Learning about economic evaluation and health inequality

What is this document for?

This document will familiarise you with the common terms and concepts used by people who conduct economic evaluations. It will teach you about the information we collect, and the methods we use to do the calculations. We demonstrate this using an example of providing smoking cessation services on the NHS.

What is economic evaluation?

An economic evaluation is a calculation of the costs and consequences that would arise from different decisions about which health interventions to provide. This process can be conducted on health interventions that already exist in the healthcare system or on interventions that may be introduced in the future. The purpose of an economic evaluation is to guide decision-makers on the best course of action to take.

What is health inequality?

Health inequality is the differences in health between groups of people, e.g. male and female, rich and poor. In our research, we focus on how people's socioeconomic characteristics (which are things like income, education and where they live) affect their chance of getting sick. This means that people from different social groups can expect to have different quality of life and can expect to die at different ages.

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***Please note, the numbers used in this example are for explanation purposes only and may not always represent real-world data.**

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Glossary:

Economic evaluation	A process for measuring the costs and consequences from decisions to inform which decision might be preferred
Health-related quality of life	A person's degree of satisfaction with their standard of health
EQ-5D	A tool used to measure someone's overall health status
Quality-adjusted life years (QALYs)	A measure of health that considers both quality of life and life expectancy
Incremental cost	The additional cost of an intervention compared to the existing cost
Incremental health benefit	The additional health generated by an intervention compared to the existing health
Health opportunity cost	The health benefit that would result if the incremental cost was spent on other NHS services
Incremental net health benefit	The net health benefit of an intervention (incremental health benefit minus health opportunity cost)
Health inequality	Differences in health between groups of people such as male and female, rich and poor
Baseline health	The level of health under current practice (in this example, when there are no smoking cessation services provided)
Socioeconomic groups	Groups of people who differ in social class and financial situation
Equally distributed equivalent (EDE) health	The weighted health for the whole population considering how people value reduction in inequality compared to increase in health
Incremental EDE health	The change in EDE health
Health equity plane	A figure that shows how a decision changes overall health and health inequality

1. Economic Evaluation

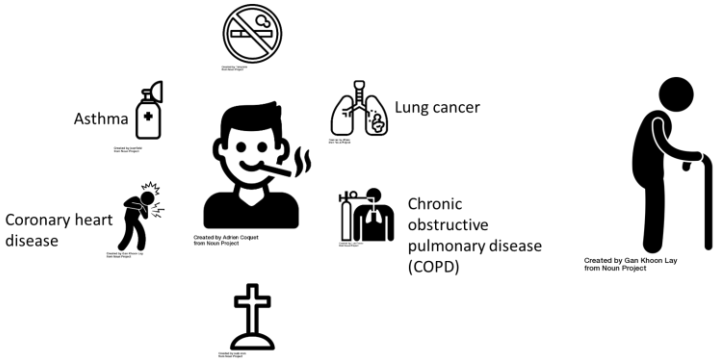
In an economic evaluation, we compare the costs and consequences that arise from decisions to see which might be preferred. The purpose of an economic evaluation is to guide decision-makers on the best course of action to take. In this example, we will focus on the decision about whether or not smoking cessation services should be provided by the NHS. In this case, the first step is to understand how smoking affects a person's lifetime health.

a) Impact on a person's lifetime health

Smoking will affect the health of people who smoke. This includes the diseases they may experience and how long they may live.

People who smoke are more likely to develop diseases such as lung disease and cancer. These diseases will reduce their **health-related quality of life**.

They are likely to die sooner than people who do not smoke.



When we measure **health-related quality of life**, we can ask people to describe their health. To make this easier, researchers have developed questionnaires. One example is called the **EQ-5D** (see **Appendix 1**). It asks people to describe whether they have any problems walking about, whether they have any problems looking after themselves, whether they have any problems that prevent them engaging in their usual activities, whether they have any pain or discomfort, and whether they have any anxiety or depression. First, researchers have conducted surveys with the public to understand how people consider the different health states described by the EQ-5D health states on a scale between full health (value=1) and death (value=0). And then, when people give their answers to the EQ-5D questions (no/some/extreme problems) based on their own health condition, we could know what the health-related quality of life is.

Large population surveys have invited members of the public to answer the EQ-5D questionnaire. The results show what the typical health-related quality of life is for people with different characteristics. For example, in England a typical man aged 65-74 has a health-related quality of life score of 0.78 [1]. From the surveys, we know the health-related quality of life of smokers, and the amount that each smoking-related disease would reduce their health-related quality of life. For example, if a person has a heart attack, his/her health-related quality of life is reduced by 0.24 in that year.

To consider both impacts on life expectancy and health-related quality of life, we calculate one summary measure, **quality-adjusted life years (QALYs)**. If a person lives in full health (health-related quality of life=1) for two years, the health effect is 1 x (2 years of life) = 2 QALYs. But for a person who lives in a health state that gives them a health-related quality of life of 0.75 for two years, the effect is 0.75 x (2 years of life) = 1.5 QALYs.

In England, people aged 25-34 have the highest proportion of current smokers. Let us take a typical smoker who is a 30-year-old male. If he continues smoking, he will live until 70. Within the 40 remaining years, he is likely to develop smoking-related diseases. These diseases will reduce his health-related quality of life. Using the economic model to calculate how smoking affects his health-related quality of life, we find that the remaining 40 years are equivalent to just 20 years of life lived in full health, that is 20 QALYs.

b) Comparing decisions

Now we consider the two decisions for this example: ***not offering any smoking cessation services on the NHS***, and ***offering smoking cessation services on the NHS***. We can compare the costs and the health effect of both decisions to see which might be preferred.

- not offering any smoking cessation services on the NHS
- offering smoking cessation services on the NHS

The following description is presented in a table format in **Table 1** below.

When smoking cessation services are not provided on the NHS, smokers may develop smoking-related diseases and these diseases cause people to use healthcare services and reduce their health-related quality of life. For example, every person with asthma receives NHS treatment that amounts to £1,300 per year. Data show that the costs of all smoking-related diseases during the lifetime of a typical smoker, at £50,000. As described previously, the smoker who continues smoking will have 20 QALYs over his lifetime. Some smokers quit without help, but the number is small.

When smoking cessation services are provided, smokers who use them are more likely to quit smoking. If people manage to quit smoking, the higher risk they faced of smoking-related diseases and death can be reduced. As a result, the costs of smoking-related diseases over the lifetime fall to £36,000. However, the NHS must spend money on providing smoking cessation services (£1,000 per person). Therefore, the total cost of providing the service is £37,000 per person (£36,000 + £1,000). Quitting smoking also affects the health-related quality of life and life expectancy. We can estimate the health effect if smoking cessation services are provided on the NHS. If the typical smoker uses the smoking cessation services and quits smoking, he will have 35 QALYs over his lifetime.

For both decisions, we can add up the costs. The difference between total costs of offering servicing and the total costs of not offering services gives the **incremental cost, -£13,000**. Negative value indicates that with smoking cessation, the saved healthcare costs are larger than the added costs of providing the services. Smoking cessation saves costs for the NHS overall. We also know the health effect of the two decisions. The difference of health effect is the **incremental health benefit, 15 QALYs**.

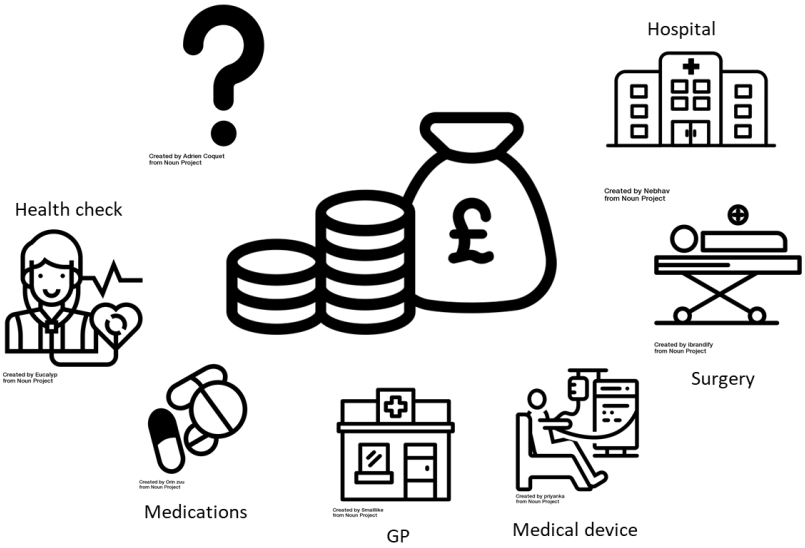
Although the smoking cessation services are provided, not every smoker will use them. If 80% smokers will use the services, the incremental cost is -£13,000 x 80% = **-£10,400** and the incremental health benefit is 15 QALY x 80% = **12 QALYs**. Providing smoking cessation services on the NHS saves £10,400 with 12 QALYs health benefit per smoker.

Table 1. Costs and health effect for a typical smoker

	For a typical smoker:				
	Costs of smoking-related diseases	Costs of smoking cessation services	**Incremental cost**	Health effect	**Incremental health benefit**
No services	£50,000	0	-	20 QALYs	-
With services	£36,000	£1,000	(36,000 + 1,000) – 50,000 = **-£13,000**	35 QALYs	35 – 20 = **15 QALYs**
Cosidering **80%** smokers use the services			-£13,000 x 80% = **-£10,400**		15 x 80% = **12 QALYs**

c) Health opportunity cost

Now we know that providing smoking cessation services would save costs for the NHS. The saved £10,400 per smoker can be spent on other NHS services, such as health check, medical devices etc. These services will improve the health for any user of the NHS. We call it **health opportunity cost**.



The costs and effect in **Table 1** are for smokers only but the users of the NHS services are not only the smokers. We need to convert the incremental cost and incremental health benefit for **all** NHS users, that is, the whole population.

If 25% of the population are smokers, this means a typical member of the population has the 25% probability of being a smoker, so the incremental cost is -£10,400 x 25% = -£2,600 and the incremental health benefit is 12 QALYs x 25% = 3 QALYs. Providing smoking cessation services on the NHS saves £2,600 with 3 QALYs health benefit for a typical individual in the population.

Table 2. Costs and health effect for a typical member of the population

	For a typical smoker:		**For a typical individual:**		
	Incremental cost	Incremental health benefit	Incremental cost	Incremental health benefit	Incremental net health benefit
No services	-	-	-	-	-
With services	-£10,400	12 QALYs	-£10,400 x 25% = **-£2,600**	12 x 25% = **3 QALYs**	3 + 2,600 / 13,000 = **3.2 QALYs**

Now we would like to know how many QALYs the £2,600 saving can produce when spent on other NHS services.

We can use this saving to add to NHS budget to improve health services. Previous analysis has shown that that increasing NHS hospital budget by £13,000 allows more services to be provided and adding up the benefits from these services is equivalent to one extra year of life in full health (1 QALY).

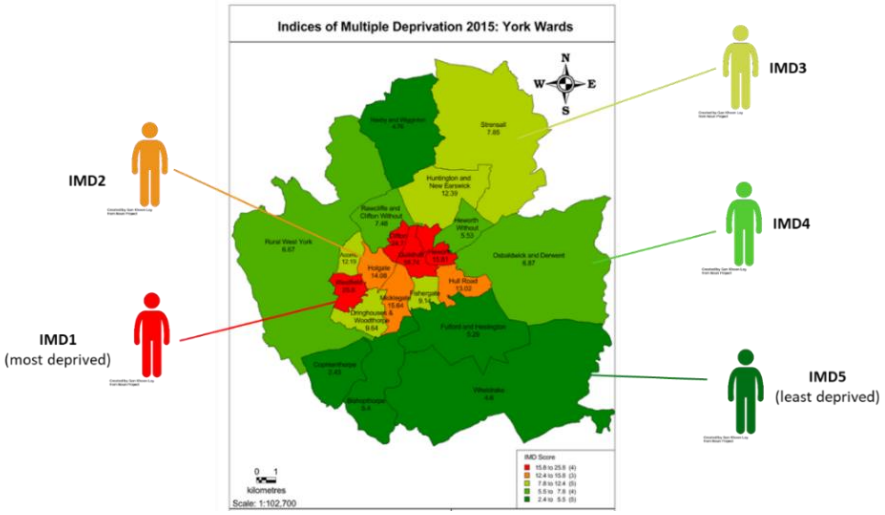
This means the saved £2,600 can produce additional health benefit of 0.2 QALYs (2,600 / 13,000 = 0.2), equivalent to 0.2 year (2.4 months) in full health per person. We can add the 0.2 QALYs to the incremental health benefit (3 QALYs, see **Table 2**) to obtain the **incremental net health benefit**, i.e., 3 + 0.2 = 3.2 QALYs. For one typical individual in the population, providing smoking cessation services on the NHS would lead to 3.2 QALYs net health benefit.

2. Health Inequality

People differing in characteristics have different level of health. For example, females have longer life expectancy than males. The difference in health between groups of people is **health inequality**.

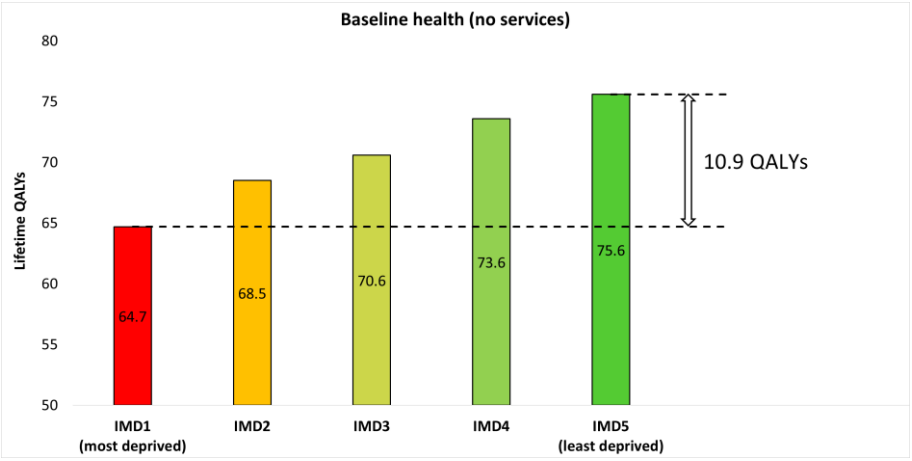
Policy makers and researchers are interested in the inequality between **socioeconomic groups**. In England, there is an index to define the socioeconomic deprivation of the geographical areas, called index of multiple deprivation (IMD). For all the small areas in England (about 1,500 residents), IMD scores are calculated and then ranked from most deprived to least deprived. All the areas are grouped into five equal groups, IMD1-IMD5. The first quintile, IMD1, represents the most deprived areas (1% to 20%); the second quintile, IMD2, represents the second fifth (21% to 40%) and so on. As IMD is not an individual-level measure, there will be variation in the socioeconomic status of residents within each area and even highly deprived areas will have some high socioeconomic status inhabitants.

We show York as an example. The areas in York can be grouped into IMD1 to IMD5.



a) Inequality in baseline health

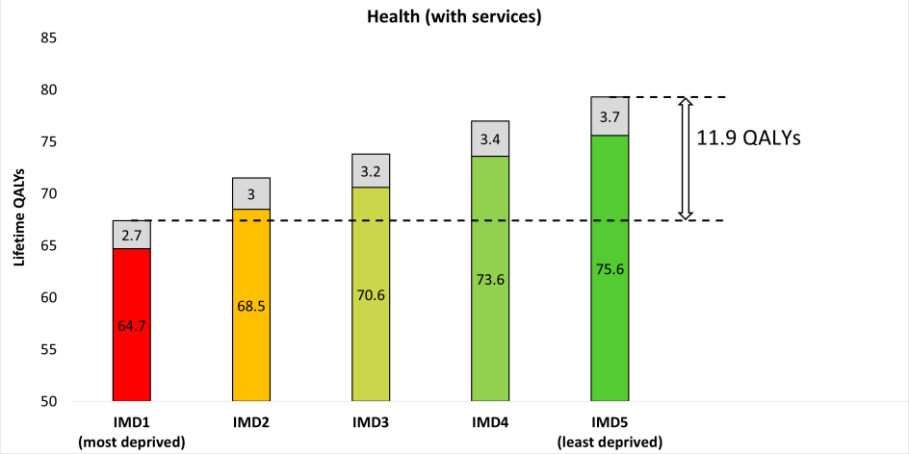
Researchers analysed data from government registry and large population surveys. Results show that under current practice (no smoking cessation services), people living in different areas differ in life expectancy and health-related quality of life. We call this '**baseline health**' and express it using QALYs. On average, people living in the least deprived areas (IMD5) live around 11 years in full health (10.9 QALYs, see the figure below) longer than people living in the most deprived areas (IMD1).



b) Inequality in health benefit of the intervention

People living in different deprived areas also differ in smoking prevalence, risks of smoking-related diseases and death. We use data about these differences to repeat the analysis shown in **section 1** for each IMD group separately to estimate the incremental net health benefit for all IMD groups.

As described in section 1 (Economic Evaluation), for one typical individual in the population, providing smoking cessation services on the NHS would lead to 3.2 QALYs (**Table 2**) of incremental net health benefit. However, a typical person living in the most deprived areas (IMD1) would have 2.7 QALYs (2.7 years in full health) health benefit while a typical smoker living in the least deprived areas (IMD5) would have health benefit of 3.7 QALYs (3.7 years in full health). These health benefits are shown in the grey bars below.



3. Trade-off between increase in health and reduction in inequality

From section 2 (Health Inequality), we know that people living in different areas have different levels of baseline health and they benefit from the smoking cessation services differently. Now we would like to know how this affects health inequality for the whole population. We need the inequality aversion parameter. It is a measure of how much the general public values health inequality.

a) Inequality aversion

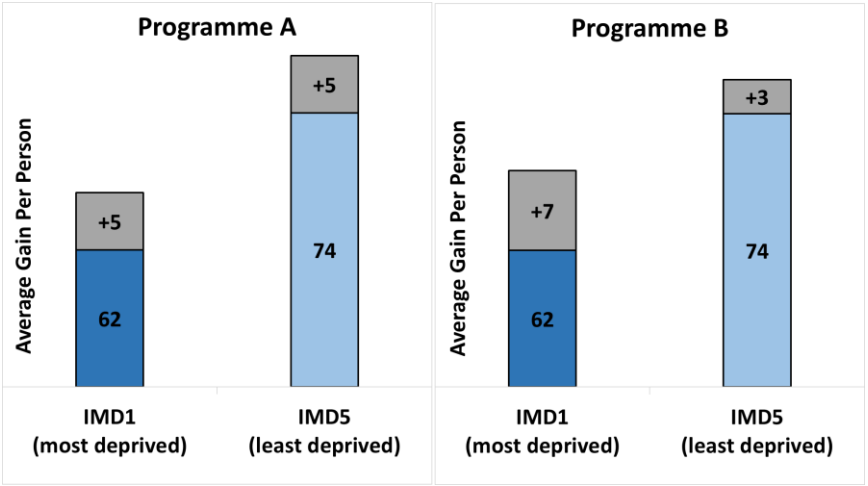
Researchers have conducted an online survey of the general public in England to ask about how much they care about reducing inequality between rich and poor groups compared to improving overall health (see **Appendix 2**) [2]. The survey includes questions asking respondents to choose between two programmes that cost the same but with different health benefits for people living in the most deprived (IMD1) and those living the least deprived (IMD5) areas. A typical question in this survey is as below.

Which programme should the government choose?

Programme A ☐

Programme A and B are equally good ☐

Programme B ☐



A series of similar questions was asked in the survey. Based on the responses, researchers have generated a parameter, ε. This is the value of the **inequality aversion index** for England. The range of this index is from zero to infinity. The higher the index value, the more importance that is given to reducing inequality. The results from the survey shows a value of 10.95.

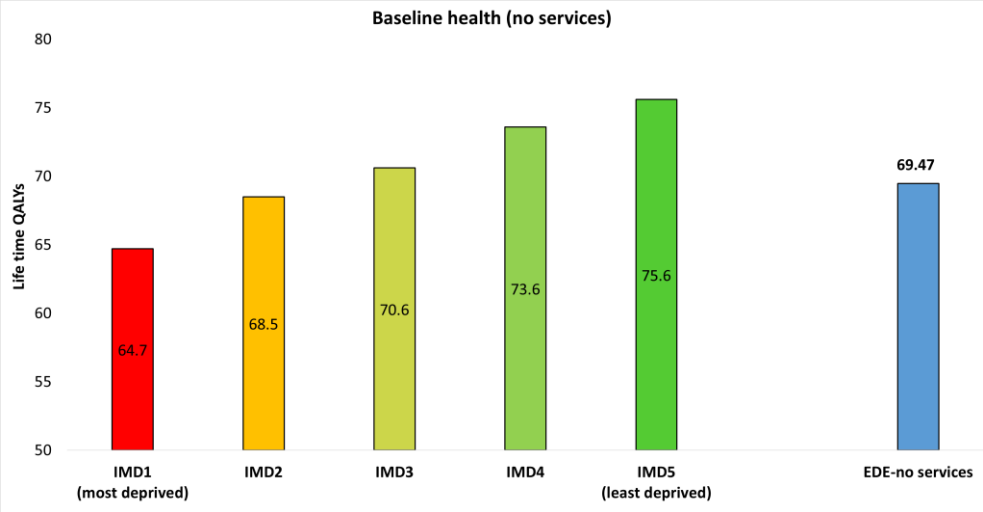
b) Equally distributed equivalent (EDE) health

We assign this parameter value of ε to the health in each group to calculate the weighted health for the whole population using the mathematic algorithm below. The weighted health is called **'equally distributed equivalent' (EDE)** health. EDE takes into account the health level and the population size of each socioeconomic group and allows us to compare the effects between the interventions.

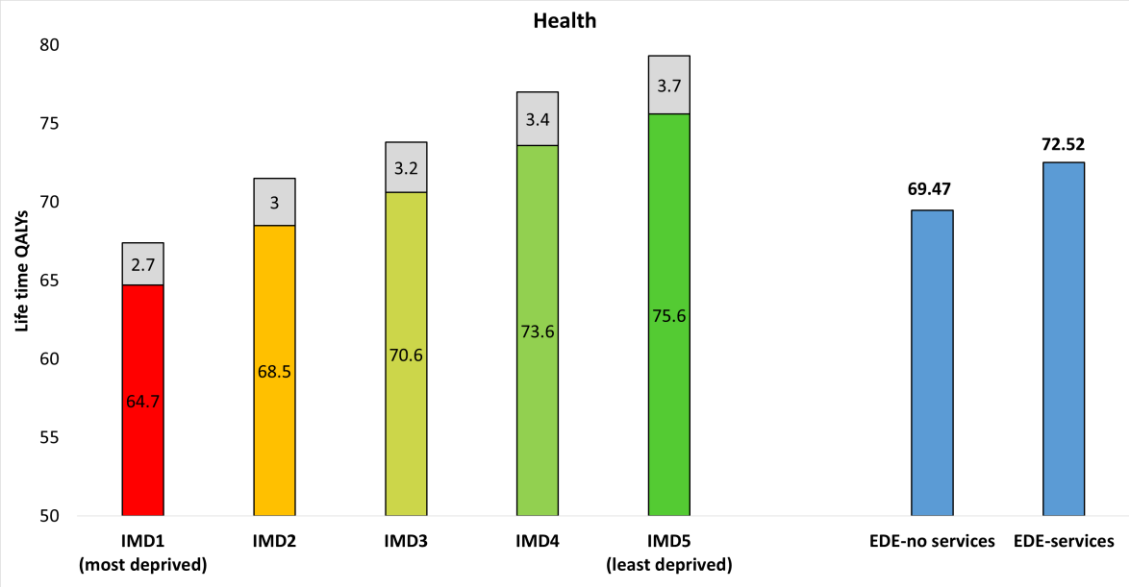
$$EDE = \left(\frac{1}{N}\sum h_i^{1-\varepsilon}\right)^{\frac{1}{1-\varepsilon}}$$

N=population size, hi=health in each group
ε=inequality aversion index

When no smoking cessation services are provided on the NHS, the EDE health is 69.47 years. This means considering the inequality aversion, the health is equivalent to that each IMD group has the life expectancy of 69.47 years in full health.



We can also calculate the EDE health if smoking cessation services were provided. The EDE health with services is 72.52 years in full health.



Now we can compare how the EDE health changes. Because the inequality is for the whole population, we compare the population EDE health.

There are 40 million adults in England, so the population EDE health without smoking cessation services is 69.47 x 40million. The EDE health with services is 72.52 x 40million. The change in population EDE health is called population **incremental EDE**, which is (72.52 x 40million – 69.47 x 40million) = 122million QALYs. It is the weighted incremental net health benefit. It includes the change in health and the change in inequality.

As described in section 1 (Economic Evaluation), providing smoking cessation services on the NHS would lead to 3.2 QALYs (see **Table 2**) incremental net health benefit per person. Thus, for the whole population, the incremental net health benefit is 3.2 x 40million = 128million QALYs. This does not include the impact on inequality.

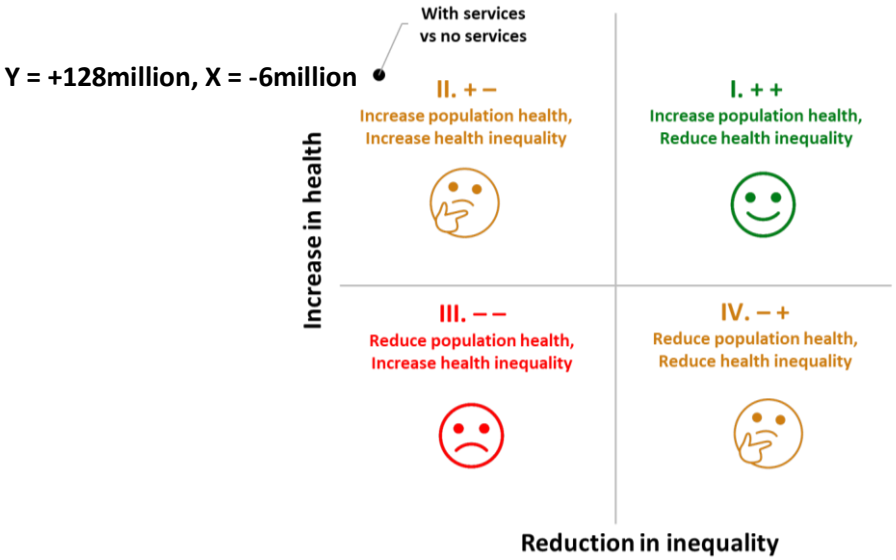
To show how the inequality changes, we take the difference between incremental EDE and incremental net health effect. It is 122million – 128million = -6million QALYs.

Table 3. Incremental EDE health and incremental NHB for the whole population

	Population EDE health	ΔEDE	Δnet health benefit	Inequality
No services	69.47 x 40million	-	-	-
With services	72.52 x 40million	122million QALYs	3.2 x 40million = **128million** QALYs	(122million – 128million) = **-6million** QALYs

c) Health equity plane

Now we can plot the results on the **health equity plane**. The y axis (vertical) is the population incremental net health benefit. This shows how offering smoking cessation services on the NHS would affect the health for the whole population in England (+128million QALYs). The x axis (horizontal) is the difference between population incremental EDE and population incremental net health benefit. This shows how providing services would affect the inequality for the whole population (-6million QALYs.)



The smoking cessation service falls within the top-left quadrant, suggesting that it increases population health but also increases inequality. Providing such services on the NHS is good for health but harms equity (people living in more deprived areas benefit less), so policy makers need to consider whether to sacrifice equity for the additional health.

Appendix 1:

(This is adapted from the EQ-5D-3L English version for the UK, see euroqol.org for more information)

By placing a tick in one box in each group below, please indicate which statements best describe your own health state today.

Mobility

I have no problems in walking about	❑1
I have some problems in walking about	❑2
I am confined to bed	❑3

Self-Care

I have no problems with self-care	❑1
I have some problems washing or dressing myself	❑2
I am unable to wash or dress myself	❑3

Usual Activities *(e.g. work, study, housework, family or leisure activities)*

I have no problems with performing my usual activities	❑1
I have some problems with performing my usual activities	❑2
I am unable to perform my usual activities	❑3

Pain / Discomfort

I have no pain or discomfort	❑1
I have moderate pain or discomfort	❑2
I have extreme pain or discomfort	❑3

Anxiety / Depression

I am not anxious or depressed	❑1
I am moderately anxious or depressed	❑2
I am extremely anxious or depressed	❑3

If the response for the five questions above is 11111, the health-related quality of life is equal to 1 (full health). If the response is 11212, the health-related quality of life is calculated to be 0.812 using the value set based on the general public in England [3].

Appendix 2:

(Please note this survey was conducted online, so the questions shown here are just for illustration purposes. Please refer to Robson et al. 2017 for details.)

TRADE OFF QUESTION

Imagine that you are asked to choose between **two large government programmes** which will improve population health. Both programmes cost exactly the same.

Who Benefits?

Programme	Population Group	Before	Change	After
Programme A	Richest Fifth	74	+7	81
	Poorest Fifth	62	+3	65
Programme B	Richest Fifth	74	+3	77
	Poorest Fifth	62	+8	70

These are gains in years of life in full health over the average person's lifetime.

When making a decision, it is important to remember the following:

- We cannot pay for both programmes - a choice must be made
- "Equally good" means you don't mind which one is chosen
- Both programmes cost exactly the same
- The only difference between the programmes is the gain to the poorest and richest fifth
- The middle three fifths of the population are not affected

Which programme should the government choose?

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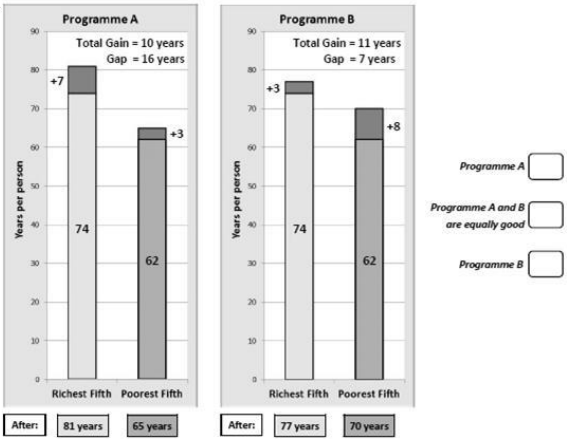

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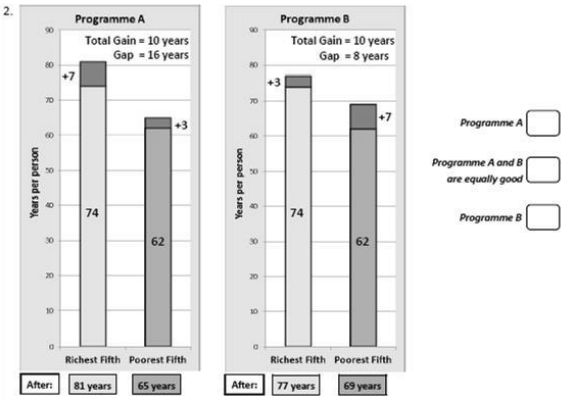

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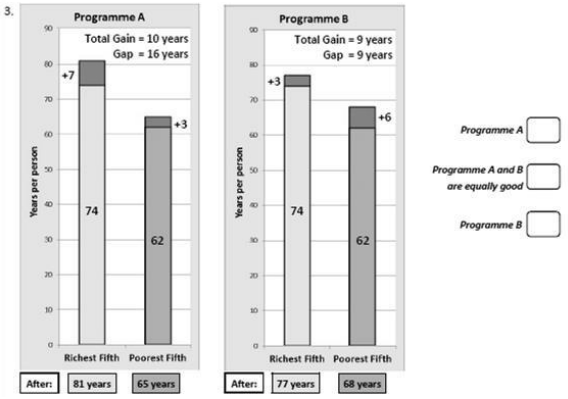

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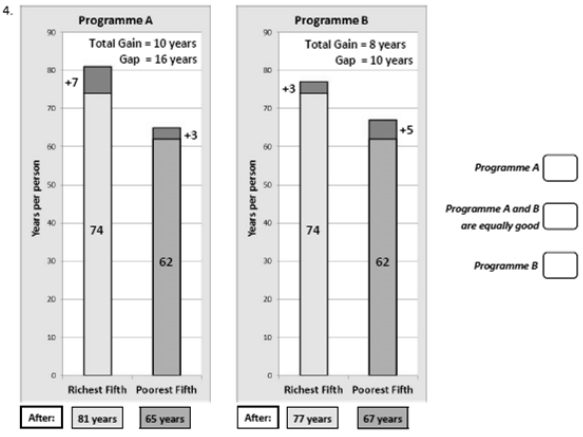

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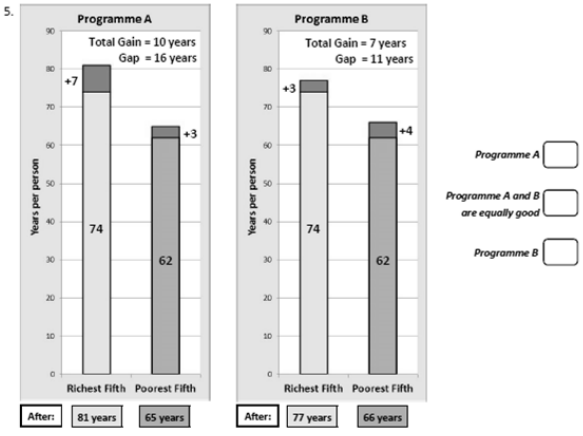

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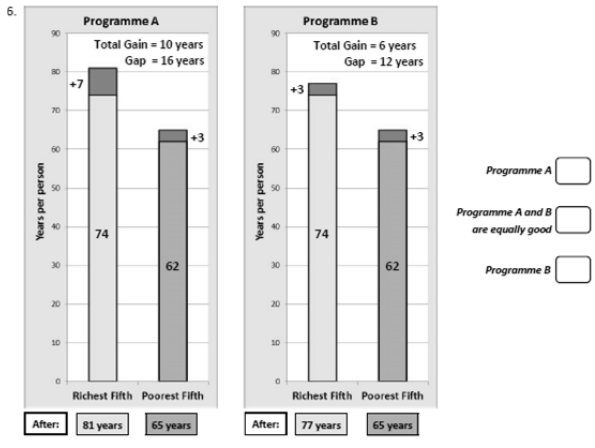

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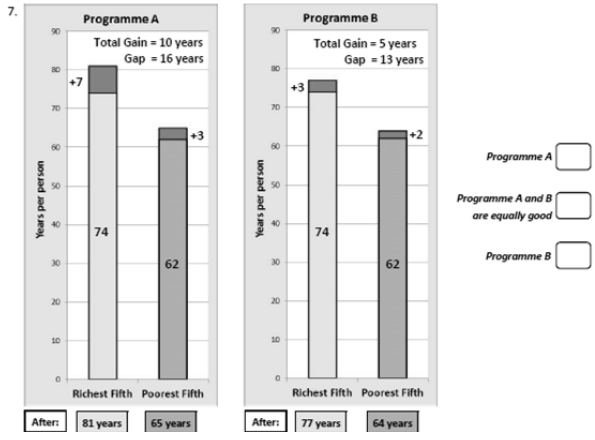

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