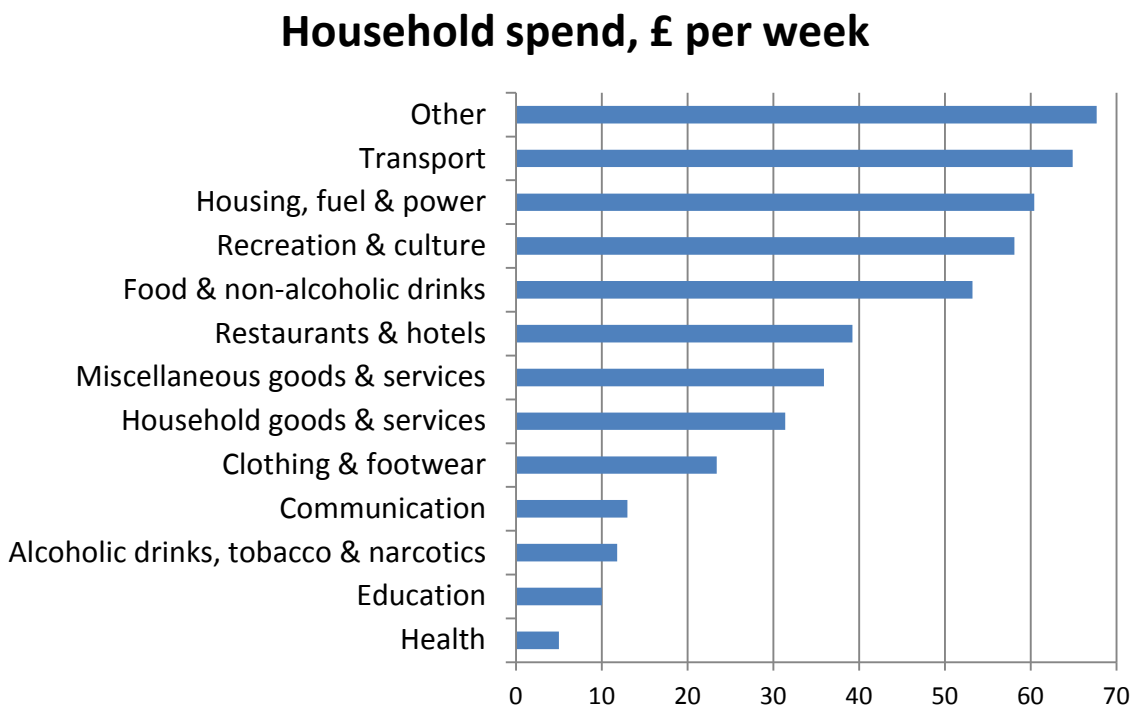
- Estimate average expenditure per household.
- Divide average household expenditure by average household size to estimate individual expenditure.
- Adjust for relative differences in consumption across different ages.

Methodology

Measure average expenditure in England, per household

232. The Living Costs and Food Survey – administered by ONS – estimates that average household expenditure in the UK is **£474 per month**.[8]

233. The composition of spending is as shown in the figure below.



Divide average household expenditure by average household size to estimate individual expenditure

234. Data from the Labour Force Survey indicates that the average household size was **2.35** in 2011. This implies the average spending per person was £202 per week, or **£865 pcm**.

Adjust for differences in consumption by age

235. A study conducted in Sweden[9] estimated how private consumption varies with age, as shown in the table below.

[8] http://www.ons.gov.uk/ons/rel/family-spending/family-spending/family-spending-2011-edition/general-nugget.html

[9] Ekman, Mattias. Consumption and production by age in Sweden: Basic facts and health economic implications. In: Ekman M. Studies in health economics: Modelling and data analysis of costs and survival. Dissertation for the degree of Doctor of Philosophy at the Stockholm School on Economics. EFI, Stockholm Sweden 2002.

Age group	Consumption pa (SKr)
0-19	56,406
20-34	87,300
35-49	80,721
50-64	105,942
65-74	95,523
75-84	71,909
85+	49,219

236. The relative consumption of different age groups is used to adjust the average consumption estimated above. The results, for each age, are shown in the table below.

Private paid consumption £ pcm, by age

Age	*Prod.*
1	*£631*
2	*£631*
3	*£631*
4	*£631*
5	*£631*
6	*£631*
7	*£631*
8	*£631*
9	*£631*
10	*£631*
11	*£631*
12	*£631*
13	*£631*
14	*£631*
15	*£631*
16	*£631*
17	*£631*
18	*£631*
19	*£631*
20	*£976*
21	*£976*
22	*£976*
23	*£976*
24	*£976*
25	*£976*
26	*£976*
27	*£976*
28	*£976*
29	*£976*
30	*£976*
31	*£976*
32	*£976*
33	*£976*
34	*£976*

Age	*Prod.*
35	*£903*
36	*£903*
37	*£903*
38	*£903*
39	*£903*
40	*£903*
41	*£903*
42	*£903*
43	*£903*
44	*£903*
45	*£903*
46	*£903*
47	*£903*
48	*£903*
49	*£903*
50	*£1,185*
51	*£1,185*
52	*£1,185*
53	*£1,185*
54	*£1,185*
55	*£1,185*
56	*£1,185*
57	*£1,185*
58	*£1,185*
59	*£1,185*
60	*£1,185*
61	*£1,185*
62	*£1,185*
63	*£1,185*
64	*£1,185*
65	*£1,068*
66	*£1,068*
67	*£1,068*
68	*£1,068*

Age	*Prod.*
69	*£1,068*
70	*£1,068*
71	*£1,068*
72	*£1,068*
73	*£1,068*
74	*£1,068*
75	*£804*
76	*£804*
77	*£804*
78	*£804*
79	*£804*
80	*£804*
81	*£804*
82	*£804*
83	*£804*
84	*£804*
85	*£551*
86	*£551*
87	*£551*
88	*£551*
89	*£551*
90	*£551*
91	*£551*
92	*£551*
93	*£551*
94	*£551*
95	*£551*
96	*£551*
97	*£551*
98	*£551*
99	*£551*
100	*£551*

Impact of Quality of Life on private consumption

237. While it might be argued that some elements of private consumption would decrease when a patient is ill (for example recreation and entertainment), it is also possible that some elements of spending would increase (for example spending more on travel by using transport instead of walking, or carrying out home improvements). No data is available to make an evidence-based estimate of the impact of QoL on private consumption. Therefore this analysis assumes private consumption does not vary with the patient's QoL.

Private consumption in residential care

238. It is assumed that patients resident in care homes have no private consumption – and that all their needs are met in the services provided by the care home.

The value of consumption to the patient

239. Consumption of privately purchased goods and services results in a cost to the rest of society who are deprived of their consumption. However there must also be a benefit to the patient from consuming these goods and services, and this must be reflected in a comprehensive estimate of the net impact of any treatment.

240. This analysis assumes that the benefits of private consumption to patients – along with the benefits of all other aspects of the patient's consumption – are captured in the measure of health gain, normally expressed in Quality Adjusted Life Years (QALYs).

241. This assumption implies that, when valuing prospective health states in order to make the trade-offs underlying the QALY calculation methodology, respondents reflect their best expectation of their likely level of private consumption.

242. Consider, for example, the Time Trade Off instrument commonly used to assign values to health states. In this instrument respondents are asked, in effect, to indicate how much time lived in full health they would be willing to sacrifice in order to avoid living for a period (say a year) in a certain state of ill health. If the respondent indicates that they would sacrifice 3 months lived in full health to avoid living a particular health state for 1 year, then that health state would be deemed equivalent to a level of quality of life of 0.75 – on the grounds that 1 year in the health state would be considered by the patient equivalent to 0.75 years in full health (9 months / 12 months = 0.75).

243. When considering the additional 3 months of life in the health state above, it appears evident that respondents do indeed reflect the contribution of their private consumption to the value they place on that time. Failing to do so would imply that they were envisaging life lived without any consumption – no clothing, food, housing or any of the necessities of life.

244. Whether the respondent fully internalises the difference in consumption between the two levels of health – for example due to their inability to earn as much if they are unwell – is less clear. However it is arguably an issue of secondary significance – particularly when it is considered that any loss of income to them is likely to be mitigated, at least in part, by transfers to them from Government or family, or in sick pay from their employer. It is also important to note that any losses in consumption would normally be smoothed over the patient's entire lifetime, thus reducing the impact of any failure by respondents to reflect changes in consumption.

245. For these reasons this approach to net production therefore assumes that the benefits of consumption to the patient are fully reflected in the QALYs attributed to them, given their profile of health over time.

Annex H: Consumption of Unpaid Production

Definition

246. Consumption of unpaid production is defined as the use of all the elements of general unpaid production identified in Annex B – including washing, cleaning, cooking and other domestic work, as well as personal care that healthy individuals may normally carry out for themselves. For the full list of activities defined as unpaid production, see Annex M.

Rationale

247. Individuals, whether healthy or unwell, will normally benefit from the provision of domestic services such as cooking and cleaning – which they may or may not provide for themselves.

248. Note that this approach to measuring net production requires that production and consumption are measured separately, and then compared to give the patient's net production – even if the patient is both the provider and beneficiary of the activity. So if an individual carries out their own cooking and cleaning, from the perspective of this analysis this would be recorded both as production and consumption – and the values of these two activities ought, in principle, to offset each other fully.

Approach

249. It is assumed that all individuals (except those in residential care) require and use the same total amount of consumption of general unpaid production – regardless of their age, gender or health condition. Therefore an average value of consumption of unpaid production is used. This is calculated as follows:

- Estimate average hours of general unpaid production *provided* per person
- Multiply by the average value of an hour of unpaid production

250. As with other elements of private consumption, it is assumed that patients in residential care do not consume any unpaid production – and that all their consumption needs are encompassed in their care costs.

Methodology

<u>Estimate average hours of general unpaid production per person</u>

251. The Time Use Survey is used to estimate the hours of general unpaid production provided by individuals per month, given their age and gender. This is combined with information on the distribution of the population (Census) to calculate an average amount of general unpaid production per person of **115 h pcm** for the whole population.

252. Consumption of unpaid production in aggregate must equal the amount of production in aggregate. As it is assumed that all individuals have the same consumption of unpaid production, this implies that the amount of consumption by each individual is equal to the average production by all individuals – that is, **115 h pcm**.

The average value of an hour of unpaid production

253. Consumption of unpaid production is valued at **£9.24 per hour**, as described in paragraph 127.

Estimated consumption of unpaid production

254. The average value of unpaid consumption per month is therefore estimated at **£1060** for all patients (115 h pcm * £9.24 per h).

255. An adjustment is made to reflect the probability that the patient is in residential care. For example, if there is a 10% probability that a patient is in residential care, their estimated consumption of unpaid production is (£1060*90% =) **£954 pcm**.

Annex I: Childcare Consumption

Definition and rationale

256. Caring for children implies time costs for those who provide the care. However it may not be appropriate to regard parentally provided childcare as a cost in the same way. If parents choose to have children, and gain enjoyment from providing them with childcare, it may be incorrect to regard the time taken for provision of that care as a burden on the parents – as the opportunity cost to them may be expected to be outweight by the benefits they realise from enjoying the company of the child.

257. Therefore this analysis assumes that children receiving childcare impose no net costs to their parents in terms of the time spent in childcare.

258. Care provided through Government, including school, is also excluded, since the cost of this is captured in the 'Government services' element of net production.

259. The only element of childcare included in consumption is private paid childcare.

Approach and methodology

260. It is assumed that the average pre-school age child (aged 0-4) consumes **50** hours of private paid childcare per month, at a cost of **£6** per hour[10].

[10] http://www.direct.gov.uk/en/Parents/Childcare/DG_181206 and http://www.direct.gov.uk/en/Parents/Childcare/DG_181084

Annex J: Government Consumption

Definition

261. The patient's consumption of services provided directly by Government, such as healthcare and education.

Rationale

262. If a patient uses services directly provided by Government, this means the resources entailed in providing those services cannot be used by others in society, and this imposes a cost on others.

263. For some elements of Government's spending, an individual's benefit from services does not reduce the amount of resources available for others. These types of spending are known as "public goods", which have the property of "non rival" consumption. These public goods are excluded, as the patient's use of these services does not reduce the benefits others can gain from them.

264. This analysis also excludes "transfer payments" such as welfare benefits, which do not correspond with a direct use of resources until they are actually used to purchase and consume some other goods and services – in which case they are measured elsewhere, for example as part of the patient's "private consumption". Note that the estimate of net production, which measures an individual's production and consumption directly, gives a measure of the total of such transfers to or from the patient.

Approach

265. The approach to measuring consumption of government services per patient, given their age, is summarised as follows:

- Calculate Government spending per person not relating to public goods or transfers (**£466 per person pcm)**.
- Adjust health and education spending for the age of the patient.

266. It is assumed that Government consumption does not vary with the patient's quality of life. Note that health spending here excludes costs of treatment for the patient's condition.

Methodology

<u>Calculate Government spending per person not relating to public goods or transfers</u>

267. The 'Public Expenditure Statistical Analyses 2013' (PESA), published by HM Treasury (see Chapter 10), measures total identifiable expenditure in England by sub-function. The most recent data available is for 2012-13. See Annex L for a full breakdown of the PESA analysis.

268. The elements of spending included in estimates of Government spending are identified using the following approach:

Exclude expenditure on transfer payments

269. Transfer payments do not result in use of resources until they are used for purchases of goods and services which are consumed. Since this is captured elsewhere, transfer payments are excluded from the measurement of Government consumption. The major category of transfer payments in the PESA analysis is social protection.

Exclude expenditure on public goods

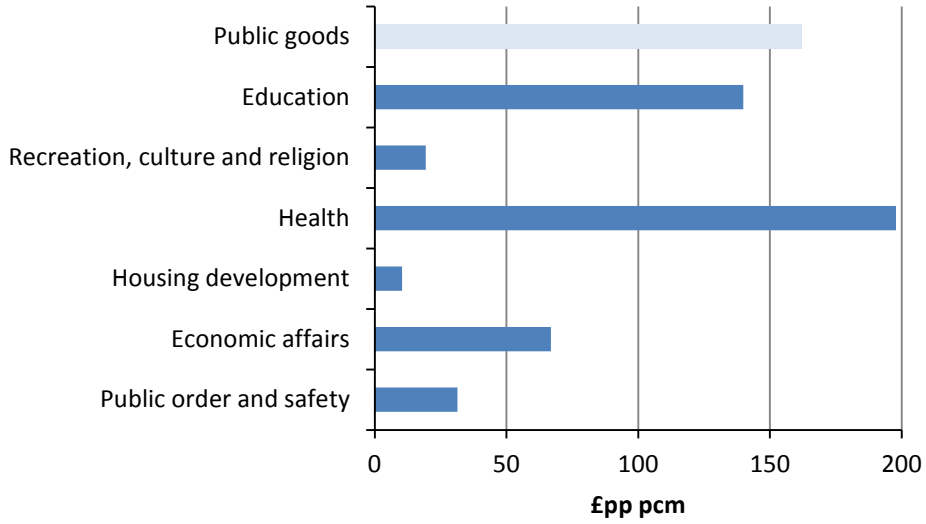
270. Since consumption of public goods is non-rival, it does not result in a cost on society and is excluded from measurement of Government consumption.

271. The following categories of public expenditure are considered to related to public goods:

- General public services – which includes central government running costs, such as the cost of parliament, MP salaries, general central government policy making, costs of tax and statistics collection
- Defence – including military defence, civil defence and foreign military aid
- Environment protection – including waste management, waste water management, pollution abatement and protection of biodiversity and landscape
- Parts of housing and community amenities – including community development, water supply and street lighting, but excluding housing development
- Parts of economic affairs – including national and local roads, but excluding local public transport, fuel and energy and mining, manufacturing and construction
- Parts of public order and safety, including police services and fire-protection services, but excluding law courts and prisons
- Research and development – in each area of government services

272. The full designation of elements included in estimates of Government consumption is provided in Annex L.

273. The average Government consumption per person is estimated at **£466 pcm**. The distribution of this amount across the major elements of spending are shown in the following diagram.

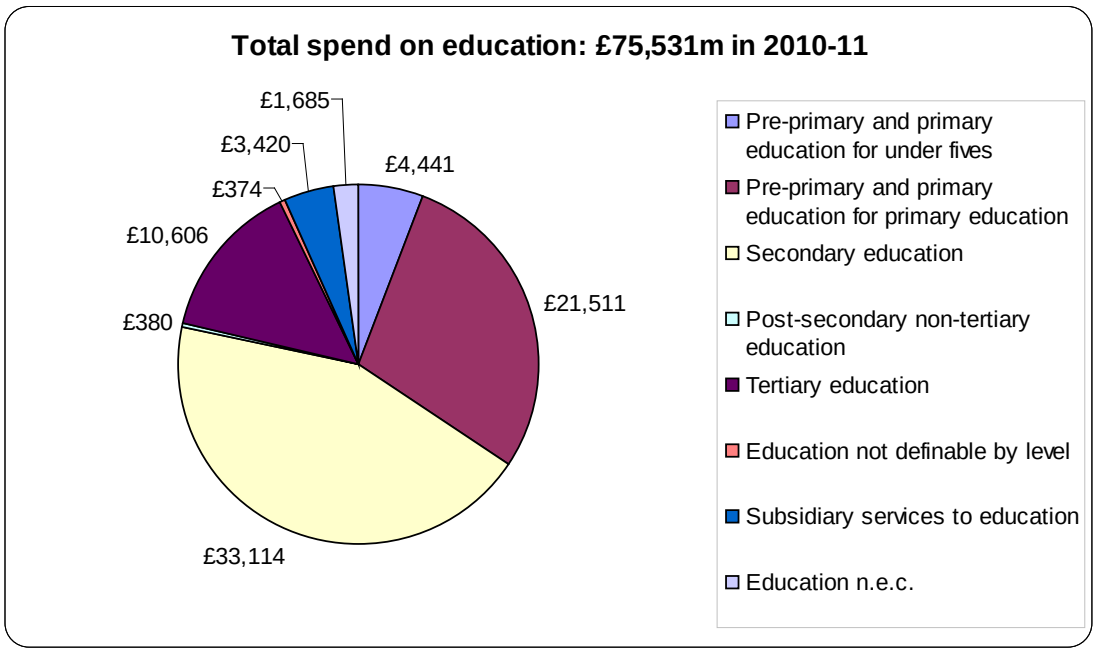


Determine how government expenditure on services varies given a patient's age

274. Since health and education are the largest categories of expenditure and the categories most likely to vary with age, an adjustment is made to the average Government consumption in these categories. All other categories of expenditure are assumed to be constant across all age groups.

Variation of spending on education with age

275. The PESA data includes a breakdown of total expenditure on education, in the categories summarised in the following diagram.



276. It is assumed that only people aged 0-21 receive state-funded education services. Within this group it is assumed that:

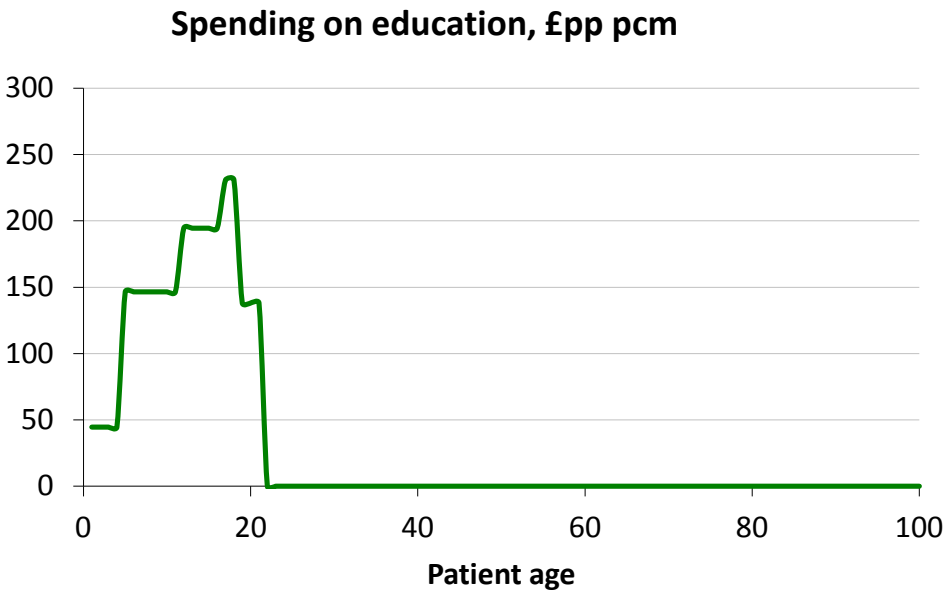
- Spending on pre-primary and primary education for under fives is evenly distributed across those aged 0-4 years;
- Spending on pre-primary and primary education for primary education for primary education is evenly distributed across those aged 5-11;
- Spending on secondary education is evenly distributed across ages 12-18;
- Spending on post-secondary and non-tertiary is evenly distributed across ages 16-18;
- Spending on tertiary education is evenly distributed across ages 19-21; and
- Other categories of spending are evenly distributed across ages 0-21.

277. ONS population estimates are used to adjust total education expenditure for each age group to per person estimates.

278. The calculation and resulting adjustments to the average spend on education are shown below.

Age group	Total spend £million	Population size (000s)	Spend per person, £	Adjustment applied to average spend
0-4 yrs	5,686	3,267	1,740	32%
5-11 yrs	23,254	4,063	5,723	105%
12-16 yrs	23,321	3,069	7,598	139%
17-18 yrs	11,916	1,321	9,022	165%
19-21 yrs	11,353	2,104	5,395	99%
22+	0		0	0%
Sum (or average)	75,531	13,825	(5,464)	

279. Applying these adjustments to the average spend on education (£140 pp pcm) gives the consumption of education by age shown in the graph below:



Variation of spending on health with age

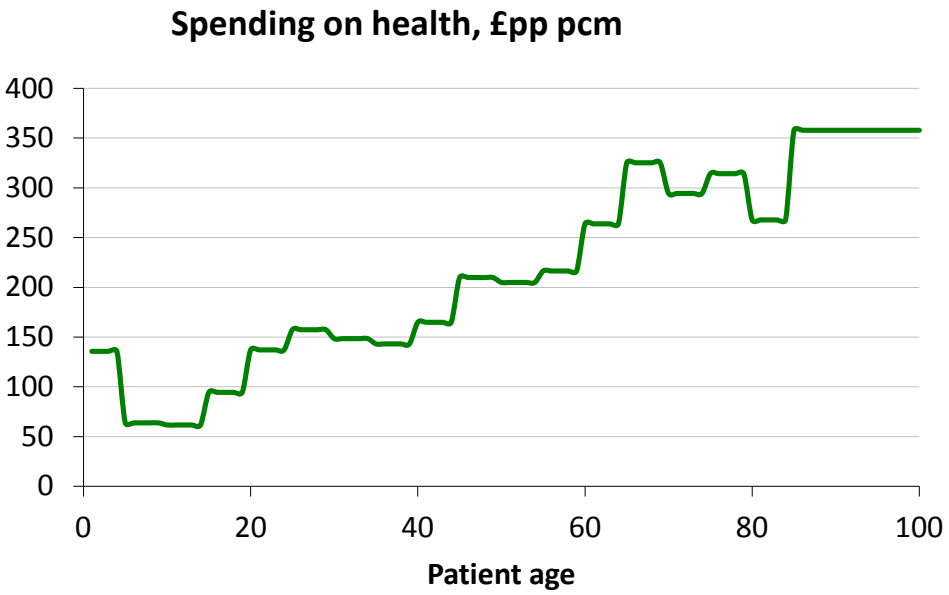
280. The variation in health spending by age is estimated using the following data:

- Resource allocation: Weighted capitation formula - 7th edition. See page 42 for Mental Health, page 50 for prescribing and page 61 for Primary Care.
- CARAN report (RAP 30), for General and Acute, Maternity
- ONS population estimates to adjust total health expenditure for each age group to per person estimates

281. The estimated adjustments to the average spend are shown below:

Age	Adjustment to average health spend
0-4 y	69%
5-9 y	32%
10-14 y	31%
15-19 y	48%
20-24 y	69%
25-29 y	80%
30-34 y	75%
35-39 y	72%
40-44 y	83%
45-49 y	106%
50-54 y	104%
55-59 y	109%
60-64 y	133%
65-69 y	164%
70-74 y	149%
75-79 y	159%
80-84 y	135%
85+	181%

282. Applying these adjustments to the average spend on health (£198 pp pcm) gives the consumption of health by age shown in the graph below:



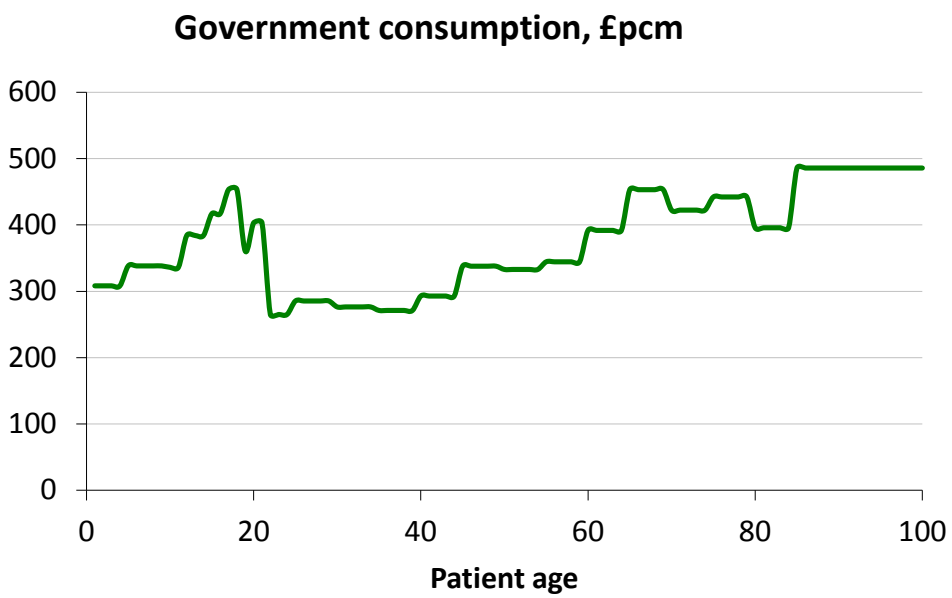
Results

283. Overall Government consumption by age (£ pcm) is as follows:

Age	*Education*	*Health*	*Other*	*Total*
1	45	136	128	308
2	45	136	128	308
3	45	136	128	308
4	45	136	128	308
5	147	64	128	338
6	147	64	128	338
7	147	64	128	338
8	147	64	128	338
9	147	64	128	338
10	147	62	128	336
11	147	62	128	336
12	195	62	128	384
13	195	62	128	384
14	195	62	128	384
15	195	94	128	417
16	195	94	128	417
17	231	94	128	453
18	231	94	128	453
19	138	94	128	361
20	138	137	128	403
21	138	137	128	403
22	0	137	128	265
23	0	137	128	265
24	0	137	128	265
25	0	157	128	285
26	0	157	128	285
27	0	157	128	285
28	0	157	128	285
29	0	157	128	285
30	0	148	128	276
31	0	148	128	276
32	0	148	128	276
33	0	148	128	276
34	0	148	128	276
35	0	143	128	271
36	0	143	128	271
37	0	143	128	271
38	0	143	128	271
39	0	143	128	271
40	0	165	128	293
41	0	165	128	293
42	0	165	128	293
43	0	165	128	293
44	0	165	128	293
45	0	210	128	338
46	0	210	128	338
47	0	210	128	338
48	0	210	128	338
49	0	210	128	338
50	0	205	128	333

Age	*Education*	*Health*	*Other*	*Total*
51	0	198	128	333
52	0	198	128	333
53	0	198	128	333
54	0	198	128	333
55	0	198	128	344
56	0	198	128	344
57	0	198	128	344
58	0	198	128	344
59	0	198	128	344
60	0	198	128	392
61	0	198	128	392
62	0	198	128	392
63	0	198	128	392
64	0	198	128	392
65	0	198	128	453
66	0	198	128	453
67	0	198	128	453
68	0	198	128	453
69	0	198	128	453
70	0	198	128	422
71	0	198	128	422
72	0	198	128	422
73	0	198	128	422
74	0	198	128	422
75	0	198	128	442
76	0	198	128	442
77	0	198	128	442
78	0	198	128	442
79	0	198	128	442
80	0	198	128	396
81	0	198	128	396
82	0	198	128	396
83	0	198	128	396
84	0	198	128	396
85	0	198	128	486
86	0	198	128	486
87	0	198	128	486
88	0	198	128	486
89	0	198	128	486
90	0	198	128	486
91	0	198	128	486
92	0	198	128	486
93	0	198	128	486
94	0	198	128	486
95	0	198	128	486
96	0	198	128	486
97	0	198	128	486
98	0	198	128	486
99	0	198	128	486
100	0	198	128	486

284. Shown graphically:



Annex K: Data sources used

Data Sources Used in calculation	Part of calculation data is used	Summary of datasets	Strengths and Weaknesses of Datasets	Alternatives considered
Annual survey of Hours and earnings (ASHE)	Paid Production: Average hours worked at full health, for those in work, given their age and gender. Paid production: Calculate average wages at full health, given age and gender.	ASHE is a UK-wide survey that collects a range of data on hourly, weekly and annual earnings, working patterns, and a range of further information relevant to understanding earnings statistics. Based on a 1% sample of employee jobs from HMRC PAYE records. Information on earnings and hours is obtained from employers and treated confidentially. ASHE does not cover the self-employed nor does it cover employees not paid during the reference period.	+ Recommended by ONS - Does not allow us to observe wages and hours worked for people *at full health*, since no health information is collected - Does not differentiate among people aged 65+ (due to small sample sizes)	LFS
GP Patient Survey (GPPS)	Paid Production: % of people at full health in work, by age and gender Formal Care Consumption: QoL distribution for the total population, by	The GP Patient survey is a questionnaire designed to give patients the opportunity to comment on their experience of their GP Practise. It collects information on 1.36 million randomly selected adult patients registered with a GP in England. T he survey asks about your experiences of your local GP surgery and other local NHS	+ Gives health information for respondents, which allows us to observe only those at full health. + Has greater dissection of information for ages 65+ + For age groups that are aligned with LFS, the GP Patient Survey provides very similar estimates of the employment rate + Large sample size	LFS, to measure % of people in work (see below) Health Survey for England for

	age	services, and includes questions about your general health.	- Does not record information for under 18 year olds	QoL distribution – but has a smaller sample size than the GP Patient Survey
Labour force Survey (LFS)	Unpaid Childcare production: Average number of care providing adults in a household Private Paid consumption: average household size.	The Labour Force Survey (LFS) is a survey of households living at private addresses in the UK. It is the largest household survey in the UK. It provides the official measures of employment and unemployment.	+Wide range of linked variables for analysis +Time series back to 1984	GP Patient survey (see above)
Health Outcomes Data Repository (HODaR)	Days of care used given a patients age gender QoL and health condition	HODaR is a dataset collated by Cardiff Research Consortium (Currie et al., 2005). The data is collected from a prospective survey of inpatients at Cardiff and Vale NHS Hospitals Trust. The survey includes information on days of informal care consumed in the previous 6 weeks. Since it is linked to routine hospital health data, it also includes socio-demographic,	+ Only known individual level survey that includes information on the AGIQ of respondents and use of informal care - Surveys those who have recently been discharged from hospital - could incur some bias in estimating days of informal care. - Asks respondents for their current health state, and use of informal care *in the last 6 weeks*, which means the two	The BHPS asks respondents for details on time off sick, but does not collect EQ5D data

		health related quality of life and ICD classification data. It surveys patients aged 18+ only.	are not completely aligned.	
Eurostat 2010 Data	Paid Production: Adjustment for On costs.	Eurostat uses structural information on labour costs, collected through the four-yearly Labour Cost Surveys (LCS), which provide detailed data on structure and level of labour costs, hours worked and hours paid.	+Recommended by BIS as appropriate rate	Level of on-costs incurred by civil service.
Time Use survey (TUS)	General unpaid production: minutes per day spent on activities of unpaid production Unpaid sickness care production: probability of being a carer Unpaid Childcare production: Age of youngest child in household for each respondent to the survey	Draws on a sample of 6414 households in England, Scotland, Wales and Northern Ireland. Measures the amount of time people spend on activities in 10 minute slots, across 24 hours a day, using a diary. Allows respondents to record a main and secondary activity across each ten minute slot. Records respondent's age, gender and health status, and whether they provide care to another person.	+ Health data on respondents allows you to observe only patients at full health + The TUS asks health questions which allow us to infer whether respondents are at full health. We have decided to use Q.34b as a proxy for QoL: Have you CUT BACK on the things you do because of illness or injury? - Since the survey was run ten years ago, the results may be outdated – however, note that, on comparison with the results of the TUS 2005 (of which the data is not easily accessible) the pattern of time use was very similar in the two surveys, with over half the day spent sleeping, working in a main job and watching TV. Some changes included that in 2005, there was less time on average spent eating and	None, but we could sense check against any estimates on individual components of unpaid production.

	Unpaid Childcare production: Time spent providing active unpaid childcare		drinking, washing and dressing, doing housework, reading and participating in sport. Conversely, there was more time spent sleeping and resting, looking after children in the household, socialising and participating in hobbies.	
OECD pubished estimates that draw on European countries, EU-SILC (2008)	Unpaid childcare production: Estimates for % of children enrolled in formal care.	The European Union Statistics on Income and Living Conditions (EU-SILC) is an instrument aimed at collecting timely and comparable cross-sectional and longitudinal multidimensional microdata on income, poverty, social exclusion and living conditions. This instrument is anchored in the European Statistical System (ESS).	Not considered	No considered
Survey of Carers in Households	Unpaid care production: Time spent on care per week for carers that live with those that they care for	Surveyed 2,199 carers 76% response rate Asks carers for a range of information, including – and most relevant for this work - information on their age, gender, and number of hours spent providing care	+Gives information on the characteristics of carers including age, and gender.	Results compared to results from the TUS
Adult Social Care Survey (ASCS)	Formal Care consumption: QoL distribution of care users Formal Care consumption:	The annual survey has run twice, starting in 2010/11. Councils send questionnaires to a stratified random sample of services users who were receiving services funded wholly or partly by Councils with Adult Social Services Responsibilities (CASSRs).	+ Only known dataset that includes data on the age, gender and QoL of care users, and expenditure on social care -Although the overall response rate for the survey was similar to other such surveys, the response rates for the variables used were poor, and the	No known alternatives that collect all data necessary Results quality

	Average costs of being a care home resident or non-residential care user	Information collected on the age and gender of respondents, along with health data (very closely aligned to EQ5D questions) and data on expenditure on their care package. The survey achieved a 40% response rate.	consistency of reporting may be questionable -Does not include all EQ5D domains, so linguistic mapping was required to estimate the quality of life of respondents	assured, eg expenditure figures checked against average care packages estimated by PSSRU
Public Expenditure Statistical Analysis published by HM Treasury (PESA)	Government consumption: Total government expenditure on services in England, per person.	Public Expenditure Statistical Analyses (PESA) is the regular publication of information on government spending. PESA is based on two datasets: The Budgetting framework and Total Expenditure on Services framework (TES)		
Directgov	Average formal childcare costs for pre-school and school age children.	DirectGov delivers information and practical advice about public services.		
The Living Costs and Food survey (LCFS)	Private Paid consumption: Average household expenditure, by category.	The LCF is a continuous survey of household expenditure, food consumption and income. Information for the LCF is collected from people living in private households. The survey is made up of: a comprehensive household questionnaire	+ Only collection of household expenditure data in UK -Data on expenditure is available only by household – this means that we have to transform it to get to individual level estimates. - Information on the respondents' health	

		which asks about regular household bills and expenditure on major but infrequent purchases; an individual questionnaire for each adult (aged 16 or over) which asks detailed questions about their income; a diary of all personal expenditure kept by each adult for two weeks, and of home grown and wild food brought into the home; a simplified diary kept by children aged 7 to 15 years, also kept for two weeks. The set sample in Great Britain is 12,000 addresses a year which are selected from the Postcode Address File (a comprehensive list of all delivery points - postboxes).	are not collected so it is not possible to assess how consumption varies with a patient's quality of life	
Understanding Society (US)	Paid production, productivity rates, sick rates	Asks respondents for if they carried out paid work in the previous week, and also records health using SF-12 instrument	+ Large, well-established survey + Links productivity with well-known instrument of health - Lacks information on type of condition - Not sensitive to sickness absence of less than 1 week - Does not record whether absence was for some other reason than non-productivity (eg holiday, training)	

Annex L: Public Expenditure Statistical Analysis

285. The table below is taken from PESA for 2012/13. Designations of categories of spending show those elements included in estimates of Government consumption. "Public goods" and "Transfers" are designated as such, for information, but are not included in the estimate of Government consumption.

286. Designations are made (and sums calculated) at the highest level possible – for example, "Total defence" is designated as Public Goods, but individual items are not designated (or counted in the sum of Public Goods).

287. Data for spend in 2012/13 is provided for England. In calculation the spend per person (£pp pcm), the population of England is estimated to be 52 million.

Category	Spend, £m 2012-13	£pp pcm	Designation
1. General public services			
1.1 Executive and legislative organs, financial and fiscal affairs, external affairs	10,861	17.41	Public goods
1.2 Foreign economic aid	5,832	9.35	Public goods
1.3 General services	783	1.25	Public goods
1.4 Basic research	-	-	Public goods
1.5 R&D general public services	9	0.01	Public goods
1.6 General public services n.e.c.	2,178	3.49	Public goods
2. Defence			
2.1 Military defence	31,489	50.46	-
2.2 Civil defence	119	0.19	-
2.3 Foreign military aid	2,235	3.58	-
2.4 R&D defence	2,324	3.72	-
2.5 Defence n.e.c.	196	0.31	-
Total defence	36,363	58.27	Public goods
3. Public order and safety			
3.1 Police services	17,692	28.35	-
of which: immigration and citizenship	1,513	2.42	Public goods
of which: other police services	16,180	25.93	Public order and safety
3.2 Fire-protection services	2,950	4.73	Public order and safety
3.3 Law courts	5,984	9.59	Public goods
3.4 Prisons	4,325	6.93	Public goods
3.5 R&D public order and safety	35	0.06	Public goods
3.6 Public order and safety n.e.c.	477	0.76	Public order and safety
Total public order and safety	31,464	50.42	-
4. Economic affairs			
4.1 General economic, commercial and labour affairs (2)	5,857	9.39	Economic affairs
4.2 Agriculture, forestry, fishing and hunting	5,310	8.51	Economic affairs
of which: market support under CAP	2,889	4.63	Economic affairs
of which: other agriculture, food and fisheries policy	2,328	3.73	Economic affairs
of which: forestry	93	0.15	Economic affairs
4.3 Fuel and energy	460	0.74	Economic affairs
4.4 Mining, manufacturing and construction	35	0.06	Economic affairs
4.5 Transport	18,573	29.76	Economic affairs

of which: national roads	2,864	4.59	Public goods
of which: local roads	4,242	6.80	Public goods
of which: local public transport	3,411	5.47	Economic affairs
of which: railway	6,819	10.93	Public goods
of which: other transport	1,238	1.98	Economic affairs
4.6 Communication	760	1.22	Economic affairs
4.7 Other industries	290	0.46	Economic affairs
4.8 R&D economic affairs	3,596	5.76	Public goods
4.9 Economic affairs n.e.c.	462	0.74	Economic affairs
Total economic affairs	35,342	56.64	-
5. Environment protection			
5.1 Waste management	8,061	12.92	-
5.2 Waste water management	-	-	-
5.3 Pollution abatement	156	0.25	-
5.4 Protection of biodiversity and landscape	388	0.62	-
5.5 R&D environment protection	350	0.56	-
5.6 Environment protection n.e.c.	2,105	3.37	-
Total environment protection	11,061	17.73	Public goods
6. Housing and community amenities			
6.1 Housing development	6,489	10.40	Housing development
of which: local authority housing	5,092	8.16	-
of which: other social housing	1,397	2.24	-
6.2 Community development	2,524	4.04	Public goods
6.3 Water supply	283	0.45	Public goods
6.4 Street lighting	715	1.15	Public goods
6.5 R&D housing and community amenities	*2*	0.00	Housing development
6.6 Housing and community amenities n.e.c.	139	0.22	Public goods
Total housing and community amenities	10,152	16.27	-
7. Health (3)			
Medical services	119,275	191.15	Health
Medical research	897	1.44	Public goods
Central and other health services	4,183	6.70	Health
Total health	124,354	199.29	-
8. Recreation, culture and religion			
8.1 Recreational and sporting services	4,036	6.47	Recreation, culture and religion
8.2 Cultural services	4,046	6.48	Recreation, culture and religion
8.3 Broadcasting and publishing services	3,790	6.07	Recreation, culture and religion
8.4 Religious and other community services	121	0.19	Recreation, culture and religion
8.5 R&D recreation, culture and religion	128	0.21	Public goods
8.6 Recreation, culture and religion n.e.c.	71	0.11	Recreation, culture and religion
Total recreation, culture and religion	12,192	19.54	-
9. Education			
9.1 Pre-primary and primary education	30,669	49.15	-
of which: under fives	4,630	7.42	-
of which: primary education	26,039	41.73	-
9.2 Secondary education	36,515	58.52	-
9.3 Post-secondary non-tertiary education	206	0.33	-
9.4 Tertiary education	13,561	21.73	-
9.5 Education not definable by level	674	1.08	-

9.6 Subsidiary services to education	3,746	6.00	-
9.7 R&D education	10	0.02	-
9.8 Education n.e.c.	1,893	3.03	-
Total education	87,272	139.86	Education
10. Social protection			
of which: personal social services(4)	28,750	46.07	-
10.1 Sickness and disability	46,296	74.19	-
of which: personal social services	9,885	15.84	-
of which: incapacity, disability and injury benefits	36,411	58.35	-
10.2 Old age	111,233	178.26	-
of which: personal social services	10,346	16.58	-
of which: pensions	100,887	161.68	-
10.3 Survivors	1,077	1.73	-
10.4 Family and children	26,540	42.53	-
of which: personal social services	8,054	12.91	-
of which: family benefits, income support and tax credits	18,486	29.63	-
10.5 Unemployment	5,939	9.52	-
of which: personal social services	-	-	-
of which: other unemployment benefits	5,939	9.52	-
10.6 Housing	26,496	42.46	-
10.7 Social exclusion n.e.c.	29,982	48.05	-
of which: personal social services	465	0.75	-
of which: family benefits, income support and tax credits (5)	29,518	47.30	-
10.8 R&D social protection	-	-	-
10.9 Social protection n.e.c.	4,633	7.42	-
Total social protection	252,196	404.16	Transfers

288. The following table summarises the elements of spending included in Government consumption, and elements identified as public goods.

Element	**£pp pcm**
Public order and safety	31
Economic affairs	67
Housing development	10
Health	198
Recreation, culture and religion	19
Education	140
Sum of elements included in Government consumption	**466**
Public goods	**162**

Annex M: Categorising activities in the TUS

Key to categories	(bold are included in General Unpaid Production)
Child care	**Childcare (Active care, so included in Unpaid Production)**
Adult care	**Adultcare (Active care, so included in Unpaid Production)**
INF_LAB	**Unpaid Production**
Paid	Paid Production
Leisure	Leisure
NullSA	No Secondary activity recorded
Study	Studying
Filling in TUS	Filling in the time use survey
Unspecified	Unspecified time use

Activity:	Label	Category
-9	Main actvty sleep/work/study - no scndry actvty required	NullSA
-2	Child diary - no secondary actvty required	NullSA
-1	Adult diary - no secondary actvty recorded	NullSA
0	Unspecified personal care	INF_LAB
10	Unspecified Sleep	Leisure
110	Sleep	Leisure
120	Sick in bed	Leisure
210	Eating	Leisure
300	Unspecified other personal care	INF_LAB
310	Wash and dress	INF_LAB
390	Other specified personal care	INF_LAB
1000	Unspecified employment	Paid
1110	Working time in main job	Paid
1120	Coffee and other breaks in main job	Leisure
1210	Working time in second job	Paid
1220	Coffee and other breaks in second job	Paid
1300	Unspecified activities related to employment	Paid
1310	Lunch break	Leisure
1390	Other specified activities related to employment	Leisure
1391	Activities related to job seeking	INF_LAB
1399	Other specified activities related to employment	Paid
2000	Unspecified study	Study
2100	Unspecified activities related to school or university	Leisure
2110	Classes and lectures	Study
2120	Homework	Study
2190	Other specified activities related to school or university	Leisure
2210	Free Time Study	Study
3000	Unspecified household and family care	INF_LAB
3100	Unspecified food management	INF_LAB
3110	Food preparation	INF_LAB

3120	Baking	INF_LAB
3130	Dish washing	INF_LAB
3140	Preserving	INF_LAB
3190	Other specified food management	INF_LAB
3200	Unspecified household upkeep	INF_LAB
3210	Cleaning dwelling	INF_LAB
3220	Cleaning yard	INF_LAB
3230	Heating and water	INF_LAB
3240	Various arrangements	INF_LAB
3250	Disposal of Waste	INF_LAB
3290	Other specified household upkeep	INF_LAB
3300	Unspecified making and care for textiles	INF_LAB
3310	Laundry	INF_LAB
3320	Ironing	INF_LAB
3330	Handicraft and producing textiles	INF_LAB
3390	Other specified making and care for textiles	INF_LAB
3400	Unspecified gardening and pet care	INF_LAB
3410	Gardening	INF_LAB
3420	Tending domestic animals	INF_LAB
3430	Caring for pets	INF_LAB
3440	Walking the dog	INF_LAB
3490	Other specified gardening and pet care	INF_LAB
3500	Unspecified construction and repairs	INF_LAB
3510	House construction and renovation	INF_LAB
3520	Repairs of dwelling	INF_LAB
3530	Unspecified making, repairing and maintaining equipment	INF_LAB
3531	Woodcraft, metal craft, sculpture and pottery	INF_LAB
3539	Other specified making, repairing and maintaining equipment	INF_LAB
3540	Vehicle maintenance	INF_LAB
3590	Other specified construction and repairs	INF_LAB
3600	Unspecified shopping and services	INF_LAB
3610	Unspecified shopping	INF_LAB
3611	Shopping mainly for food	INF_LAB
3612	Shopping mainly for clothing	INF_LAB
3613	Shopping mainly related to accommodation	INF_LAB
3614	Shopping or browsing at car boot sales or antique fairs	INF_LAB
3615	Window shopping or other shopping as leisure	INF_LAB
3619	Other specified shopping	INF_LAB
3620	Commercial and administrative services	INF_LAB
3630	Personal services	INF_LAB
3690	Other specified shopping and services	INF_LAB
3710	Household management not using the internet	INF_LAB
3720	Unspecified household management using the internet	INF_LAB
3721	Shping for&ordring unspec gds&srvs via internet	INF_LAB
3722	Shping for&ordring food via the internet	INF_LAB

3723	Shping for&ordring clothing via the internet	INF_LAB
3724	Shping for&ordring gds&srv related to acc via internet	INF_LAB
3725	Shping for&ordring mass media via the internet	INF_LAB
3726	Shping for&ordring entertainment via the internet	INF_LAB
3727	Banking and bill paying via the internet	INF_LAB
3729	Other specified household management using the internet	INF_LAB
3800	Unspecified childcare	Child care
3810	Unspecified physical care & supervision of a child	Child care
3811	Feeding the child	Child care
3819	Other specified physical care & supervision of a child	Child care
3820	Teaching the child	Child care
3830	Reading, playing and talking with child	Child care
3840	Accompanying child	Child care
3890	Other specified childcare	Child care
3910	Unspecified help to an adult household member	Adult care
3911	Physical care & supervision of an adult household member	Adult care
3914	Accompanying an adult household member	Adult care
3919	Other specified help to an adult household member	Adult care
4000	Unspecified volunteer work and meetings	INF_LAB
4100	Unspecified organisational work	INF_LAB
4110	Work for an organisation	INF_LAB
4120	Volunteer work through an organisation	INF_LAB
4190	Other specified organisational work	INF_LAB
4200	Unspecified informal help	INF_LAB
4210	Food management as help	INF_LAB
4220	Household upkeep as help	INF_LAB
4230	Gardening and pet care as help	INF_LAB
4240	Construction and repairs as help	INF_LAB
4250	Shopping and services as help	INF_LAB
4260	Help in employment and farming	INF_LAB
4270	Unspecified childcare as help	Child care
4271	Physical care and supervision of a child as help	Child care
4272	Teaching the child as help	Child care
4273	Reading, playing & talking to the child as help	Child care
4274	Accompanying the child as help	Child care
4279	Other specified childcare as help	Child care
4280	Unspecified help to an adult member of another household	Adult care
4281	Physical care and supervision of an adult as help	Adult care
4284	Accompanying an adult as help	Adult care
4289	Other specified help to an adult member of another household	Adult care
4290	Other specified informal help	INF_LAB
4300	Unspecified participatory activities	Leisure
4310	Meetings	Leisure

4320	Religious activities	Leisure
4390	Other specified participatory activities	Leisure
5000	Unspecified social life and entertainment	Leisure
5100	Unspecified social life	Leisure
5110	Socialising with household members	Leisure
5120	Visiting and receiving visitors	Leisure
5130	Feasts	Leisure
5140	Telephone conversation	Leisure
5190	Other specified social life	Leisure
5200	Unspecified entertainment and culture	Leisure
5210	Cinema	Leisure
5220	Unspecified theatre or concerts	Leisure
5221	Plays, musicals or pantomimes	Leisure
5222	Opera, operetta or light opera	Leisure
5223	Concerts or other performances of classical music	Leisure
5224	Live music other than classical concerts, opera and musicals	Leisure
5225	Dance performances	Leisure
5229	Other specified theatre or concerts	Leisure
5230	Art exhibitions and museums	Leisure
5240	Unspecified library	Leisure
5241	Brwing bks rcds audio video,CDs,VDs from library	Leisure
5242	Reference to bks and other library materials within library	Leisure
5243	Using internet in the library	Leisure
5244	Using computers in the library other than internet use	Leisure
5245	Reading newspapers in a library	Leisure
5246	Listening to music in a library	Leisure
5249	Other specified library activities	Leisure
5250	Sports events	Leisure
5290	Other specified entertainment and culture	Leisure
5291	Visiting a historical site	Leisure
5292	Visiting a wildlife site	Leisure
5293	Visiting a botanical site	Leisure
5294	Visiting a leisure park	Leisure
5295	Visiting an urban park, playground or designated play area	Leisure
5299	Other specified entertainment or culture	Leisure
5310	Resting - Time out	Leisure
6000	Unspecified sports and outdoor activities	Leisure
6100	Unspecified physical exercise	Leisure
6110	Walking and hiking	Leisure
6111	Taking a walk or hike that lasts at least 2 miles or 1 hour	Leisure
6119	Other walk or hike	Leisure
6120	Jogging and running	Leisure
6130	Biking, skiing and skating	Leisure
6131	Biking	Leisure

6132	Skiing or skating	Leisure
6140	Unspecified ball games	Leisure
6141	Indoor pairs or doubles games	Leisure
6142	Indoor team games	Leisure
6143	Outdoor pairs or doubles games	Leisure
6144	Outdoor team games	Leisure
6149	Other specified ball games	Leisure
6150	Gymnastics	Leisure
6160	Fitness	Leisure
6170	Unspecified water sports	Leisure
6171	Swimming	Leisure
6179	Other specified water sports	Leisure
6190	Other specified physical exercise	Leisure
6200	Unspecified productive exercise	Leisure
6210	Hunting and fishing	INF_LAB
6220	Picking berries, mushroom and herbs	INF_LAB
6290	Other specified productive exercise	INF_LAB
6310	Unspecified sports related activities	Leisure
6311	Activities related to sports	Leisure
6312	Activities related to productive exercise	Leisure
7000	Unspecified hobbies and games	Leisure
7100	Unspecified arts	Leisure
7110	Unspecified visual arts	Leisure
7111	Painting, drawing or other graphic arts	Leisure
7112	Making videos, taking photos or related activities	Leisure
7119	Other specified visual arts	Leisure
7120	Unspecified performing arts	Leisure
7121	Singing or other musical activities	Leisure
7129	Other specified performing arts	Leisure
7130	Literary arts	Leisure
7190	Other specified arts	Leisure
7200	Unspecified hobbies	Leisure
7210	Collecting	Leisure
7220	Computing - programming	Leisure
7230	Unspecified information by computing	Leisure
7231	Information searching on the internet	Leisure
7239	Other specified information by computing	Leisure
7240	Unspecified communication by computer	Leisure
7241	Communication on the internet	Leisure
7249	Other specified communication by computing	Leisure
7250	Unspecified other computing	Leisure
7251	Unspecified internet use	Leisure
7259	Other specified computing	Leisure
7260	Correspondence	Leisure
7290	Other specified hobbies	Leisure
7300	Unspecified games	Leisure
7310	Solo games and play	Leisure

7320	Unspecified games and play with others	Leisure
7321	Billiards, pool, snooker or petanque	Leisure
7322	Chess and bridge	Leisure
7329	Other specified parlour games and play	Leisure
7330	Computer games	Leisure
7340	Gambling	Leisure
7390	Other specified games	Leisure
8000	Unspecified mass media	Leisure
8100	Unspecified reading	Leisure
8110	Reading periodicals	Leisure
8120	Reading books	Leisure
8190	Other specified reading	Leisure
8210	Unspecified TV watching	Leisure
8211	Watching a film on TV	Leisure
8212	Watching sport on TV	Leisure
8219	Other specified TV watching	Leisure
8220	Unspecified video watching	Leisure
8221	Watching a film on video	Leisure
8222	Watching sport on video	Leisure
8229	Other specified video watching	Leisure
8300	Unspecified listening to radio and music	Leisure
8310	Unspecified radio listening	Leisure
8311	Listening to music on the radio	Leisure
8312	Listening to sport on the radio	Leisure
8319	Other specified radio listening	Leisure
8320	Listening to recordings	Leisure
9000	Travel related to unspecified time use	Leisure
9010	Travel related to personal business	Leisure
9110	Travel in the course of work	Paid
9130	Travel to work from home and back only	Paid
9140	Travel to work from a place other than home	Paid
9210	Travel related to education	Study
9230	Travel escorting to/ from education	Study
9310	Travel related to household care	INF_LAB
9360	Travel related to shopping	INF_LAB
9370	Travel related to services	INF_LAB
9380	Travel escorting a child (other than education)	Child care
9390	Travel escorting an adult (other than education)	Adult care
9410	Travel related to organisational work	INF_LAB
9420	Travel related to informal help to other households	INF_LAB
9430	Travel related to religious activities	Leisure
9440	Travel rlt to participatory actv except rel actv	Leisure
9500	Travel to visit friends/ relatives in their homes	Leisure
9510	Travel related to other social activities	Leisure
9520	Travel related to entertainment and culture	Leisure
9610	Travel related to physical exercise	Leisure
9620	Travel related to hunting & fishing	INF_LAB

9630	Travel related to productive excs expt hunting & fishing	INF_LAB
9710	Travel related to gambling	Leisure
9720	Travel related to hobbies other than gambling	Leisure
9810	Travel to holiday base	Leisure
9820	Travel for day trip/ just walk	Leisure
9890	Other specified travel	Leisure
9940	Punctuating activity	Leisure
9950	Filling in the time use diary	Filling in TUS
9960	No main activity, no idea what it might be	Unspecified
9970	No main activity, some idea what it might be	Unspecified
9980	Illegible activity	Unspecified
9990	Unspecified time use	Unspecified

Annex N: Calculating the impact of interventions on net production

289. The calculation described in this document enables net production to be estimated for any patient, given their age, gender, ICD and QoL.

290. In principle, calculating the impact of an intervention on net production simply requires the net production with and without the intervention to be calculated over an appropriate time period – with the impact being the difference between the two.

291. This Annex describes a number of practical issues that may arise in carrying out this calculation, and proposes solutions.

Calculating the net production impact of an intervention over a health profile

292. The calculation described enables net production to be calculated as a function of QoL. Most assessments of interventions will include health profiles in which patient QoL is recorded over time. This enables the QALYs enjoyed by patients with and without the intervention to be calculated. The treatment impact is then the difference between the QALYs enjoyed by patients with the two profiles.

293. Calculating the net production associated with a treatment is, in principle, an identical procedure. As the net production of a patient can be calculated for any given QoL, the health profile used to calculate QALY gains can be used to generate a net production profile for patients with and without the intervention. Summing the net production over the course of the health profile will give the total net production associated with the patient. Comparing net production with and without the intervention gives the impact of the intervention on net production.

Calculating net production requires information on the age distribution of the population

294. However there may be practical difficulties with this approach. The most important of these is that net production is not a function only of QoL. It varies significantly with the age of the patient, in particular. If the age distribution of the patient population were known it would be possible to calculate net production for different ages and QoL levels. However this information may not be available in a suitable form for populations of patients.

295. Any calculation of net production must use some estimate of the distribution of a patient population by age – for example across appropriate age bins.

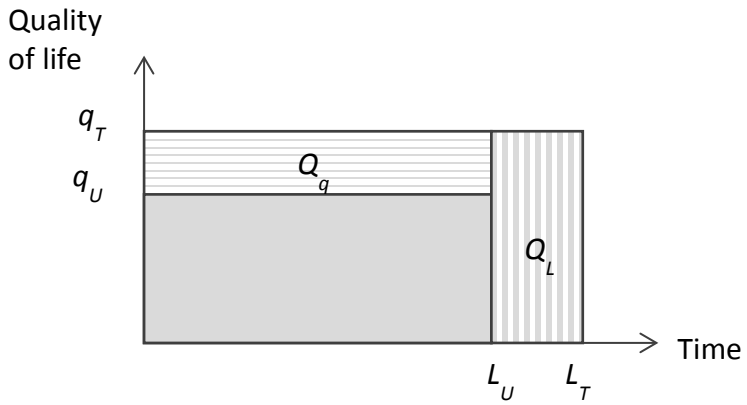
296. The following sections describe approaches to estimating net production, given limited knowledge of treatment impacts. However they still require

knowledge of patient ages, and calculation of net production by this approach must be carried out for each age group within the population.

297. A description of a set of Reference Estimates for patient populations in the NHS is provided in the paper "Using a set of Reference Estimates to support value assessment" provided in the documentation accompanying the NICE consultation on Value-Based Assessment. This set of estimates contains distributions of patient populations in 1,281 disease areas, across 16 age and gender groups, with information for each group to allow net production to be estimated, using the approaches described in this section.

Approximating net production assuming constant health profiles

298. A useful approach to approximating net production estimates is to characterise treated and untreated health profiles as having constant QoL. Represented graphically:



299. Here q_U and q_T are the untreated and treated QoL respectively, while L_U and L_T are the expected (future) length of life in the untreated and treated health profiles, respectively.

300. Q_q may be considered the QALY gain due to improvement of quality of life, in which case Q_L is the QALY gain through life extension.

301. The net production, Π, associated with this treatment is then:

$$\Pi = (\pi_T - \pi_U)L_U + \pi_T(L_T - L_u)$$

302. Where π_U and π_T are the rates of net production at the quality of life q_U and q_T respectively.

303. If all these variables are known for a given patient population, net production can therefore be calculated.

Calculating the net production per QALY gained using the proportion of the QALY gains through life extension vs QoL improvement

When the impact on quality of life is known

304. It is often sufficient – and useful *per se* – to calculate the value of net production *per QALY of health gain*. This can be achieved using only knowledge of:

- the treated and untreated quality of life, q_U and q_T; and
- the proportion of QALY gains that are provided through life extension and quality of life improvement

305. That is, without requiring knowledge of the durations of impacts.

306. The value of net production per QALY gained can be expressed as a weighted average of the value of net production per QALY gained through quality of life improvement, Π_q/Q_q, and the value of net production per QALY gained through life extension, Π_L/Q_L.

$$\frac{\Pi}{Q} = \frac{\Pi_q}{Q_q} p_q + \frac{\Pi_L}{Q_L} p_L$$

307. where p_Q and p_L are the proportions of the QALY gain represented by QoL and life extension respectively. These sum to 1, so

$$\frac{\Pi}{Q} = \frac{\Pi_q}{Q_q}(1 - p_L) + \frac{\Pi_L}{Q_L} p_L$$

308. The value of net production per QALY gained through quality of life improvement is the difference in the net production accrued over the relevant period of time, *t*, divided by the QALYs gained over that time period.

$$\frac{\Pi_q}{Q_q} = \frac{\pi_T t - \pi_U t}{q_T t - q_U t}$$

309. The time period cancels out, giving:

$$\frac{\Pi_q}{Q_q} = \frac{\pi_T - \pi_U}{q_T - q_U}$$

310. The value of net production per QALY gained through life extension for a time period *s* is:

$$\frac{\Pi_L}{Q_L} = \frac{\pi_T s}{q_T s}$$

311. The time periods again cancel out, giving

$$\frac{\Pi_L}{Q_L} = \frac{\pi_T}{q_T}$$

312. These expressions can be substituted into the original expression for the value of net production per QALY gained, to give:

$$\frac{\Pi}{Q} = \frac{\pi_T - \pi_U}{q_T - q_U}(1 - p_L) + \frac{\pi_T}{q_T} p_L$$

313. All these variables are known.

When the impact on quality of life is not known

314. The above calculation requires knowledge of quality of life in treated and untreated health states. However an approximation to this result can also be found if only the untreated (or treated) quality of life is known, by simply *assuming* a plausible impact on quality of life – and calculating net production as above, using the implied value of q_T.

315. This approach is reasonable because the value of net production approximates to a linear function of quality of life, over relatively small intervals of quality of life. Note that assuming a particular impact on quality of life does not affect the proportion of QALY gains through life extension, which is fixed in this analysis (the variable p_L, which is an exogenous input). Instead it amounts to specifying whether QALYs gained through quality of life improvement are spread over a short period (implied by greater quality of life impact) or a long period (implied by a small quality of life impact).

316. The validity of this assumption can easily be tested by observing the impact of different choices of quality of life impact on the results.

Annex O: Using a set of Reference Estimates to calculate net production impacts for typical treatments

317. This annex is adapted from the document "Using a set of Reference Estimates to support Value Assessment in VBP" published with the NICE consultation on Value-Based Assessment (2013). It is based on research funded by the MRC and NIHR to estimate the cost-effectiveness threshold, carried out by University of York [insert reference when published]. These estimates draw on data from ONS, HoDAR and MEPS as well as the UK element of the WHO GBD study.

The need for reference estimates to estimate net production impacts

318. The methodology described in this document enables the net production rate to be calculated for any individual patient, based on their age, gender, QoL and ICD. The impact of treatments can be calculated by comparing the net production rate in treated and untreated states, over time.

319. In principle, this approach can be used to calculate impacts for populations of patients – simply by adding the impacts for each patient in the population. However this requires information that may not be readily available. In particular, because net production rates vary significantly (and non-linearly) with age, it requires detailed information about the distribution of patients by age – and, in principle, the associated levels of QoL. Average age values cannot be used.

A set of Reference Estimates exists which net production impacts to be calculated for treatments of conditions across the NHS

320. This annex describes a set of reference estimates, which enable the net production calculation to be carried out for representative treatments in each of 1,281 diseases (ICDs).

321. The set of Reference Estimates divides the full range of illnesses and disabilities treated in the NHS into 1281 separate conditions (defined according to the International Classification of Disease – ICD).

322. Each of these 1281 conditions, or ICD codes, is further divided into 16 age / gender groups – giving a total of 20,496 groups, or "bins", each defined by a unique ICD, age and gender.

323. For each of these bins estimates of the following are provided:

- The age and gender of patients (being the definition of the bin)
- The average Quality of Life (QoL), based on observations of the treatment population. (That is, the QoL given the current treatment provided)
- The proportion of QALY gains that accrue through *life extension* for typical treatments of the condition received by patients of that age and gender

- The proportion of the disease population represented by each age / gender bin (sums to 100% within each ICD)

324. These data are sufficient to calculate the net production impact of treatments of patients in each bin, per QALY of health gain. The age/gender distribution of patients within the disease can be used to calculate the weighted average net production impact for the disease overall.

325. The set of Reference Estimates also includes the **proportion of the notional displaced QALY** that is associated with the particular bin. That is, the number of QALYs lost by patients in each bin when 1 QALY is displaced at the margin in the NHS. This information allows the weighted average net production impact of the displaced QALY to be calculated.

Illustrative example: M06, *Rheumatoid Arthritis*

326. This excerpt from the dataset shows the calculation of net production impacts (referred to as "Wider Societal Benefits") across the 16 age and gender bins for the above ICD (one of 1281 in the dataset).

327. The final row calculates the weighted averages of data and results across the patient population in the ICD (using the % of ICD population in the 6th column).

328. (Note that these results are based on an obsolete version of the net production calculation, and are for illustration only. The table refers to estimates of "Burden of Illness", which are not related to net production).

Bin Identifiers			Reference data						Burden of Illness (QALYs pp)			-> Wider Societal Benefits (£pp, per QALY gained through treatment)							
Row no.	ICD code	Age, Gender bin	Age	Gender	% of ICD population	% of notional displaced QALY	Starting QoL score	% QALY gains through LoL	Total	Loss through QoL	Loss through LoL	Paid production	Unpaid production	Formal care	Informal care	Private paid cons.	Private paid cons.	Govt cons.	Total WSBs
12625	M06	M00	2	M	0%	0.0000%	0.52	0%	3.00	3.00	0.00	0	0	-515	-3,996	0	0	0	-4,511
12626	M06	M05	8	M	0%	0.0001%	0.52	0%	3.99	3.99	0.00	0	519	-515	-17,257	0	0	0	-17,253
12627	M06	M15	22	M	1%	0.0004%	0.51	0%	4.33	4.33	0.00	5,224	3,838	-515	-3,855	0	0	0	4,692
12628	M06	M30	40	M	5%	0.0025%	0.49	0%	3.72	3.70	0.01	36,713	12,804	-308	-5,389	65	72	28	43,985
12629	M06	M45	55	M	9%	0.0046%	0.43	1%	2.98	2.95	0.03	44,468	21,913	-2,605	-6,426	302	255	127	58,034
12630	M06	M60	66	M	6%	0.0030%	0.38	4%	2.18	2.09	0.10	12,730	24,676	-6,302	-6,395	1,423	1,303	953	28,386
12631	M06	M70	76	M	5%	0.0028%	0.37	6%	1.52	1.43	0.09	2,589	24,062	-23,032	-2,899	1,260	1,470	1,247	4,698
12632	M06	M80	86	M	2%	0.0009%	0.26	5%	0.84	0.80	0.04	0	27,614	12,990	-2,041	728	1,210	1,734	42,234
12633	M06	F00	2	F	0%	0.0001%	0.55	0%	2.86	2.86	0.00	0	0	-515	-3,488	0	0	0	-4,003
12634	M06	F05	8	F	1%	0.0004%	0.55	0%	3.83	3.83	0.00	0	632	-515	-15,214	0	0	0	-15,097
12635	M06	F15	22	F	3%	0.0017%	0.53	0%	4.24	4.24	0.00	3,685	5,982	-515	-3,842	0	0	0	5,310
12636	M06	F30	40	F	16%	0.0083%	0.50	0%	3.78	3.77	0.01	20,981	16,494	-308	-6,375	67	74	29	30,962
12637	M06	F45	55	F	27%	0.0143%	0.43	1%	3.13	3.10	0.03	22,837	28,850	-2,604	-9,026	308	260	129	40,754
12638	M06	F60	66	F	13%	0.0067%	0.40	5%	2.44	2.33	0.11	3,828	31,817	-6,308	-9,069	1,410	1,291	939	23,908
12639	M06	F70	76	F	8%	0.0041%	0.35	10%	1.77	1.59	0.18	592	30,547	-21,252	-3,967	2,268	2,646	2,320	13,154
12640	M06	F80	86	F	4%	0.0023%	0.24	9%	0.88	0.80	0.08	0	30,099	13,787	-2,226	1,449	2,409	3,554	49,071
(weighted averages across ICD patient population)							**0.42**	**3%**	**2.83**	**2.77**	**0.06**	**16,836**	**24,322**	**-4,300**	**-6,741**	**711**	**765**	**665**	**32,259**

329. These data and calculations are repeated for all 1281 ICDs. The "% of notional displaced QALY" (7th column) is then used to calculate weighted average values for the displaced QALY across all ICDs.

For further tools and reference information please see *tools*