National Institute for Health and Clinical Excellence

Public Health Programme

Walking and cycling: local measures to promote walking and cycling as forms of travel or recreation:

Health economic and modelling report

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EXECUTIVE SUMMARY

Objectives

This health economic and modelling report has two main objectives:

1. Review existing health economic studies on walking and cycling interventions relevant to the scope.

2. Model, to the extent that evidence allows, the likely cost effectiveness/cost utility of those interventions identified in the earlier effectiveness review and considered by the Programme Development Group (PDG) to be of highest priority.

Economic Evidence Review

The economic evidence review identified a small number of economic evaluations of specific walking and cycling interventions. The findings are:

ER1. Some UK and international evidence exists that interventions to promote walking or cycling could be considered cost-effective, particularly for the following types of interventions: led walking including walking school bus, pedometers, TravelSmart, media campaigns, and multi-component.

ER2. For the interventions either modelled or directly assessed by the small number of studies available, all would be considered cost-effective when compared to standard care or 'do nothing', except under the extremes of some of the sensitivity analyses.

ER3. There remain however, some significant gaps when compared with the range of intervention categories highlighted by the effectiveness review.

ER4. Only one of the reports, the Cycling Demonstration Towns considered environmental outcomes, and the general applicability of these may be in question, as the intervention was infrastructure based.

ER5. There is a need for some *de novo* modelling work to provide additional cost-effectiveness evidence to the PDG.

Method: The ScHARR Walking and Cycling Model version 1.0

The modelling team has developed a new model, which in brief operate as follows:

The modelling builds upon three key components

- The relationship between levels of walking and cycling, and overall physically activity. We use the Health Survey for England (HSE) 2008 to estimate statistical relationships between these variables. This allows direct evidence from studies of the effect of interventions on levels of walking and cycling to be converted into estimated changes on overall physical activity.
- The relationship between physical activity and relative risk of mortality as reported in the long-term observational study by Anderson et al. (2000). This allows transformation of physical activity level changes into life expectancy, numbers of deaths and quality adjusted life-years.
- The relationship between levels of walking and cycling, and travel, especially driving distance but also driving time and numbers of trips. We use the National Travel Survey (NTS) data from 2002 to 2008 to estimate statistical relationships between these variables. This allows estimation of the effects of interventions that increase levels of walking and cycling on reduced kilometres driven and hence reduced congestion, pollution, and greenhouse gas emissions.

In overview, the steps taken to produce this common platform have been as follows

1. Analysis of baseline data (by age, sex, work status, car ownership)
    a. HSE walking, cycling, physical activity
    b. NTS trips, walking, cycling, driving by purpose
2. Take evidence from effectiveness review on effectiveness of specific interventions (chosen as priorities by the PDG).
3. For health benefits, estimate change in levels of physical activity either directly from the evidence or indirectly via statistical relationships between walking and cycling levels and overall physical activity from HSE.
4. Quantify reduced mortality risk given increased levels of physical activity using Anderson *et al.* Copenhagen study (as is used in the HEAT) using

either a step function on relative risks taken directly from the study and based on per cent of people achieving over 2 hours moderate activity per week, or a modelled continuous risk function.

5. Use ONS life-tables and evidence on average health related quality of life by age and sex to estimate discounted lifetime QALYs for baseline versus with intervention.

6. For the environmental benefits considered, estimate change in levels of car drive distance either directly from the evidence on reduced car distance / trips or indirectly via statistical relationships between walking and cycling levels and overall car distance from NTS. (We relate driving to walking and cycling via NTS zero inflated negative binomial regressions for car driving distance, car driving time and number of trips made).

7. Estimate cost of intervention if rolled out across all England.

8. Compute cost per discounted QALY gained over a lifetime horizon using health benefits modelling.

9. Compute value per annum of congestion reduction, pollution, and other environmental outcomes using DfT guidelines on economic evaluation (*e.g.* average value of 13.1p per vehicle km for congestion across the whole road network) as well as value of deaths avoided using value of a statistical life.

<u>Analyses Undertaken</u>

Following consultation with the Economic Sub-group members and PDG, four main intervention types were selected for modelling. These were:

1. Multi-component Interventions including Cycling Demonstration Towns, and Sustainable Travel Towns

2. Personalised Travel Advice - TravelSmart,

3. Pedometer interventions

4. Community based led walks

5. In addition, a series of what-if analyses was undertaken. The purpose of these was to determine the level of cost is justifiable for interventions with particular levels of effect, and to investigate the trade-off between narrow

interventions with large effects per person versus wider interventions with smaller effects per person. Specific scenarios considered were:

- a 1% increase in the population who are physically active
- encouraging those who are not physically active to walk an extra 10mins per week on average
- encouraging those who are not physically active to cycle an additional 10mins per week
- considering levels of decay ranging from the effect continuing forever, through annual decay rates of 25, 50%, 75% and 100% (*i.e.* no effect after year 1).

<u>Results</u>

<u>The modelling findings for specific interventions are given below</u>

M1. For Cycling Demonstration Towns, the modelling undertaken suggests that the intervention appears cost-effective. The cost per QALY is estimated to be of the order of £5,000 for models runs using either the continuous or the step risk function.

M2. For Sustainable Travel Towns, the modelled cost-effectiveness is estimated to be of the order of £900 per QALY for models runs using either the percentage change in trips evidence or the walking and cycling distance evidence.

M3. For TravelSmart, the modelling undertaken suggests that the intervention appears cost-effective. The cost per QALY is estimated to be of the order of £300 using the continuous risk function, or £2,500 using the step risk function.

M4. For pedometers, a short-term 4-week pedometer intervention appears cost-effective, but less so than some of the multi-component interventions. The cost per QALY is estimated to be of £2,900 using the continuous risk function, or £9,400 using the step risk function. Part of the reason for this is the decay in effect – we assume zero effect after year one.

M5. For the longer-term support pedometer intervention, evidence suggests that an effect persists to 12 months. In the scenarios modelled, we assume that this level would be maintained in future years provided the support costs (advice and telephone support) were maintained. The results suggest that longer-term support to pedometers appears cost-effective. For a scenario where the ongoing cost per participant is around £25, the cost per QALY is estimated to be of the order of £1,700 (continuous risk function), or £7,800 (step risk function). With ongoing cost £9 per participant, results are estimated at £750 per QALY (continuous risk function), or £3,400 per QALY (step risk function).

M6. The main led-walking evidence modelled comes from a UK RCT by Lamb et al. Using this evidence has been a topic of debate and concern within the PDG, as the RCT shows no difference between led walking and a comparator arm of advice. If we use the before and after comparison of the led walking arm itself, it could be considered that some or even all of the effect was a regression to the mean effect. The results of the modelling undertaken suggest that the intervention appears cost-effective but is very sensitive to the level of effect assumed. The cost per QALY is estimated to be of the order of £1,900 using 100% of the apparent effect from the trial, £3,600 using 50% of the apparent effect, and £16,500 using 10% of the apparent effect. For this 10% of the apparent effect scenario, but using slightly lower costs obtained from personal communication with representatives of Derbyshire Primary Care Trust, the cost per QALY is estimated to be of the order of £10,400.

M7. We also model the 'Get Walking Keep Walking' intervention using evidence from an evaluation of a large UK study. The modelling undertaken suggests that the intervention appears cost-effective. The cost per QALY is estimated to be of the order of £2,700.

<u>The modelling findings for what-if analyses are given below</u>

M8. The results suggest that interventions that could achieve a permanent shift of one percentage point in the proportion of the total population achieving over 2 hours physical activity per week, would have a substantial effect. The cost per QALY estimates for a range of different costs are:

Investment per person currently not-physically active	**Cost per QALY of achieving 1% of the population becoming more physically active**

£1	£118
£50	£4,733
£100	£9,465
£1,000	£94,650

M9. However, decay rates in effectiveness have a substantial influence on cost-effectiveness. For a £50 per person intervention, the cost per QALY estimates for a range of decay rates are:

Annual Decay Rate in Effect	Cost per QALY of achieving 1% of the population becoming more physically active
0%	£4,733
25%	£40,068
50%	£66,255
100%	£99,199

M10. For a £10 per person intervention, the cost per QALY estimates for a range of decay rates are:

Annual Decay Rate in Effect	Cost per QALY of achieving 1% of the population becoming more physically active
0%	£947
25%	£8.014
50%	£13,251
100%	£19,824

M11. The results suggest that interventions that could achieve a permanent shift in walking of 10 minutes per week in those who are currently under 2 hours physical activity per week would have a substantial benefit. If this effect could be maintained, the modelling suggests that such interventions would be very cost-effective (using the continuous risk function approach). Again, the results are sensitive to the rate of decay in effect, but such interventions would remain cost-effective under the modelling assumptions used. For a £10 per person intervention, the cost per QALY estimates for a range of decay rates are:

Annual Decay Rate in Effect	**Cost per QALY (assuming a £10 walking intervention)**
0%	£43
50%	£666
100%	£991

M12. The results suggest that interventions which could achieve a permanent shift in cycling of 10 minutes per week in those who are currently under 2 hours physical activity per week would have a substantial benefit. If this effect could be maintained, the modelling suggests that such interventions would be very cost-effective (using the continuous risk function approach). Again, the results are sensitive to the rate of decay in effect, but such interventions would remain cost-effective under the modelling assumptions used. For a £10 per person intervention, the cost per QALY estimates for a range of decay rates are:

Annual Decay Rate in Effect	**Cost per QALY (assuming a £10 cycling intervention)**
0%	£40
50%	£617
100%	£918

M13. For decision makers considering which of these interventions to implement given limited resources or considering what mix of a variety of interventions to invest in, it might be useful to consider comparison across interventions rather than each intervention versus ‘do nothing’. This is most easily done in health economic terms by calculating the incremental ‘net benefit’ of each intervention, which is simply a way of estimating the monetary value of the QALYs gained (assuming 1 QALY is 'worth' £20,000) and netting off the cost of the intervention. We present detailed analyses of this kind and the results suggest that interventions such as sustainable travel towns could probably be considered more cost-effective than pedometers or led-walking. The implication of these analyses is not that decision makers should only implement the intervention suggested as having the lowest cost per QALY (or highest incremental net benefit) because clearly local context issues, feasibility and timing of implementations, the value of a mix of measures to encourage different subgroups within the population etc., are all going to be important. It does however mean that decision makers should begin to consider, estimate and monitor the effectiveness of the measures they put in place to encourage walking and cycling and their costs.

M14. Where possible, DfT guidelines have been followed when assessing environmental and traffic related outcomes. These have been informed by the series of published Web-Tag guides and by personal communication with transport economists at the department. The results suggest that TravelSmart is the most cost-effective intervention; followed by the Sustainable Travel Towns programme. The three pedometer interventions are next with very similar results, while the Cycling Demonstration Towns appears to be the least cost-effective. It should be noted that these cost–benefit ratios take into account only a limited selection of environmental outcomes, and are used for comparison across interventions, rather than as full assessments of each programme.

When the reduced travel by motorised traffic is presumed to apply to a subset of roads types, rather than to the national road mix, calculated benefits increase for all individual road types except for minor roads in rural areas. This is because of the proportionately large influence of the congestion cost in the total calculation

M15. We have also considered the question regarding the balance of costs and effects that accrue for interventions that are designed for small numbers of people but have large effects versus interventions which are designed for much wider populations and have smaller effects per person. In particular, we have undertaken what-if analyses to examine the sensitivity of results to the proportion of people achieving uptake of the intervention from the wider population to whom it is offered. When the offer cost is small, the effect of uptake is negligible. The higher the level of effect, the more cost-effective the intervention, but this is not a simple linear relationship, because the relative risk function used. The continuous logarithmic relative risk function means that increasing levels of physical activity by 5 minutes is more beneficial for those who are not physically active, than for those who already are. Therefore, increasing physical activity by say 60 minutes, is not twice as beneficial as increasing physical activity by 30 minutes, a kind of diminishing returns. As the offer cost becomes a higher component of the total cost, then the cost per QALY becomes more and more sensitive to the level of uptake, and it becomes apparent that there can be a threshold level of uptake below which the intervention would not be considered cost-effective. This threshold is higher when the effectiveness of the intervention is subject to quick decay e.g. all effect is lost by the end of year 1 or year 3 than it is when there is a sustained effect, *i.e.* no decay.

Limitations and Conclusions

- In the health related benefits modelling, the key evidence used is the Copenhagen study relating level of physical activity to relative risk of mortality from all causes. We assume that such risk reductions occur within a year of the increased physical activity and are removed similarly quickly of the physical activity levels are reduced.
- Throughout we have not examined effects on under 18s, partly because a lack of direct evidence on children's behaviour in many of the studies and partly because we did not feel that the Copenhagen study on relative mortality risk reduction could be extrapolated to younger age groups.
- The transport/ congestion modelling has used different methods to estimate reductions in car distance and may not mean that direct comparison across the interventions is like for like. When considering the monetary values of the congestion benefits, it should be noted that these forecasts were made in 2002, and traffic growth has been lower than thought. This would result in the calculated benefits being over-estimated. The DfT is currently updating its

forecasts. The benefit to cost ratios shown in the congestion tables, apply only to the environmental outcomes listed, the DfT would normally consider congestion benefits as only one part of the overall assessment of a project. These benefit-cost ratios here are not directly comparable with those typically used by DfT which usually also, include environmental and health benefits.

- A number of the interventions considered in this report were part of multi-component programmes, requiring either new or existing infrastructure to realise their full potential benefit. Investors should consider whether such interventions would be appropriate in their own areas.

- Care must be taken with interventions where the offer cost is a large proportion of the total, as these will require significant take-up rates to become cost-effective. In addition, given the sensitivity of the benefits to costs, uptake, and decay, it would be sensible to monitor these factors during the lifetime of any intervention

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AUTHOR CONTRIBUTIONS

Drafting of the report was shared between, AB and LB.

LB undertook main work on economic evidence review.

AB and LB undertook model design, building and analysis.

DH-M undertook regression analyses on HSE and NTS

NP and AB with support from LB and LB agreed on use of effectiveness evidence in model inputs.

HB-W undertook literature searches.

1 INTRODUCTION

1.1 Overall Aims and objectives

This is one of a series of reports that was undertaken to support the development of guidance on walking and cycling: local measures to promote walking and cycling as forms of travel or recreation.

1.2 Overall Research Questions

Question 1: Which local interventions are effective and cost effective at promoting and increasing cycling and walking for recreational and travel purposes?

Question 2: Which local interventions are effective and cost effective at changing population-level norms and behaviour in relation to cycling and walking for recreational and travel purposes?

Question 3: What health and other outcomes may be achieved by increasing cycling and walking for travel and recreation?

1.3 Objectives of This Report

Presented here is the health economic and modelling report that will:

1. review existing health economic studies which consider relevant health related outcomes;

2. Model, to the extent that evidence allows, the likely cost effectiveness/cost utility of those interventions identified in the earlier effectiveness review and considered by the Programme Development Group (PDG) to of highest priority to be considered in this way.

1.4 Description of Modelling Requirements from NICE Scope / Protocol

Input to the modelling approach has been driven mainly by the results of the literature review and economic model searches. A lot of transport modelling work has already been done by various agencies, and this has been built on where possible. In addition, talks were held with individuals involved with the HEAT project, the DfT, and PDG members to identify suitable modelling approaches to adopt for this model. Outcomes are reported using a variety of metrics. Heath benefits use measures of quality of life and the statistical value of a life, while environmental outcomes such as pollution and congestion are reported in natural units. These units are related to vehicle distance travelled, the approach taken by the Department of Transport.

1.5 Background

Physical activity is essential for good health (DH 2004); it can help reduce the risk of coronary heart disease, stroke and type 2 diabetes by up to 50%. It also keeps the musculoskeletal system healthy and promotes mental wellbeing. However, based on self-reporting, 61% of men (71% of women) in England aged 16 and over did not meet the national recommended levels (Craig et al. 2009). Guidance for adults has recently been revised to recommend 150mins (two and a half hours) each week of moderate to vigorous intensity physical activity (and adults should aim to do some physical activity every day). Muscle strengthening activity should also be included twice a week (Department of Health 2011). The proportion of men who are physically active enough to meet national recommended levels decreases markedly as they age (from 53% at age 16–24 to 16% at 65 plus). The level of activity among women is considerably lower once they reach age 65. (Around 12% of women over 65 meet the recommended levels compared to 28–36% of younger women.) In children, 63% of girls (72% of boys) aged between 2–15 report being physically active for 60 minutes or more on 7 days a week. (Girls' activity declines after the age of 10.) (The Information Centre 2007). However, objective data suggest this is an overestimate. Only 2.5% (boys 5.1%, girls 0.4%) actually did more than 60 minutes of moderate to vigorous physical activity daily (Riddoch et al. 2007). Black African and Asian adults and black Caribbean women are less likely to meet the recommended activity levels of physical activity than the general population (The Information Centre 2006).

Walking is reported to be the most common, and cycling the fourth most common recreational and sporting activity undertaken by adults in Britain (Fox and Rickards 2004). Among women of all ages, walking (for any purpose) is the most important way of achieving the recommended physical activity levels. (It accounted for between 37% and 45% of the total time they spend doing moderate or vigorous physical activities [MVPA]). It is also one of the most important physical activities for men of all ages –accounting for between 26% and 42% of total MVPA (Belanger et al. 2011).

Of all trips made in Great Britain in 2009, 20% covered less than 1 mile. More than half (56%) of car journeys were less than 5 miles (Department for Transport 2010b). It is estimated that, on an average day in London, around 4.3 million trips are 'potentially cycle-able' (Transport for London 2010). However, in Britain, the average time spent travelling on foot or by bicycle has decreased, from 12.9 minutes per day in 1995/97 to 11 minutes per day in 2007 (Department for Transport 2010c). Cycle use in Britain is lower than in other European Union (EU) countries. It is estimated that bicycles are used for 2% of journeys in Britain compared to about 26% of journeys in the Netherlands, 10% in Denmark and 5% in France (Ministry of Transport, Public Works and Water Management 2009).

Changes in the number of people walking and cycling could have an effect on health, the environment and the economy. These may be positive or negative, and can be experienced by individuals or populations. Health outcomes include increased physical activity and changes to conditions such as obesity, cardiovascular disease (CVD), type 2 diabetes, some cancers, and mental wellbeing. Cycling and walking are also important ways for people to travel to local places and services (such as education, employment, shops, healthcare and recreation). This, in turn, could boost the local economy while having a positive effect on the environment. For example, a decision to cycle or walk rather than drive reduces the emission of air pollutants and carbon dioxide.

Walking and cycling may have unintended consequences, some of which may be counter-intuitive. For example, deciding to cycle might replace another more intense activity (such as going to the gym) which may result in an overall reduction in physical activity. In addition, walking or cycling, rather than driving, may result in a different level of exposure to air pollution. Generally, cyclists and pedestrians experience higher rates of injuries than motorists (Department for Transport 2010b). However, there is also some evidence to support the hypothesis that increasing the number of cyclists reduces the risk of injury, possibly by making drivers and cyclists more familiar with each other (Jacobsen 2003). The decision to drive rather than walk may expose others to risk of injury from a collision.

Motorised transport in urban areas is associated with considerable costs. Congestion, poor air quality, collisions and physical inactivity in English urban areas each cost around £10 billion a year (Department for Transport 2009). The cost of greenhouse gas emissions and the annoyance associated with noise are smaller, but still significant. In the case of greenhouse gases, costs are expected to rise sharply in future years (Department for Transport 2009).

Interventions to promote walking or cycling may have an effect on health inequalities. For instance, the change experienced as a result may be different for people with limited mobility. Ensuring planning decisions improve access on foot or by cycling, may help those who are unable to drive. Changes in vehicle use may alter the risk of injury – which itself varies significantly according to people's socioeconomic background. As exposure to air pollution also varies across the social gradient, so changes in the level of pollutants may be more significant for some groups than others.

2 ECONOMIC LITERATURE REVIEW

2.1 Objectives of Economic Literature Review

To review existing literature on the cost-effectiveness of Interventions to promote cycling and walking for recreational and travel purposes.

2.2 Economic Review Methods

2.2.1 Search Strategy

To inform the economic modelling, an economic literature review was undertaken. Searches were made of a number of databases, and all search results were downloaded to Reference Manager. Potentially relevant papers were identified based on title and abstract, and full versions obtained. A number of papers and reports were also suggested by PDG members.

Studies were identified through the review search strategies, which included searching in the NHS Economic Evaluation Database (via Wiley). An additional search was undertaken that included the use of the Scottish Intercollegiate Guidelines Network economics study filter. The aim of the search was to identify relevant cost effectiveness papers in medical, health, social science and transport databases including the NHS Economic Evaluation Database. The search focussed on health economic studies that dealt with interventions to increase walking and/or cycling, and reported relevant health related outcomes and cost benefit analysis results studies which considered wider outcomes including travel, congestion, and pollution where the evidence permits. Expert advice was sought for non-NHS sources. Simplified search strategies were also used to search another economic specific database: EconLit (via OVID SP).

The search strategies used were discussed by and agreed between the ScHARR and NICE teams.

2.2.2 Economic Modelling Searches

Searching, that was agreed by the ScHARR and NICE teams, was also undertaken to support the initial stages of the modelling process. This took the form of reference tracking and consultation with experts. In addition, economic specific databases were searched: NHS Economic Evaluation Database (via Wiley) and EconLit (via OVID SP). These were supplemented by expert advice regarding sources. The strategies were based in part on existing search strategies (Ogilvie et al., 2007; Yang et al., 2010; YHEC, 2007) and from keywords generated from the project scope and key known literature in the field.

2.2.3 Inclusion and Exclusion Criteria for Obtaining Full Papers

Studies were included if they:

- were studies of specific interventions that promoted walking or cycling,
- included a cost-effectiveness measure or a cost-benefit analysis.

Studies were excluded if they:

- were judged as irrelevant from title or abstract,
- were intervention areas specifically excluded by the study protocol:
    - disease rehabilitation studies,
    - national policy, fiscal and legislative change,
    - infrastructure and physical environment.

2.3 Results of Review of Cost-Effectiveness Studies

2.3.1 Summary of Studies Included in this Review

The literature searches of the economic and transport databases identified 1089 studies. 1077 of these were rejected based on title or abstract, leaving 12 for further investigation. Of these, 8 were rejected after reading mainly because they were cost-effectiveness studies that did not link the observed behaviour modification to health or environmental benefits, or because the walking and cycling elements could not be disaggregated from a more general measure of physical activity. In addition, 20 potentially relevant publications were forwarded by PDG members or identified by ourselves. Following reading, 18 of these were rejected based on the inclusion and exclusion criteria. Table 2.1 provides a summary.

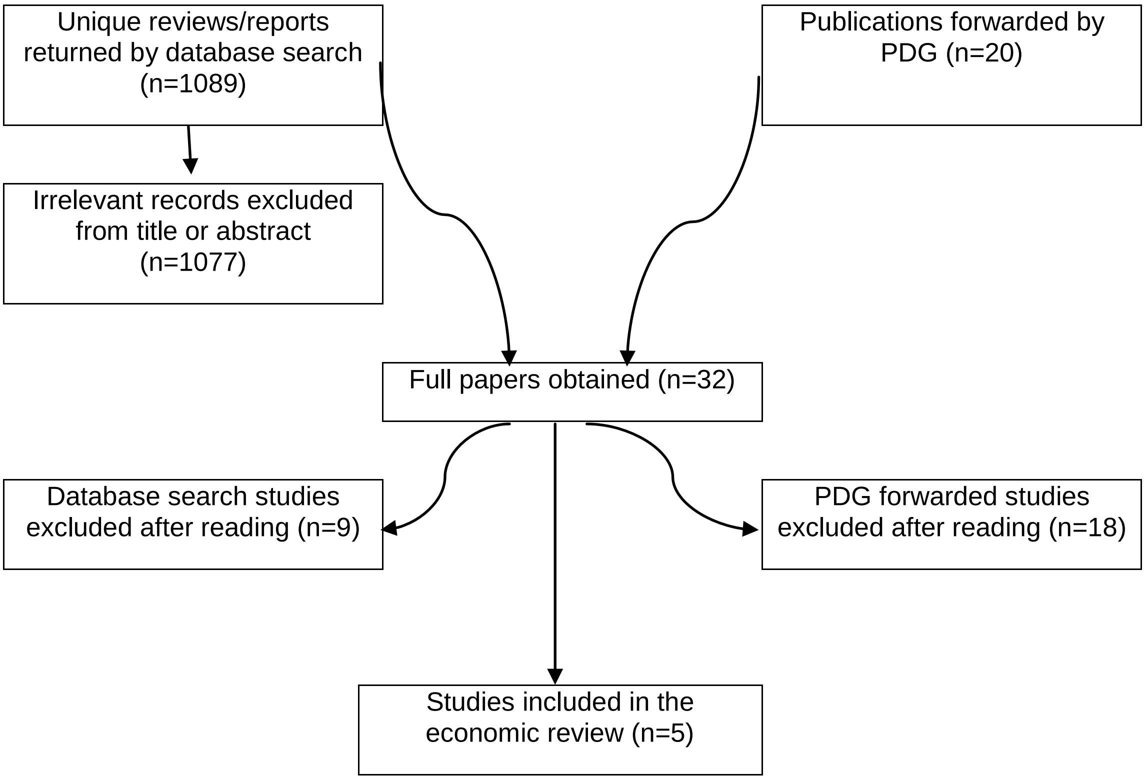

Table 2.1 Summary of economic literature review process

Table 2.2 lists the five included reports. The Cycling Demonstration Towns, whilst primarily an analysis of infrastructure investment, also had a number of other elements, thus making it a multi-component intervention. The NICE programme guidance (Fordham 2008) included a section on walking school buses, which, while not analysing a specific intervention, estimated cost, effectiveness, and benefit data from a number of sources to arrive at an estimate of cost-utility (Mackett 2008, DfT 2006,). The three remaining studies drew data from a number of different interventions for comparative modelling. Intervention groups considered included led walking, pedometers, media campaigns, and the TravelSmart programme.

Study/report	Setting	Study Type	Intervention Type	Economic evaluation
Roux 2008	U.S.	Review	Led walking (3)	Cost per QALY
Cobiac 2009	Australia	Review	Pedometer (1) TravelSmart (1)	Cost per DALY
Pringle 2010	U.K.	Review	Media campaign(2) Led walking (2)	Cost per QALY
Cycling Demonstration Towns 2010	U.K.	Trial	Multi-component	Cost/benefit ratio
Fordham NICE 2008	U.K.	Economic assessment	Walking school bus	Cost per QALY

Table 2.2: Summary of studies included in the review of cost-effectiveness evidence.

2.3.2 Intervention Types Examined in Cost-Effectiveness Literature

The Roux (2008) study aimed to model the costs and benefits of seven public health interventions to promote physical activity in a simulated cohort of healthy U.S. adults. Of the seven interventions, only three were solely concerned with encouraging an increase in walking, as opposed to general physical activity. Two of these used community based social support strategies, including organised walking groups, home visits and phone calls, and newsletters, maps and handouts. The other was an intensive mass-media campaign that promoted walking among sedentary adults aged 50 to 65years.

Cobiac (2009), in Australia, used data from six categories of interventions designed to promote physical activity. As with the Roux studies, most of the interventions measured outcomes as an aggregated total of activity, however two categories derived their data from interventions that reported effectiveness in terms of increases in walking or cycling. The first of these categories was pedometer interventions, which used a meta-analysis of eight randomised control trials, and the second was the TravelSmart programme, which pooled the results from twenty-one individual TravelSmart interventions. The target group for both of these categories was the general population of adults aged fifteen an over.

The study by Pringle (2010) measured changes in moderate physical activity in seven community-based intervention types at nine sites across the U.K., a total of 39 individual programmes. Again, most interventions were concerned with overall activity, leaving just four individual programmes that focused on the promotion of walking or walking and cycling. Two of these were media campaigns circulating maps of walking and cycling routes, the other two were organised community walking groups. Participation appears to have been open to everyone, however demographic details are provided only for completers, and at an aggregate level across all intervention types and sites.

The Cycling Demonstration Towns programme was a £14 million investment in eight towns, designed to promote cycling. It consisted of infrastructure measures such as the building cycle paths, combined with a programme of education and marketing, and was aimed at the general population.

The walking bus is an intervention designed to encourage schoolchildren to walk to school. Children are escorted along a set route by a number of adults. In producing the NICE programme guidance, no intervention was instigated. Rather, estimations for costs and effectiveness were made by reference to studies of a number of previously operating walking buses (Mackett 2008,DfT 2006,)

2.3.3 Effectiveness Measures Examined in Cost-Effectiveness Literature

Roux (2008) used data from the original studies to model the effectiveness of a one-year intervention on physical activity, divided into four levels, ‘inactive’, ‘irregularly active’, ‘meets guidelines’, and ‘highly active’. Following the intervention, cohort members had an annual probability of either remaining in the new activity level or moving to a lower level. The decline in activity level in the second year was presumed to be 50%. After this initial rapid decline, cohort members were moved to a natural history model developed from age and gender specific activity data from the Behavioural Risk Factor Surveillance System (CDC). Health outcomes considered were CHD, ischaemic stroke, type 2 diabetes, breast cancer, colon cancer, and death. The annual probability of developing each disease was estimated using population-based, disease specific incidence data combined with relative risks derived from epidemiological studies, specific for activity levels and disease. Benefits were given as QALY gains derived from disease state, physical activity level, age, and gender using data from 2001 National Health Interview Survey (CDC) quality of well-being scores.

Participation rates and effectiveness data for the study by Cobiac (2009) were taken from the underlying studies. For pedometer interventions, the change in activity was measured as the change in the number of steps taken per day, and for the TravelSmart interventions, it was a weighted average of change in the number of walking and cycling trips made per week in the 21 study areas. For the model, this change in activity level was converted to a change in energy expenditure and linked to the relative risk of experiencing or dying from a number of activity-related diseases. These were stated as: ischaemic heart disease, ischaemic stroke, type 2 diabetes, breast cancer and colon cancer. A cost-effectiveness rate was generated based on intervention in the first year, with health outcomes measured over the lifetime of the Australian population. The base case analysis presumed a decay in the intervention effects, after the first year, of 50% per year. Health benefits were expressed as changes in Disability Adjusted Life Years (DALYs) compared with a “do nothing” scenario using disease-specific disability weights.

The assessment of the effectiveness of the interventions considered by Pringle (2010) was compromised by the low numbers of completers from whom physical activity data were collected. From the 194 participants in the media campaign, 14 completed, while from the 273 people who took part in the walking groups, effectiveness data were collected from just eight. Before and after activity levels were measured and grouped into four bands, ‘sedentary’, ‘lightly active’, ‘moderately active’, and ‘highly active’. The Matrix model was then used to estimate the effect of activity levels on the likelihood that people will experience CHD, stroke, type 2 diabetes or colon cancer. This model also estimates the effect of experiencing these conditions on a person’s quality of life, expressed as QALY gains. It was presumed that 50% of those who achieved increases in activity level maintained that increase.

Conducting a benefit-cost analysis was not the primary purpose of the data collection in the Cycling Demonstration Towns; therefore it was necessary to make a number of presumptions about the effectiveness of the programme. The change in the number of cyclists in each town was estimated by Cavill (2009) using sample surveys comparing before and after cycling levels. Benefits considered were reduced absenteeism, decongestion, accident rates among cyclists, and benefits to cyclists from better facilities.

Presumption of the effectiveness of walking bus interventions were mainly based on the findings of Mackett (2008). It was estimated that, on average, 10.71 pupils would take part, 50% of whom would be replacing a car journey, the journey would take 22 minutes, and the bus would operate for one year, with children attending school for 38 weeks. Benefits were estimated by linking increases in physical activity directly to QALY gain at a fixed rate using data from The Health Survey for England.

2.3.4 Costs Examined in Cost-Effectiveness Literature

Roux (2008) conducted the cost effectiveness from a societal perspective. Unit costs of the interventions were obtained through direct communication with the authors of the original investigations. In addition to the costs of intervention delivery, and expenses incurred by the participants were included, as was a measure of the value of their time based on age and gender specific salaries. Medical costs were derived from an analysis of claims for each of the diseases considered, from a longitudinal medical claims database. Medical costs were inflated by an annual 8%, and discounted back at 3% per year.

The costs of each intervention considered in the Cobiac (2009) study used an Australian health service perspective. This includes costs to both the government and the patients, including time and travel costs, but excluding patient time costs associated with changes in physical activity. Start-up costs of research and development were also excluded, so that the interventions were compared as if operating under steady-state conditions. The monetary benefits accruing from improved health were based on cost per incident of the five exercise-related morbidities modelled; however the source of these costs is not stated. Health care costs for all other diseases in added years of life were excluded from the basic analysis. Future health outcomes and costs were discounted back to the baseline year of 2003 at 3% per year.

For the interventions taken from the work by Pringle (2010), costs were derived from quarterly interviews with the intervention manager. They included the implementation costs of personnel, training, premises, transport, equipment, publicity, and other running costs, and excluded costs to participants. In the cost effectiveness analysis, cost and attendance data were combined to estimate the monthly implementation cost, and the cost per participant in the intervention. Potential future savings to the NHS are implicit to the Matrix model used.

The Cycling Demonstration Towns took a market unit of account approach to their costing. This involved removing VAT and uplifting all costs by the market cost adjustment factor of 20.9%. For the purpose of discounting, all costs, initial capital investment and running costs, were evenly spread over the three years of the programme.

Costs for setting up a walking bus were estimated by allocating a unit cost to the component tasks. These included, among others, route planning and risk assessment, administration, insurance training and criminal record checking for volunteers, and the provision of tabards.

2.3.5 Cost Utilities and Cost Benefits Reported in Cost-Effectiveness Literature

Results for the Roux (2008) study were given in US$ per QALY based on 2003 prices. The mass-media campaign produced a cost per QALY of $14,286, while the two social support interventions were less cost-effective at $27,373 and $39,690. Some sensitivity analysis was conducted on the modelling assumptions. Repeating the intervention once after 20 years was reported to have a small effect as was varying the dissipation of the effect sizes, although no figures were given. Shortening the analytic time-horizon had a significant effect with one of the social support interventions quoted as an example. The figure of $27,373 based on a 40-year horizon increasing to $147,000 using 10 years.

Cobiac (2009) reported cost effectiveness in AUS$ per DALY at 2003 prices. The pedometer interventions were reported to have a net saving of $21,000 per DALY, while the TravelSmart programme resulted in a cost of $18,000 per DALY. Sensitivity analyses were conducted on the rate of decay of the intervention effects. Pedometer interventions maintained a net saving even when the intervention effect was modelled to decay completely by the end of the first year, although no figures were given. The TravelSmart programme had net savings with annual decay rates of 0% and 25%, but costs rose to $41,000 per DALY at 75%, and $63,000 per DALY at 100% decay.

Pringle (2010) reported costs per QALY in UK pounds at 2003 prices. For the campaign based interventions, the cost per QALY was given as £86 for provision of a healthy living map with walking and cycling routes, and £288 for the promotion of walking and cycling though printed media approach. The two organised walking group interventions showed a cost per QALY of £301 and £475.The authors conducted sensitivity analyses, and stated that the conclusions of the cost effectiveness analysis were not sensitive to presumptions made in the modelling process.

Benefits accruing in the Cycling Demonstration Towns program were converted to monetary values and compared with the initial investment and running costs to produce a benefit-cost ratio. A range of 2.6 to 3.5 was given, reflecting the different approaches available for estimating accident and absenteeism benefits. Sensitivity analysis was done to consider different rates at which the increases in cycling fall over time, varying from 0% to 30%. Time-horizons of 10, 20, and 30 years were also considered. Under all but the most pessimistic of scenarios considered, the benefit-cost ratio remained above one, with a potential to reach 12.3 (under a scenario presuming 10% annual growth in demand over 20years with no additional costs).

The cost-benefit of providing a walking school bus was estimated to be £4,010 per QALY gained. Sensitivity analyses were concentrated on participation rate and the number of volunteers involved. Uncertainty around the relationship between physical activity and quality of life was also explored. In the best-case scenario for the variables considered, the cost per QALY dropped to £2,431.51, while at the other extreme, the authors reported that the cost per QALY was "only slightly less favourable" than the assumed threshold of £20,000/QALY.

2.4 Economic Review Evidence Statement Summaries

2.4.1 Economic Evidence Statement 1. Led walking including Walking School Bus

Moderate evidence from 4 studies suggests that led walking interventions (7 different interventions analysed in 4 studies) could be cost-effective

Gusi 2008 (Spain) [six-month programme to promote walking based exercise via a supervised exercise programme with three 50-minute sessions per week]. Incremental cost per QALY range of 94 to 871 Euros per QALY.

Roux 2008 (USA) [community based social support strategies, including organised walking groups, home visits and phone calls, and newsletters, maps and handouts]. Incremental cost per QALY of $27,373 and $39,690 for the two different led walking interventions versus do nothing.

Pringle 2010 (UK) [*organised community walking groups*]. The two organised walking group interventions showed a cost per QALY of £301 and £475.

Fordham (NICE) 2008 (UK) [*walking bus intervention designed to encourage schoolchildren to walk to school*]. Incremental cost per QALY estimated to be approx. £4,007 per QALY gained

The evidence is partially applicable to the UK, with 2 of the studies UK based, and the other international studies concerning interventions that could be of UK relevance.

2.4.2 Economic Evidence Statement 2. Pedometer

Moderate evidence from 1 study suggests pedometer interventions could be cost-effective

Cobiac 2009 (Aus) [*pedometer interventions, which used a meta-analysis of eight randomised control trials*]. Pedometer interventions maintained a net saving even when the intervention effect was modelled to decay completely by the end of the first year. That is, the modelled lifetime cost savings to the health service outweighed the pedometer costs as well as providing health benefits.

The evidence is partially applicable to the UK as similar pedometer interventions are of relevance.

2.4.3 Economic Evidence Statement 3. Media campaigns

Moderate evidence from 1 study suggests media campaigns could be cost-effective

Pringle 2010 (UK) [*media campaigns circulating maps of walking and cycling routes*]. The cost per QALY £86 for provision of healthy living map with walking & cycling routes, and £288 for the promotion of walking and cycling though printed media approach

The evidence is applicable to the UK.

2.4.4 Economic Evidence Statement 4. Community Health Information (TravelSmart)

Moderate evidence from 1 study suggests TravelSmart interventions could be cost-effective

Cobiac 2009 (Aus) [TravelSmart intervention with individualised information to households on travel choices measuring change in the number of walking and cycling trips made per week]. TravelSmart programme resulted in a cost of $18,000 per DALY assuming 50% decay per annum. The TravelSmart programme had net savings with annual decay rates of 0% and 25%, but costs rose to $41,000 per DALY at 75%, and $63,000 per DALY at 100% decay

The evidence is partially applicable to the UK as the TravelSmart style intervention is relevant in the UK.

2.4.5 Economic Evidence Statement 5. Multi-component (Cycling Demonstration Towns)

Moderate evidence from 1 study suggests that the Cycling Demonstration Towns projects have a good benefit/cost rate.

Cycling Demonstration Towns 2010 (UK) [infrastructure measures such as the building cycle paths, combined with a programme of education and marketing, and was aimed at the general population]. Benefits converted to monetary values and compared with the initial investment and running costs to produce a benefit-cost ratio. A range of 2.6 to 3.5 was given, reflecting the different approaches available for estimating accident and absenteeism benefits. Under all but the most pessimistic of scenarios considered, the benefit-cost ratio remained above one.

The evidence on cycle demonstration town is directly applicable as it was conducted in the UK.

2.5 Conclusions from the Economic Evidence Review

ER6. Some UK and international evidence exists that interventions to promote walking or cycling could be considered cost-effective, particularly for the following types of interventions: led walking including walking school bus, pedometers, TravelSmart, media campaigns, and multi-component.

ER7. For the interventions either modelled or directly assessed by the small number of studies available, all would be considered cost-effective when compared to standard care or ‘do nothing’, except under the extremes of some of the sensitivity analyses.

ER8. There remain however, some significant gaps when compared with the range of intervention categories highlighted by the effectiveness review.

ER9. Only one of the reports, the cycling demonstration towns considered environmental outcomes, and the general applicability of these may be in question, as the intervention was infrastructure based.

ER10. There is a need for some *de novo* modelling work to provide additional cost-effectiveness evidence to the PDG.

3 MODELLING METHODOLOGY

3.1 Brief review of Existing Model Frameworks

3.1.1 Previous Physical Activity Work for NICE (MATRIX)

In 2006, Matrix Research and Consultancy undertook a project to model the cost effectiveness of a number of interventions aimed at increasing physical activity. The areas considered were, brief interventions in primary care, pedometers, exercise referral, and walking and cycling programmes in the community. An economic model was constructed to estimate the effects of these interventions on participants' change in experiencing CHD, stroke diabetes, and colon cancer, and the consequent effect on their quality of life and NHS cost savings. Their study concluded that all the interventions were dominant when compared to usual care

3.1.2 Previous Walking and Cycling Infrastructure Economics Work for NICE (YHEC)

York Health economic Consortium, (Beale 2007), undertook a study for NICE, which was an economic analysis of environmental interventions that promote physical activity. They took three different approaches to assess the benefit of building walking and cycling trails. The first method was a standard cost-benefit model that considered such benefits as health, comfort and security, travel time, and short-term absenteeism. Their second approach was a disease –specific model that considered a range of health benefits including the risks of CHD stroke and diabetes. This model was based on the aforementioned Matrix project and reported results as cost per QALY. The final approach was an econometric model that used data from the HSE to link activity levels to EQ-5D measures of quality of life.

3.1.3 The HEAT

In 2008, the World Health Organisation produced the Health Economic Assessment Tool for cycling. This draws on the work of Anderson *et al.* (2000) and is designed to assist people or organisations conducting economic appraisals of the health effects related to increased cycling. It produces an estimate of the mean annual benefit per cyclist due to reduced mortality as a result of cycling. In this way, it allows the user to attach a value to the health benefits resulting from an estimated level of cycling when new infrastructure is put in place.

3.1.4 The National Transport Model

The Department for Transport has produced a multi-modal model of land-based transport in Great Britain. The main objectives are to produce forecasts of traffic volume, congestion, carbon dioxide and pollutants, and to provide a policy and scenario-testing tool. The model forecasts are based on presumptions of future trends in population, oil price, and GDP. Whilst walking and cycling trips are included in the model, it is mainly designed to produce national level forecasts, and as such is of limited value when considering small-scale local interventions.

3.1.5 Need for a New Model

There is a need for some *de novo* modelling work to provide additional cost-effectiveness evidence to the PDG.

3.2 Overview of Conceptual Modelling Framework

A modelling methodology has been developed to provide a common platform for health economic assessment of interventions that are local measures to promote walking and cycling as a form of travel or recreation. The modelling builds upon three key components

- The relationship between physical activity and relative risk of mortality as reported in the long-term observational study by Anderson et al. (2000). This allows transformation of physical activity level changes into life expectancy, numbers of deaths and quality adjusted life-years.
- The relationship between levels of walking and cycling, and overall physically activity. We use the Health Survey for England to estimate statistical relationships between these variables. This allows direct evidence from studies of the effect of interventions on levels of walking and cycling to be converted into estimated changes on overall physical activity, and hence life expectancy etc.
- The relationship between levels of walking and cycling, and travel, especially driving distance but also driving time and numbers of trips. We use the National Travel Survey to estimate statistical relationships between these variables. This allows estimation of the effects of interventions that increase levels of walking and cycling on reduced kilometres driven, and hence reduced congestion, pollution and greenhouse gas emissions.

In overview, the steps taken to produce this common platform have been as follows

1. Analysis of baseline data (by age, sex, work status, have a car)
    a. HSE Walking, cycling, physical activity
    b. NTS trips, walking, cycling, driving by purpose
2. Take evidence from effectiveness review on effectiveness of specific interventions (chosen as priorities by the PDG).
3. For health benefits, estimate change in levels of physical activity either directly from the evidence or indirectly via statistical relationships between walking and cycling levels and overall physical activity from HSE.
4. Quantify reduced mortality risk given increased levels of physical activity using Anderson *et al.* Copenhagen study (as is used in HEAT) using either a step function on relative risks based on per cent of people achieving over two hours moderate activity per week or a modelled continuous risk function.
5. Use ONS life-tables and evidence on average health related quality of life by age and sex to estimate discounted lifetime QALYs for baseline versus with intervention
6. For environmental outcomes, estimate change in levels of car driving distance, either directly from the evidence on reduced car distance / trips, or indirectly via statistical relationships between walking and cycling levels and overall car distance from NTS. (We relate driving to walking and cycling via NTS zero inflated negative binomial regressions for car driving distance, car driving time and number of trips).
7. Estimate cost of intervention if rolled out across all England
8. Compute cost per discounted QALY gained over a life-time horizon using health benefits modelling.
9. Compute value per annum of congestion reduction, pollution, and other environmental outcomes using DfT guidelines on economic evaluation (*e.g.* average value of 13.1p per vehicle km for congestion across the whole road network) as well as value of deaths avoided using value of a statistical life..

3.3 Population of Interest and Baseline Estimates of Behaviour

3.3.1 Population Modelled

For the analyses undertaken, we have used the 2008 Health Survey for England as a representative sample of the general population. For all analyses reported in this draft report we have used the population aged 16+, as under 16s had a different set of questions asked of them regarding their walking, cycling and physical activity.

3.3.2 Key Dataset 1 – Health Survey for England

The HSE is a series of annual surveys about the health of people living in England. Relevant details on individuals were taken from the 2008 survey, which covered 22,623 people. These details included some general information such as, age, gender, employment status, and whether the person had access to a car. Health related measures such as BMI, blood pressure and cholesterol ratio were included, as were measures of general physical activity.

3.3.3 Key Dataset 2: National Travel Survey

The NTS has data covering seven years on 152,344 individuals, of whom 133,664 completed a trip diary, recording the mode and purpose of every journey they made over a period of one week. Details of the individuals also included age, gender, employment status, and access to a car, enabling a link to be established with the HSE.

3.3.4 Health Survey for England Overall Physical Activity

Data from the HSE were analysed to derive population measures of physical activity.

The key variable used in the modelling is the number of hours spent per week doing all different kinds of physical activity, where the activity lasted more than 10 minutes, known as “Hours 10+mins/wk all PA”.

We used this to classify each individual into ‘active’ and ‘inactive’ groups using a cut-off point of two hours of physical activity per week (Figure 3.1, Figure 3.2)

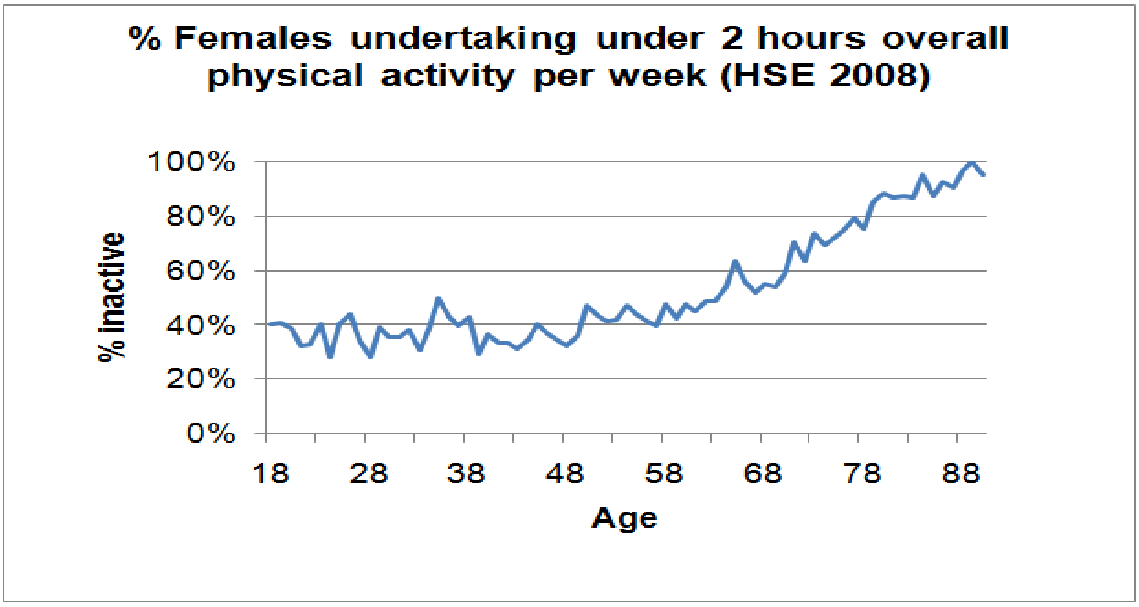

Figure 3.1: % Females undertaking under 2 hours overall physical activity per week (HSE 2008)

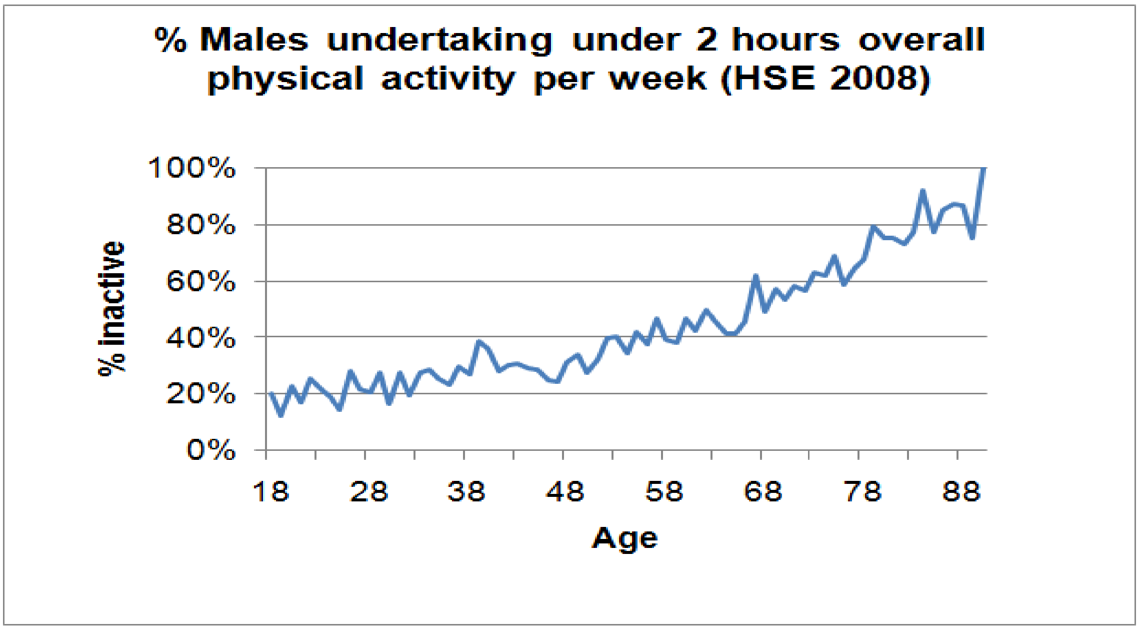

Figure 3.2: % Males undertaking under 2 hours overall physical activity per week (HSE 2008)

3.3.5 HSE Compared with NTS for Cycling Data

Individual levels of cycling may be expected to very greatly, as the majority of the population do not do any cycling at all. Respondents to the HSE and NTS reported very similar levels of cycling; the similarity persisting when considering either the full samples or just those who did any cycling.

Mean bike time (minutes per week)	HSE	NTS
of all people	7.42	5.25
if cycle	107.10	106.93

Table 3.1 Comparison of HSE and NTS cycling time data

3.3.6 HSE Compared with NTS for Walking Data

At the overall average level, there is a marked difference in the reported levels of walking in the HSE and NTS. The HSE average is 118 minutes compared with the NTS average of 45 minutes. This difference may, at least in part, be explained by the differing recording methods and definitions used by each survey. The HSE gives a value for the number of hours per week of walking episodes of at least ten minutes at a brisk or fast pace, which is derived from each individual's recall over the four weeks previous to their interview. The maximum value of any person for this is 147 hours, which represents over six days walking in a week, and raises concerns over the accuracy of the measure. For the NTS, participants kept a trip diary for one week in which all walking trips were recorded with their respective start and finish times and distance travelled. While there may be issues with people neglecting to record all trips, it does avoid the issue of memory when using recall data. For these reasons, it was felt that the NTS methodology probably provided the more accurate measure of walking.

3.4 Outcomes of Interest for Inclusion in the Modelling

3.4.1 Walking and Cycling Outcomes

The most common outcome reported in the effectiveness studies was a change in a measure of walking or cycling or both. This could be in terms of

- Minutes spent
- Number of steps

- Numbers of ‘sessions’ of walking or cycling
- Numbers of trips made

Travel behaviours were reported in terms of active travel, measured as time spent, distance travelled or number of trips made. Some studies also report

- Changes from baseline in level of overall physical activity or
- percentage of people achieving physical activity guidelines (2 hours of moderate physical activity per week)

3.4.2 Health Outcomes

In order to estimate effects on health, one needs to convert any increases in walking and cycling outcomes into risks of morbidity and mortality. In particular, for NICE decision-making and recommendations, one would like to achieve an estimate of the quality-adjusted life-years gained by the intervention. This incorporates together effects on extended survival due to mortality risk reductions (the life-years) with health related quality of life measures. A person living in full or perfect health is measured with a health related quality of life score of 1. A person in a state of health that is so bad it might be considered equally preferable to being dead is scored 0. Any health state between these can be scored on the 0 to 1 scale. A person living 15 years in perfect health would enjoy 15 quality adjusted life years. A person living 15 years in a moderately poor health state of score 0.666, would experience 10 quality-adjusted life-years.

Therefore the primary health outcome of interest is

- Mortality risk

With a secondary outcome related to

- Health related quality of life

Occasionally the published effectiveness studies report health related outcomes, including mortality, cardio-respiratory fitness, reduction in blood pressure, and changes in weight or BMI. A small number of studies reported well-being or quality of life measures as outcomes.

For most studies, we will need to transform the walking, cycling, or physical activity outcomes into risk reductions for mortality and health related quality of life.

3.4.3 Environmental Outcomes

The scope of the health economic appraisal indicates that, if possible, NICE would like to receive estimates of the effects of interventions on environmental outcomes. Ideally, these would include

- Improvements in congestion measured by reductions in time spent driving
- Local air quality
- CO_2 / greenhouse gas emissions

3.4.4 Cost and Economic Outcomes

For an assessment of the cost-effectiveness of interventions, one needs to balance the investment cost against the effects achieved.

We include:

- Direct costs of the intervention to public sector or related bodies including
  - costs of staff time in giving advice or training,
  - costs of materials related to the intervention e.g. pedometers or booklets

On the effect side, we make estimates of:

- Quality adjusted life years gained (QALYs)
- Deaths avoided
- Car travel distance reductions
- Environmental outcomes

We provide several indicators of the economic performance of the intervention therefore. As is common for health related interventions, we estimate

- Incremental cost per QALY gained for the intervention

As is common in transport related appraisals, we have attempted to estimate

- Value of deaths avoided using the statistical value of a life approach
- Value of reduced congestion

- Value of reduced pollution

3.4.5 Other Outcomes Excluded

At this stage non-health or non-congestion related outcomes have been excluded from the analysis. Outcomes considered out of scope included:

- Effects on the economy including
    - suppliers of materials related to walking and/or cycling
    - effects on public and other forms of transport
    - personal spending from changed travel behaviours

3.5 Transforming Physical Activity Outcome to Reduced Mortality Risk

3.5.1 Evidence Used for Transforming Physical Activity Outcome to Reduced Mortality Risk

A multivariate adjusted relative risk of mortality for moderate physical activity, compared with low physical activity, was taken from the Copenhagen Study for Mortality Risk Reduction (Anderson, 2000).Table 3.2 shows the relative risks categorised by age-band and gender.

The key results used are from the multivariate adjusted relative risk, moderate physical activity (two hours per week) versus low physical activity This evidence is also used in HEAT.

Age	Male	Female
20-44 years	0.73	0.75
45-64 years	0.75	0.73
65 + years	0.62	0.65
All ages	0.72	0.65

Table 3.2. Relative risk of mortality by age and gender.

3.5.2 Step Function Version of the Mortality Risk Model

In the simplest version of the modelling, we simply use the relative risks from Table 3.2. Hence, for example, we can define RR=1 if physical activity reported in HSE is <2 hrs, and RR=0.75 if >2hrs (F20-44), as shown in Figure 3.3.

3.5.3 A Modelled Continuous Risk Function Based on a Logarithmic Curve Fitting to Copenhagen Relative Risks

Feedback from the PDG suggested that the very simple step function modelling approach might miss benefits for those whose physical activity might move from say 30mins per week to 1 hour 59 minutes within the model, and over-estimate benefits for people moving from 1 hour 59 minutes to 2 hours and 1 minute. With a population level model these over / under estimates might well cancel out, but to investigate the effects we developed a simple continuous risk function model by fitting a logarithmic curve to the 3 points provided from the Anderson evidence *i.e.* under 2 hours, 2-4hours, and 4 hours plus. We used the HSE to find the mean level of physical activity in each of these four categories. As an example, for females 20-44, we fitted the curve below (Note: we adjusted the relative risks so that the HSE mean would be 1, rather than basing 0-2 hours as 1). We have assumed, by looking at the trend in the fitted curve close to zero, that the upper limit relative risk, *i.e.* for physical activity reported as zero, is 1.8.

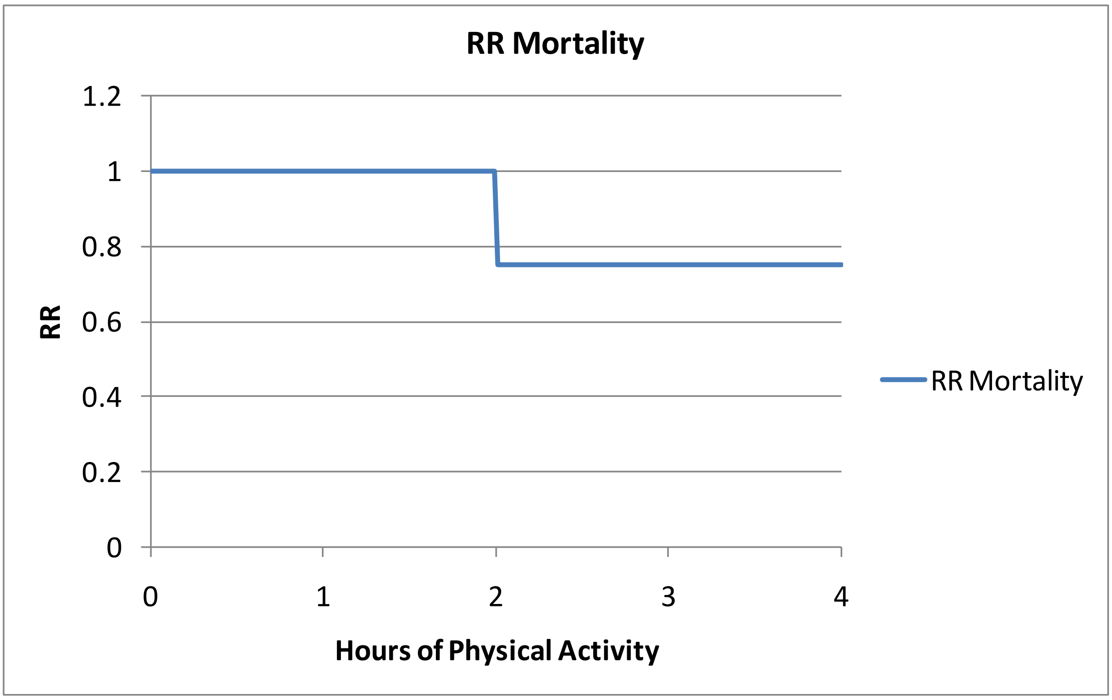

Figure 3.3 Illustration of step-function risk model for mortality

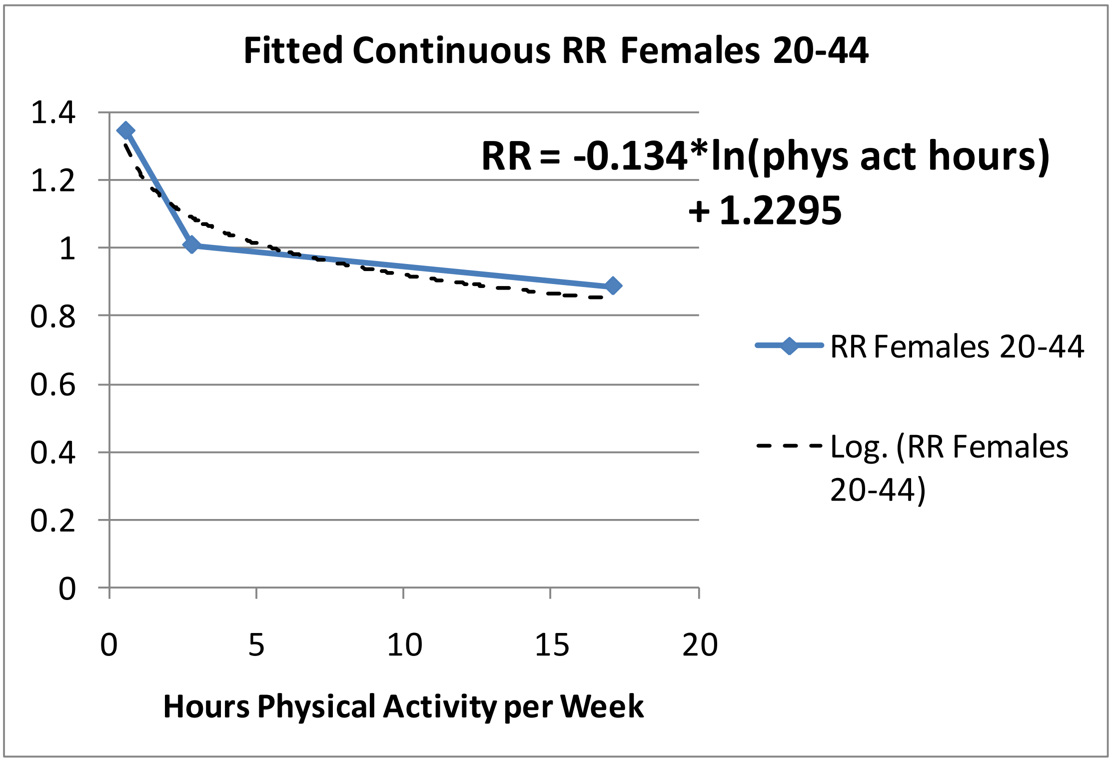

Figure 3.4 Example of fitted continuous mortality risk function (dotted line)

3.6 Using Life-Tables,

An average annual risk of death was computed for each single year age band for each gender, for active and inactive adults.

Given the average probability of death for each single-year age band and gender (http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-213645), we used the baseline inactive percentage combined with the relevant relative risk, to calculate the probability of death for active and inactive people in each band.

Thus, when there is an increase in the percentage of active people, we can compute the associated increase in average life expectancy.

3.7 Estimating Change in Physical Activity given Evidence on Walking/Cycling using Statistical Models: Health Survey for England

Using the HSE 2008, a statistical model was constructed relating a person's level of walking and cycling to their overall levels of physical activity. This was then incorporated into the model in order to adjust an individual's total physical activity following an intervention targeted at either walking or cycling, or both.

The outcome measure of interest is the average number of minutes doing all physical activities for 10+ minutes per week, as derived in the HSE 2008. We chose to mode this variable as a count variable and the distribution of observed values from inspection of the HSE resembles a Poisson distribution. Further inspection revealed both over-dispersion and a very large number of excess zeros in the data. We therefore assumed a zero-inflated negative binomial distribution in order to account for both of these characteristics.

We have been made aware of the possibility that some survey respondents may have misinterpreted the questions relating to their total time walking and cycling per week, and provided responses that were unreasonable high. We made the assumption that any respondents who recorded spending more than 84 hours a week (12 hours a day, 7 days a week) walking or cycling had misunderstood the question and given incorrect answers. Therefore we have chosen to discard all respondents whose combined walking and cycling time exceeded 84 hours a week.

The regression model was estimated using STATA/SE version 10.1. Likelihood ratio tests were used to determine the most appropriate set of predictor variables for inclusion in the final model. Overall the final model was highly statistically significant, $P<0.0000$. We also conducted the usual tests for the applicability of the zero-inflated model versus the standard negative binomial, and of the zero-inflated negative binomial versus the zero-inflated Poisson. A highly significant Vuong statistic ($P<0.000$) indicates that the zero-inflated model is appropriate as opposed to non zero-inflation, and the dispersion parameter, alpha, being significantly greater than 0 (0.089, lower 95% CI: 0.86 and lower 95% CI: 0.92) indicates that it was appropriate to account for the over-dispersion using this model. The regression estimation results for the final model are presented in Table 3.3.

Physical Activity Regression Coefficients	Coefficient	Robust Std. Err.	P Value
Weekly Walk Time (mins)	0.0008	0.0000	0.0000
Weekly Bike Time (mins)	0.0011	0.0001	0.0000
Gender = Male	-0.1714	0.0174	0.0000
Car/Van = Not Available	0.0971	0.0459	0.0340
Age Band	-0.0231	0.0114	0.0430
Econ. Status = Unemployed	-0.3285	0.0595	0.0000
Econ. Status = Retired	-0.6207	0.1139	0.0000
Econ. Status = Other Inactive	-0.4492	0.1291	0.0010
Interaction(Age#Econ. Status)	-0.0080	0.0063	0.2090
Interaction(Car/Van Available#Age Band)	-0.0978	0.0208	0.0000
Constant	7.1454	0.0469	0.0000
Inflation Model Coefficients			
Car/Van = Not Available	0.7415	0.0534	0.0000
Econ. Status = Unemployed	0.6343	0.1539	0.0000
Econ. Status = Retired	2.5688	0.0672	0.0000
Econ. Status = Other Inactive	1.9267	0.0775	0.0000
Constant	-3.2899	0.0596	0.0000
Overdispersion Parameter			
ln(alpha)	-0.1133	0.0142	0.0000
alpha	0.8929	0.0127	-

Table 3.3 Physical activity related to walking and cycling from HSE – regression results

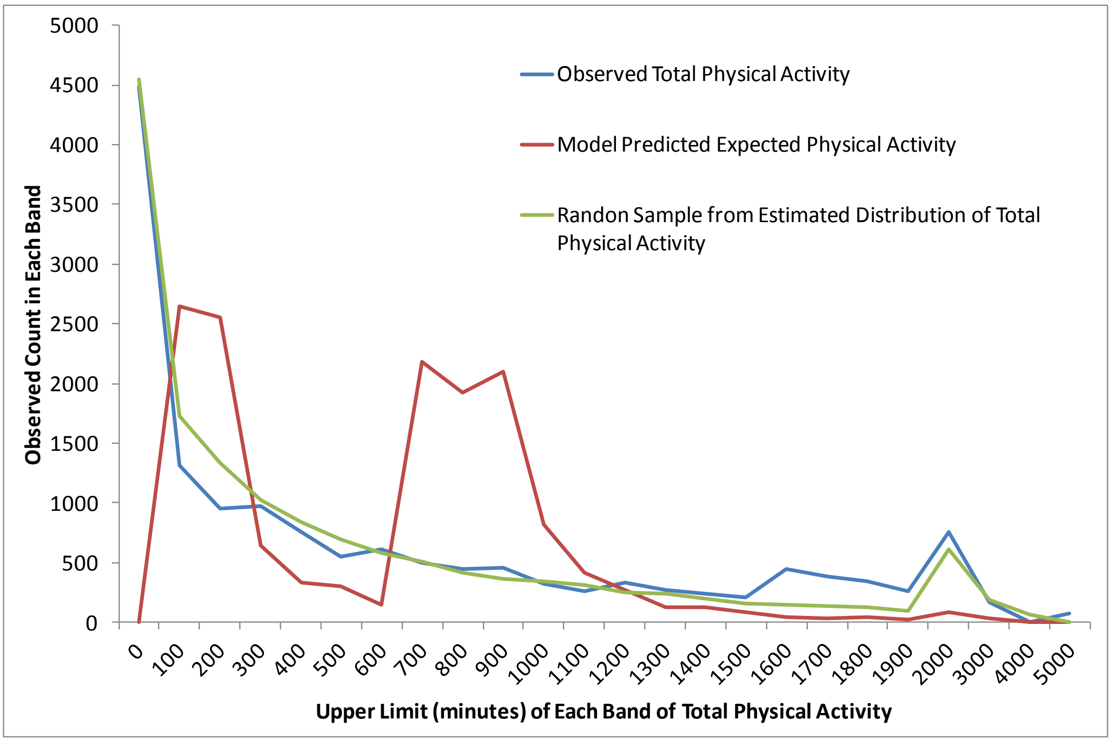

Figure 3.5 Physical activity regression, comparison of observed, expectation and randomly sampled values

3.8 Estimating Change in Driving given Evidence on Walking/Cycling using Statistical Models: National Travel Survey

Using the National Travel Survey, we constructed statistical models relating a person's level of walking and cycling to various measures of driving behaviour, including:

- Weekly total distance of car travel
- Weekly total time driving
- Weekly total number of car trips

These were then incorporated into the model in order to adjust an individual's driving behaviour following an intervention targeted at either walking or cycling, or both.

The measures of driving behaviour are derived from each individual's trip diary and only include the trips where this individual was driving, and not those for which they were a passenger. Data from the trip diaries were aggregated by purpose, mode, and purpose/mode combinations, and appended to the respective person from the individual database.

In addition to the three measures above, a regression model was developed that included trip purpose with mode in the predictors of car distance. Trip times were grouped based on a four-mode and six-purpose matrix. Coefficients were computed for time spent walking for each purpose (commuting, business, education, escort education, shopping, and leisure/other). Cycling times for commuting, shopping, and leisure/other were also included. This approach should be useful when considering interventions that are aimed at specific combinations of purpose and mode that are shown by the regression model to have an effect on driving time, for example, encouraging walking to school or cycling to work.

3.8.1 Car Distance Related to Walking, Cycling and Other Covariates

This outlines the modelling approach used to deriving the statistical relation between the total distance driven ('cardist') and other individual covariates available in the NTS. The procedure is also following when estimating models for the other measures of driving behaviour: time spent driving and number of trips.

From inspection of the data we found that the distribution of the amount of distance travelled in a car during the diary period displays a different form depending on the parameter 'carstatus', which records the level of car access a person has. We further found that the multiple categories of car access contained in 'carstatus' could be condensed into a binary variable which indicates whether a person has access to a car as a main driver. The two distributions of car distance, defined according to the new binary variable ‘caraccess’, have significant differences which proved to be difficult to capture by assuming a single distributional form for ‘cardist’. Therefore, we chose to assume a separate distribution for each of these groups and estimate two separate regression models.

For the group with access to a car as a main driver, the mean car distance is 83 miles and the variance is 175,009 miles. The over-dispersion does not appear due to excess zeros and we therefore assume a negative binomial distribution. We also banded the ‘cardist’ variable and plotted this against the Poisson and Negative Binomial distribution with the same mean and the same mean and dispersion respectively. The similarity of the observed distribution to the negative binomial provided further evidence for the appropriateness of the Negative Binomial distribution.

We restricted our choice of predictor variables, by only considering those that are available both in the HSE and the NTS. The potential predictor variables considered were:

Individual age, banded (variable id: i6a)
Gender (variable id: i3)
Ethnicity, white or non-white (variable id: ethnic)
Work status, bands include full time, part time, retired, etc (variable id: i77a)
Frequency of walking banded (variable id: ethnic)
Time spent walking
Frequency of bike rides (variable id: i265)
Whether they own a bike (variable id: i271)
Car access status, categories (variable id: i203)

The regression model was estimated using STATA/SE version 10.1. Likelihood ratio test were used to determine the most appropriate set of predictor variables for inclusion in the final model:

$$\log(\text{cardist}) = \beta_0 + \text{walktime} * \beta_1 + \text{biketime} * \beta_2 + I(\text{worker})_j * \beta_{3\,j} + I(\text{age band})_j * \beta_{4\,j} + I(\text{sex})_j * \beta_{5\,j} + I(\text{ethnic})_j * \beta_{6\,j}$$

The variables ‘worker’, ‘age’, ‘sex’ and ‘ethnic’ are categorical, while ‘walktime’ and ‘biketime’ are continuous. Worker categories are: in work, unemployed, retired, and student/home/other. The age bands categories are: 16-19, 20-29, 30-39, 40-49, 50-

59, 60-69 and 70+. Sex categories are: Male or female. Ethnic categories are: White or non-white.

Overall, the model is highly significant, as are all of the predictor variables. The Negative Binomial distribution is equal to the Poisson distribution when alpha, the dispersion parameter, is zero. As shown in the Table 3.4, zero is outside the 95% confidence intervals for alpha and the likelihood ratio test comparing this model with alpha = 0 shows that alpha is significant in this model. This strongly suggests that alpha is non-zero and the negative binomial model is more appropriate than the Poisson model. The regression estimates are presented in Table 3.4.

Physical Activity Regression Coefficients	Coefficient	Robust Std. Err.	P Value
Weekly Walk Time (mins)	-0.00002	0.00006	0.7490
Weekly Bike Time (mins)	-0.00100	0.00015	0.0000
Worker = Unemployed	-0.31142	0.04302	0.0000
Worker = Retired/Sick	-0.56538	0.01257	0.0000
Worker = Student/Home/Other	-0.33813	0.02006	0.0000
Age Band = 30-49	0.10075	0.01376	0.0000
Age Band = 50+	0.03147	0.01497	0.0360
Gender = Female	-0.43070	0.00875	0.0000
Ethnicity = non-white	-0.32902	0.02219	0.0000
Constant	7.48580	0.01308	0.0000
Overdispersion Parameter			
ln(alpha)	0.28262	0.00914	-
alpha	1.32661	0.01212	-

Table 3.4 Regression estimates for predictor variables of car distance travelled from the NTS for the group with access to a car as a main driver.

In the next step, we estimated the model for the group without access to a car as a main driver. Within this group we found a large number of zero observations. However, the non-zero observations are not constrained to being small values and some of these people do in fact have very high drive distances. To allow for both the over-dispersion and the excess zeros, as for the physical activity model using the HSE, we assume a zero inflated negative binomial distribution.

For the group of people who do not have access to a car as a main driver, by comparing models using likelihood ratio tests, we selected the final model:

$$\log(\text{cardist}) = \frac{\text{Linear Predictor(Negative Binomial)}}{\text{Linear Predictor(Inflation)} + 1}$$

Linear Predictor(Negative Binomial) = β_0 + walktime * β_1 + biketime * β_2 + $I(worker)_j$* $\beta_{3\,j}$ + $I(sex)_j$ * $\beta_{4\,j}$ + $I(ethnicity)_j$* $\beta_{5\,j}$ + $I(age\ band)_j$* $\beta_{6\,j}$

Linear Predictor(Inflation) = β_0 + $I(worker)_j$* $\beta_{2\,j}$ + $I(ethnicity)_j$ * $\beta_{3\,j}$

Although the category worker = 2 is not statistically significantly different from the reference category 1, testing the difference between other combinations of worker all show P < 0.0000 and therefore this variable is retained.

Overall the model is significant, as are all of the predictor variables except for the category worker = 2. As in the previous model, zero is outside of the 95% confidence intervals of alpha, indicating that the negative binomial distribution is more appropriate than the Poisson distribution.

Re-running the model without the survey weights allows the inclusion of the Vuong statistic, which provides a test of the zero inflated model versus the standard Negative Binomial model. The p value for the Vuong statistic is <0.0000 and indicates that the zero inflated model is more appropriate than the standard Negative Binomial model. The regression estimates are presented in Table 3.5.

Physical Activity Regression Coefficients	**Coefficient**	**Robust Std. Err.**	**P Value**
Weekly Walk Time (mins)	-0.0008	0.0002	0.0000
Weekly Bike Time (mins)	-0.0014	0.0004	0.0000
Age Band = 30-49	0.1135	0.0402	0.0050
Age Band = 50+	0.0311	0.0452	0.4920
Gender = Female	-0.7011	0.0299	0.0000
Ethnicity = non-white	-0.4022	0.0665	0.0000
Worker = Unemployed	-0.1017	0.1183	0.3900
Worker = Retired/Sick	-0.6096	0.0439	0.0000
Worker = Student/Home/Other	-0.2182	0.0511	0.0000
Constant	7.0766	0.0370	0.0000
Inflation Model Coefficients			
Ethnicity = non-white	0.8627	0.0530	0.0000
Worker = Unemployed	1.2137	0.0872	0.0000
Worker = Retired/Sick	1.5301	0.0314	0.0000
Worker = Student/Home/Other	1.1659	0.0396	0.0000
Constant	0.8359	0.0162	0.0000
Overdispersion Parameter			
ln(alpha)	0.1706	0.0118	0.0000
alpha	1.1861	0.0140	-

Table 3.5 Regression estimates for predictor variables of car distance travelled from the NTS for the group without access to a car as a main driver.

A further regression was run in which journeys were summarised by mode and purpose, so that it would be possible to fine-tune the predicted car time to account for interventions that affect a particular combination of mode and purpose, These may include for example workplace programmes to encourage employees to commute by bicycle. Results are summarised below, again separately for those individuals with or without access to a car as main driver.

		Robust	
	Coef.	Std. Err.	p
cardist			
wacotime	-0.0043093	0.0003762	0.0000
wabust	0.0009169	0.0004949	0.0640
waedut	0.0008157	0.0013308	0.5400
waescedut	-0.0027104	0.000341	0.0000
washopt	-0.0003329	0.0001779	0.0610
waothert	0.0002203	0.0000654	0.0010
cyccomt	-0.0035965	0.0003151	0.0000
cycbust	-0.0040126	0.00224	0.0730
cycedut	-0.0094917	0.001612	0.0000
_Iworker_2	-0.2010386	0.0409023	0.0000
_Iworker_3	-0.4400548	0.0140982	0.0000
_Iworker_4	-0.2311311	0.0237947	0.0000
_Isex_1	-0.4216409	0.0083202	0.0000
_Iethnic_1	-0.2425118	0.0206822	0.0000
_In_ageban~2	0.0650727	0.0130603	0.0000
_In_ageban~3	0.008836	0.0142519	0.5350
_Ihhincome_1	0.1428002	0.014491	0.0000
_Ihhincome_2	0.2981614	0.0208697	0.0000
wkxhhin	-0.0089287	0.0061433	0.1460
_cons	7.402567	0.0147911	0.0000
inflate			
_Iworker_2	0.4845056	0.1551	0.0020
_Iworker_3	0.4584069	0.0438734	0.0000
_Iworker_4	0.6366353	0.0676007	0.0000
_Iethnic_1	0.8405768	0.0686415	0.0000
_cons	-3.068784	0.0254629	0.0000
/lnalpha	-0.3106304	0.0079955	0.0000
alpha	0.7329847	0.0058606	

Table 3.6 Mode and purpose regression estimates of car distance travelled for the group without access to a car as a main driver.

	Coef.	Robust Std. Err.	p
cardist			
wacotime	-0.0044385	0.0004472	0.0000
wabust	0.0005246	0.0015643	0.7370
waedut	-0.0033347	0.0009731	0.0010
waescedut	-0.002515	0.0007643	0.0010
washopt	-0.0015309	0.0007584	0.0440
waothert	-0.0001252	0.0001877	0.5050
cyccomt	-0.0029845	0.0005547	0.0000
cycbust	-0.0070223	0.0021507	0.0010
cycedut	-0.0037823	0.0012809	0.0030
_Iworker_2	-0.0725272	0.1187964	0.5420
_Iworker_3	-0.5655061	0.0511906	0.0000
_Iworker_4	-0.1496827	0.0688427	0.0300
_Isex_1	-0.6969139	0.0296501	0.0000
_Iethnic_1	-0.3767963	0.0679518	0.0000
_In_ageban~2	0.1066527	0.0402282	0.0080
_In_ageban~3	0.0180466	0.0448271	0.6870
_Ihhincome_1	0.1348435	0.0494961	0.0060
_Ihhincome_2	0.2258664	0.072156	0.0020
wkxhhin	-0.0139526	0.0189629	0.4620
_cons	6.976987	0.0464894	0.0000
inflate			
_Iworker_2	1.214239	0.0872161	0.0000
_Iworker_3	1.530649	0.0314004	0.0000
_Iworker_4	1.166402	0.0396099	0.0000
_Iethnic_1	0.8628102	0.0530221	0.0000
_cons	0.8355504	0.0161789	0.0000
/lnalpha	0.1552871	0.0121255	0.0000
alpha	1.167993	0.0141625	

Table 3.7 Mode and purpose regression estimates of car distance travelled for the group with access to a car as a main driver.

Predictor variables in the regressions are abbreviated thus:

cardist	Total car distance
wacotime	walk time commuting
wabust	walk time business
waedut	walk time education
waescedut	walk time education escortir
washopt	walk time shopping
waothert	walk time other
cyccomt	cycle time commuting
cycbust	cycle time business
cycedut	cycle time education

3.8.2 *Car Time Related to Walking, Cycling and other Covariates*

The following regression results for the time spent driving were produced using a similar regression approach to that described for car distance, Section 3.8.1.

As for the previous model for car distance, for the purpose of this regression the population was split according to whether they had access to a car as a main driver. The regression estimates for those who do have car access as main driver are presented in Table 3.6 and for those without in Table 3.7. Both models were highly significant overall, with p values <0.0000. The usual statistical tests also supported the choice of both the Negative Binomial and the zero-inflated Negative Binomial models.

Physical Activity Regression Coefficients	Coefficient	Robust Std. Err.	P Value
Weekly Walk Time (mins)	-0.00016	0.00005	0.0010
Weekly Bike Time (mins)	-0.00095	0.00012	0.0000
Worker = Unemployed	-0.20506	0.03168	0.0000
Worker = Retired/Sick	-0.38751	0.00927	0.0000
Worker = Student/Home/Other	-0.23172	0.01469	0.0000
Age Band = 30-49	0.11743	0.00995	0.0000
Age Band = 50+	0.07585	0.01085	0.0000
Gender = Female	-0.24110	0.00639	0.0000
Ethnicity = non-white	-0.05492	0.01529	0.0000
Constant	5.91156	0.00953	0.0000
Overdispersion Parameter			
ln(alpha)	-0.10432	0.01075	-
alpha	0.90093	0.00969	-

Table 3.8 Stata output for negative binomial regression model of 'cartime' for group with access to a car as main driver

Physical Activity Regression Coefficients	Coefficient	Robust Std. Err.	P Value
Weekly Walk Time (mins)	-0.0008	0.0001	0.0000
Weekly Bike Time (mins)	-0.0015	0.0003	0.0000
Age Band = 30-49	0.1622	0.0300	0.0000
Age Band = 50+	0.0904	0.0331	0.0060
Gender = Female	-0.4699	0.0225	0.0000
Ethnicity = non-white	-0.0605	0.0486	0.2130
Worker = Unemployed	-0.0871	0.0713	0.2220
Worker = Retired/Sick	-0.4665	0.0338	0.0000
Worker = Student/Home/Other	-0.1880	0.0371	0.0000
Constant	5.5226	0.0279	0.0000
Inflation Model Coefficients			
Ethnicity = non-white	0.8638	0.0530	0.0000
Worker = Unemployed	1.2131	0.0872	0.0000
Worker = Retired/Sick	1.5309	0.0314	0.0000
Worker = Student/Home/Other	1.1659	0.0396	0.0000
Constant	0.8382	0.0162	0.0000
Overdispersion Parameter			
ln(alpha)	-0.2491	0.0186	0.0000
alpha	0.7795	0.0145	-

Table 3.9 Stata output for negative binomial regression model of 'cartime' for group without access to car as main driver.

3.8.3 Number of Trips by Car Related to Walking, Cycling and other Covariates

The following regression results for the number of car trips were produced using a similar regression approach to that described for car distance, Section 3.8.1.

As for the previous model for car distance, for the purpose of this regression the population was split according to whether they had access to a car as a main driver. The regression estimates for those who do have car access as main driver are presented in Table 3.8 and for those without in Table 3.9. Both models were highly significant overall, with p values <0.0000. The usual statistical tests also supported the choice of both the Negative Binomial and the zero-inflated Negative Binomial models.

Physical Activity Regression Coefficients	Coefficient	Robust Std. Err.	P Value
Weekly Walk Time (mins)	-0.00058	0.00004	0.0000
Weekly Bike Time (mins)	-0.00102	0.00013	0.0000
Worker = Unemployed	-0.03973	0.02804	0.1570
Worker = Retired/Sick	-0.18417	0.00823	0.0000
Worker = Student/Home/Other	-0.05954	0.01266	0.0000
Age Band = 30-49	0.16529	0.00832	0.0000
Age Band = 50+	0.09304	0.00905	0.0000
Gender = Female	0.00607	0.00541	0.2630
Ethnicity = non-white	-0.13199	0.01385	0.0000
Constant	2.72736	0.00791	0.0000
Overdispersion Parameter			
ln(alpha)	-0.85754	0.01040	-
alpha	0.42420	0.00441	-

Table 3.10 Stata regression output for the number of journeys for the group with access to a car as main driver.

Physical Activity Regression Coefficients	Coefficient	Robust Std. Err.	P Value
Weekly Walk Time (mins)	-0.0013	0.0001	0.0000
Weekly Bike Time (mins)	-0.0017	0.0003	0.0000
Age Band = 30-49	0.4335	0.0304	0.0000
Age Band = 50+	0.3217	0.0328	0.0000
Gender = Female	-0.1804	0.0205	0.0000
Ethnicity = non-white	-0.1127	0.0463	0.0150
Worker = Unemployed	-0.0097	0.0763	0.8980
Worker = Retired/Sick	-0.3220	0.0305	0.0000
Worker = Student/Home/Other	-0.1199	0.0379	0.0020
Constant	2.1406	0.0295	0.0000
Inflation Model Coefficients			
Ethnicity = non-white	0.8686	0.0537	0.0000
Worker = Unemployed	1.2204	0.0886	0.0000
Worker = Retired/Sick	1.5357	0.0319	0.0000
Worker = Student/Home/Other	1.1628	0.0403	0.0000
Constant	0.7557	0.0171	0.0000
Overdispersion Parameter			
ln(alpha)	-0.4402	0.0370	0.0000
alpha	0.6439	0.0238	-

Table 3.11 Stata regression output for the number of journeys for the group without access to a car as main driver.

3.9 General Approach to Incorporating Interventions' Effectiveness Evidence and Cost Evidence into the Model

3.9.1 Types of Outcomes Reported by Effectiveness Studies

The most common outcome reported in the effectiveness studies was a change in a measure of walking or cycling or both. In some studies, there were also measures of overall physical activity. Travel behaviours were reported in terms of active travel, measured as time spent, distance travelled or number of trips made. Occasionally, outcomes were health related, including mortality, cardio-respiratory fitness, reduction in blood pressure, and changes in weight or body mass index (BMI). A small number of studies reported well-being or quality of life measures as outcomes.

3.10Selection of Interventions for Modelling

Following consultation with the Economic Sub-group members and PDG, four main intervention types were selected for modelling. These were:

6. Multi-component Interventions including Cycling Demonstration Towns, and Sustainable Travel Towns
7. Personalised Travel Advice - TravelSmart,
8. Pedometer interventions
9. Community based led walks

In addition, a series of what-if analyses was undertaken to see what level of cost is justifiable for interventions with particular levels of effect.

3.11 Specific Intervention Effectiveness Estimates

3.11.1 Multi-Component - Cycling Demonstration Towns

3.11.1.1 Effectiveness Evidence

Analysis of data from the Cycling Demonstration Towns project [Sloman, 2009], reported an annual 4% increase in the number of cyclists, and an increase in the number of cycle trips of 27% by 2009, compared with the baseline in 2005. The percentage of adults who cycled regularly rose, and those who were classified as inactive fell from 26.2% to 23.6%. The effectiveness data are summarised in Table 3.610.

	Before	After	Absolute change	Relative Change
Percentage inactive	26.2%	23.6%	-2.6%	-9.92%
New cyclists				4%
Extra journeys				27%
% cycling 30+ minutes once a month	11.8%	15.0%	3.2%	27.12%
% cycling 30+ minutes 12+ times per month	2.6%	3.5%	0.9%	34.62%

Table 3.62 Cycling Demonstration Towns: key effectiveness evidence.

3.11.1.2 Assumptions used to transform effectiveness evidence to inputs needed for the model

- All age/gender bands have a 2.6% absolute increase in proportion doing two hours per week physical activity.
- There is a lifetime persistence in increase in physical activity

3.11.1.3 Inputs Used in the Model

To determine health outcomes, the derived change in the measure of physical activity in the Cycling Demonstration Towns was applied to all adults in the HSE. For environmental outcomes related to driving levels, the reported change in cycle journeys was used in the regression model to derive the expected change in distance driven.

3.11.2 Multi-Component – Sustainable Travel towns

3.11.2.1 Effectiveness Evidence

The key evidence from the Economic Appraisal by the DfT, relates to walking and cycling increases (13.1% and 26.1% respectively), which can be incorporated into the health model. Also available is evidence on the reduction in car/motorcycle trips (-8.4%).

Effectiveness Evidence				
Intervention:	Sustainable travel towns			
Study	Economic Appraisal of the Sustainable travel towns by DfT			
Summary: Darlington, Peterborough and Worcestor received funding over 4 years to promote sustainable travel, including walkking and cycling infrastructure, Smarter Choices personalised travel planning, promotion of active modes and 'soft				
Summary of effects (see Table 3)	Trips per annum (Thousand)			
	2004	2008	Change	% Change
Walk	76,621	86,687	10,066	13.1%
Cycle	10,800	13,622	2,822	26.1%
Car + Motorbike Driver	139,417	127,648	-11,769	-8.4%
Car Passenger	70,408	66,232	-4,176	-5.9%
Bus and other Public Transport	24,410	27,756	3,346	13.7%
Total	321,656	321,945	289	0.1%

Table 3.73 Sustainable Travel Towns key effectiveness evidence

For the model, the increase in the number of walking and cycling trips needed to be converted to the corresponding increase in walking and cycling time. For this, the NTS trip diary was used to compute average time per trip, from the total time and number of trips. The observed increase in trip numbers was then multiplied by the average trip time to give an implied increase in the weekly walking and cycling time. It was presumed that new trips were similar in duration to the existing average.

3.11.2.2 Assumptions to transform effectiveness evidence to inputs for the model

Assumptions to Convert % Increase in Trips into Bike Time and Walktime		
Walking		
Mean walktime per week	44.70	NTS average
Percentage increase	13.1%	
Implied increase in walk time	5.87	
Cycling		
Mean biketime per week	5.25	NTS average
Percentage increase	26.1%	
Implied increase in cycle time	1.37	
Note: The study assumed a 40% decay rate and also modelled trends in different numbers of trips e.g. See Figure 1		

Table 3.84 Assumptions to transform Sustainable Travel Towns evidence into walk-time and bike-time increases.

Another way of examining the effects of Sustainable Travel Towns uses the evidence available on % increases in cycling distance (28% to 32%) and walking distance (18% to 27%) rather than trip numbers.

Effectiveness Evidence				
Intervention:	Sustainable travel towns			
Study	The Effects of Smarter Choice programmes in the Sustainable Travel towns: Summary Report			
	http://assets.dft.gov.uk/publications/the-effects-of-smarter-choice-programmes-in-the-sustainable-travel-towns-summary-report/summaryreport.pdf			
Summary: Darlington, Peterborough and Worcestor received funding over 4 years to promote sustainable travel, including walkking and cycling infrastructure, Smarter Choices personalised travel planning, promotion of active modes and 'soft measures' for piblic transport.				
Summary of effects (see Table 3 and 4)				
% Increase in Cycling Distance per Person	28% to 32%			
We assume	30.0%			
% Increase in Walking Distance per Person	18% to 27%			
We assume	22.5%			

Table 3.95 Sustainable Travel Towns alternative evidence formulation based on percentage increase in distances rather than trips.

Again, the mean trip time and distance from the NTS was used to convert these distance increases into an implied increase in time for use in the model.

Assumptions to Convert % Increase in Distance into Bike Time and Walktime		
Mean Trip Time and Distance from NTS		
Walking		
Mean walktime per week	44.70	
Mean distance per week	3.15	miles
Mean speed per mile	4.23	mph
Implied mean absolute increase in walk distance per person	0.71	miles
Implied mean absolute increase in walk time per person	10.06	mins
Cycling		
Mean biketime per week	5.25	
Mean distance per week	0.66	miles
Mean speed per mile	7.50	mph
Implied Mean absolute increase in cycle distance per person	0.20	miles
Implied Mean absolute increase in cycle time per person	1.58	mins

Table 3.106 Assumptions to convert Sustainable Travel Towns percentage increase in distance into model inputs in terms of mean distance increase.

3.11.3 Personalised Travel Support – TravelSmart

3.11.3.1 Effectiveness Evidence

Evidence for the effectiveness of the TravelSmart programme come in the form of increases in walking and cycling, decrease in car trips, and increases in sustainable travel trips as shown in the table below

Calculations on Effects				
Area	Relative change (where reported)			
	Increase in walking	Increase in cycling	Decrease in car trips	Increase in sustainable travel trips
East Inverness			-13%	19%
Cramlington			-11%	17%
Doncaster	29%	14%	-13%	29%
Sheffield			-12%	15%
Nottingham			-12%	20%
Peterborough			-11%	16%
Lowestoft	19%	19%		
Ipswich *				
Broxbourne*				
Watford	20%	33%		
London (Kingston)			-14%	17%
Exeter	18%	33%		
Bristol (Windmill Hill and Southville)			-10%	10%
Bristol (Bishopston)			-11%	9%
Gloucester (Quedgeley)			-12%	18%
Gloucester (Barton, Tredworth and White City)	18%	16%	-13%	17%
Worcester			-10%	12%
Preston and South Ribble	11%	35%	-10%	11%
Lancaster City & Morecambe	18%	69%	-14%	19%
Population weighted avarage	19.8%	32.1%	-11.9%	17.4%

Table 3.117 Estimated weighted average effectiveness for TravelSmart

3.11.3.2 Assumptions to Transform Effectiveness Evidence to Model Inputs

Once again, the average trip lengths from the NTS were used to transform the evidence into inputs suitable for the model.

Assumptions to Convert % Increase in Trips into Bike Time and Walktime		
Mean Trip Time from NTS	Mean walktime per week	
Walking		
Mean walktime per week	44.70424348	
Mean No of trips	1.820407888	
Mean Walk time per trip	24.5572675	
Implied Mean absolute increase in walk time per person	4.856881795	
Cycling		
Mean biketime per week	5.252820505	
Mean No of trips	0.27	
Mean Biketime per trip	19.38681798	
Implied Mean absolute increase in bike time per person	6.225322663	

Table 3.128 Assumptions used to transform effectiveness evidence on TravelSmart to inputs needed for the model

3.11.4 Pedometer Interventions

3.11.4.1 Effectiveness Evidence

We model three scenarios of evidence around pedometers.

1. UK trial of pedometer use with most of the support in first 4 weeks

2. UK trial of more sustained support for pedometer use

3. Larger sample size Australian trial of pedometers

For the first two studies by Baker (2008a&b), effectiveness was measured as an increase in the number of steps taken from baseline compared with the control group. This was converted to extra minutes walking by equating 3,100- 4,000 steps to 30 minutes of walking. In the Australian trial by Merom (2007) outcomes were reported as walking sessions, which could be directly converted to times to give an indication of the percentage considered active or inactive. The tables below summarise the key evidence.

Effectiveness Evidence				
Intervention:	Pedometers			
Study	Baker 2008a			
Summary: RCT of pedometers. Most of the intervention takes place over the first 4 weeks, but follow up is over 52 weeks				
Sample Size	n=26	n=24		
	No. of steps per week		Relative change from baseline	
Week	Control with sealed pedometers	Pedometer	Control with sealed pedometers	Pedometer
0	69,171	62,065	1.00	1.00
1		75,722		1.22
2		78,041		1.26
3		84,315		1.36
4	86,820	94,219	1.26	1.52
16	84,612	86,953	1.22	1.40
52	63,084	64,549	0.91	1.04
Week	No of weeks	Increase in mean steps per week over baseline	Area under curve	Mean increase in steps per week
0		0		
1	1	13,657	6,828.5	
2	1	15,976	14,816.5	
3	1	22,250	19,113.0	
4	1	32,154	27,202.0	
16	12	24,888	342,252.0	
52	36	2,484	492,696.0	
			902,908.0	17,364
Convert Additional Steps to Additional Walktime				
3100 to 4000 steps equates to 30 min walk	Implied steps per hour		Implied added hours of walking	Implied added Minutes of walking
	7,100		2.45	146.73

Table 3.139 Summary of effectiveness from UK trial of pedometers (main resource input over first 4 weeks of intervention)

Study	Baker 2008b + Personal Communication on Longer Term Follow-Up			
Summary: RCT of pedometers with support and advice at weeks 12,24 and 36. Thus providing additional information on sustained support and use.				
Sample Size	n=39	n=40		
	No of Steps per Day		Relative change from baseline	
Week	Control	Walking programme + pedometer	Control	Walking programme + pedometer
0	6,924	6,802	1.00	1.00
12	7,078	9,977	1.02	1.47
24		9,201	-	1.35
48		8,678	-	1.28
Additional Information from point where control group crossed over to intervention receive intervention after 12 weeks in original study				
	No of Steps per Day		Relative change from baseline	
Week		Control group given interv'n at 12 weeks		
0		7,078		1.00
12		8,693		1.23
24		8,417		1.19
48		8,208		1.16
Week	No of weeks	Increase in mean steps per week over baseline	Area under curve	Mean increase in steps per day
0		0		
12	12	3,175	19,050.0	
24	12	2,399	33,444.0	
48	24	1,876	51,300.0	
			103,794.0	2,162
Mean increase in steps per day				15,137
Convert Additional Steps to Additional Walktime				
3100 to 4000 steps equates to 30 min walk	Implied steps per hour		Implied added hours of walking	Implied added Minutes of walking
	7,100		2.13	127.92
Sustained level of Effect Assumtpion				
Mean Increase in Steps per Day over Year 1				2,162
Mean Increase in Steps per Day Maintained beyond Year 2				1,876
Implied Sustained level of effect after decay				86.8%

Table 3.20 Effectiveness evidence from UK trial to support sustained use of pedometers

Effectiveness Evidence					
Intervention:	Pedometers				
Study	Merom 2007				
Summary: RCT of 3 arms - Control, Walking program alone and pedometers with walking programmes. Large sample size. Set in Australia. Follow up 3 months.					
Sample Size	n=123	n=123	n=123		
				Relative change from baseline	
Australia	Control	Walking programme	Walking programme + pedometer	Control	Walking programme + pedometer
Walking sessions undertaken					
0	2.54	2.8	2.36	1.00	1.00
12	3.74	4.1	4.66	1.47	1.97
Difference 0 to 12	1.2	1.3	2.3		
				-	-
Mins all purpose walking per week					
0	69	59	63	1.00	1.00
12	112	114	115	1.62	1.83
Difference 0 to 12	43	55	52		
>=150 mins activity					
0	16.30%	17%	16.30%	1.00	1.00
12	31.70%	31.70%	39.00%	1.94	2.39
Difference 0 to 12	15.40%	14.70%	22.70%		

Table 3.14 Effectiveness evidence for larger Australian trial of pedometers (3 months follow up)

3.11.5 Led Walking Interventions

3.11.5.1 Effectiveness Evidence

For led walks, the evidence was presented as the percentage of participants who became active compared with the baseline.

Effectiveness Evidence				
Intervention:	Led Walking			
Study	Lamb 2001			
Summary: RCT of led walking "health walks" versus advice only. Sample size n=260 across 2 arms. Follow up = 12 months.				
Sample Size	n=131	n=129		
	% partcipants achieving 120 mins		Relative change from baseline	
Week	Advice	Health walks	Advice	Health walks
0	3.1%	2.3%	1.00	1.00
26	24.4%	17.2%	7.87	7.48
52	26.6%	31.0%	8.58	13.48
Absolute Increase in % of people active who were previously inactive				
Week	Advice	Health walks		
0	0.0%	0.0%		
26	21.3%	14.9%		
52	23.5%	28.7%		

Table 3.152 Summary of effectiveness evidence from UK trial of led walking.

3.12Specific Interventions: Cost Estimates and Assumptions

3.12.1 Costing Multi-component Intervention - Cycling Demonstration Towns

Costs for the Cycling Demonstration Towns were taken from the published economic evaluation (Cope 2010).

Cost Evidence				
Intervention:	Cycling Demonstration Towns			
Study	Cycling Demo Towns (Ref)			
Descriptions of Cost Items				
http://www.etcproceedings.org/paper/cycling-demonstration-towns-an-economic-evaluation				
investment programme (£18 million over three years). The towns received funding of £500,000 per year (approximately £5 per head of population per year), starting in October 2005, and matched by the respective local authorities so that the total level of investment in cycling was at least £10 per head per year. This represented a substantially higher level ofinvestment than the English local authority average, which, at the beginning of the programme, was closer to roughly £1 per head per year. This represented a substantially higher level of investment than the English local authority average, which, at the beginning of the programme, was closer to roughly £1 per head per year				
Annual cost per person (Central Government) of £5 per annum plus matched funding from local towns over 3 years implies mean cost of £30 per person over 3 years. Hence, an implied population of the 6 towns of 600,000				
Costs Assumptions / Calculations	Unit Cost	Number of Units	Implied Cost per particpant	No of people
Total Cost	£ 18,000,000	1	£ 30.00	600,000

Table 3.163 Estimated costing for Cycling Demonstration Towns

3.12.2 Costing Multi-Component Intervention – Sustainable Travel Towns

Cost evidence for Sustainable Travel Towns was taken from the Economic Appraisal published by the Department for Transport.

Cost Evidence	
Intervention:	Sustainable travel towns
Study	Economic Appraisal of the Sustainable travel towns by DfT
Population (see Table 1)	316,000
Table 10 Scheme Costs	
2004/5	£ 2,338,070
2005/6	£ 3,303,445
2006/7	£ 3,989,989
2007/8	£ 3,759,921
Total	£ 13,441,425
PVC (after discounting)	£ 12,226,441
PVC(after market price adjustment)	£ 14,830,091
Implied Cost per Individual	£ 46.93

Table 3.174 Costing multi-component intervention – Sustainable Travel Town

3.12.3 Costing Personalised Travel Support - TravelSmart

Cost Evidence				
Intervention:	TravelSmart			
Study	TravelSmart			
Leading the way in travel behaviour change	Unit Cost per household	£ 20.00		
Information sheet FF36				
http://www.sustrans.org.uk/assets/files/travelsmart/behaviour_change_ff36.pdf				
TravelSmart project review	Unit Cost per household	£ 25.00		
Sept 2009				
http://www.sustrans.org.uk/assets/files/travelsmart/TravelSmart%20Project%20Review.pdf				

3.12.4 Costing Pedometer Interventions

The following tables present four sets of costing estimates for use in the modelling scenarios. Costs were estimated for the Baker studies, and supplemented by evidence from Shaw (2011) when this was published

Cost Evidence				
Intervention:	Pedometers			
Study	Baker 2008a			
Descriptions of Cost Items				
Weekly meetings in first 4 weeks including suggestions for goals				
Pedometer				
Briefing Session at 4 weeks (including option to buy pedometer at a discounted price)				
Costs Assumptions / Calculations	Unit Cost	Number of Units	Implied Cost	
		Hrs		
15 Mins initial briefing (Cost of staff / hour from Unit Costs of Health and Social Care 2011 Equivalent to physiotherapy salary £22,700)	£ 31.00	0.25	£ 7.75	
3 * 15 mins session (weeks 1,2,3)	£ 31.00	0.75	£ 23.25	
Half hour final briefing	£ 31.00	0.50	£ 15.50	
Subtotal Staff Time				
Pedometer	£ 6.00	1	£ 6.00	
Subtotal Staff Time				£ 46.50
Subtotal Other Costs				£ 6.00
Resulting Cost estimate per person			£ 52.50	

Table 3.185 Cost estimates for pedometer study Baker, 2008a

Cost Evidence				
Intervention:	Pedometers			
Study	Baker 2008b + Longer term Follow Up			
Descriptions of Cost Items				
Initial Consultation				
Pedometer				
"Walking Program"				
Relapse Consultation at 12 weeks				
Leaflet given at 24 weeks				
Support Telephone Call at 36 weeks				
Costs Assumptions / Calculations	Unit Cost	Number of Units	Implied Cost	
	Cost of staff (Equiv to physio / health promotion worker)	Hrs		
30 Mins initial briefing	£ 31.00	0.50	£ 15.50	
Pedometer	£ 6.00	1	£ 6.00	
Relapse Consultation at 12 weeks	£ 31.00	0.50	£ 15.50	
24 week leaflet	£ 1.00	1	£ 1.00	
Phone Call at 36 weeks				
Staff Time (assume 15 mins)	£ 31.00	0.25	£ 7.75	
Call Cost	£ 1.00	1	£ 1.00	
Subtotal Staff Time				£ 38.75
Subtotal Other Costs				£ 8.00
Resulting Cost estimate per person (Year 1)			£ 46.75	
Resulting Cost estimate per person (Year 2 and beyond assuming 12,24,36 week contact as in Y1)			£ 25.25	
Resulting Cost estimate per person (Year 2 and beyond assuming 24,36 week contact as in Y1)			£ 9.75	

Table 3.196 Cost Estimates for pedometer study Baker 2008b and its longer term follow-up to 12 months

Cost data from	Shaw	Min			Max
	Unit cost	Number of Units	Implied Cost	Number of Units	Implied Cost
Consultation	£17.50	0.08	£1.46	0.50	£8.75
Pedometer	13	1.00	£13.00	1.00	£13.00
Walking programme	£1.00	1.00	£1.00	1.00	£1.00
Relapse prevention	£17.50	0.08	£1.46	0.50	£8.75
Physical activity advice leaflet	£0.16	0.00	£0.00	1.00	£0.16
Follow up call	£17.50	0.08	£1.46	0.13	£2.33
		Yr1	£18.38		£33.99
		yr2	£1.46		£11.24

Table 3.207 Cost estimates for pedometer study Baker 2008b and its longer term follow-up to 12 months using cost data from Shaw (2011)

Cost Evidence				
Intervention:	Pedometers			
Study	Merom 2007 Australia			
Descriptions of Cost Items				
Booklet Step-by-Step				
6 * Postcard walking diaries				
20 minute telephone interview at baseline				
20 minute telephone interview at 3 motnhs				
Costs Assumptions / Calculations	Unit Cost	Number of Units	Implied Cost	
		Hrs		
Booklet (Step-by-Step) (assumed £5)	£ 5.00	1	£ 5.00	
Prepaid poastage postcard walking diary	£ 1.00	6	£ 6.00	
Pedometer	£ 6.00	1	£ 6.00	
20 minute telephone interview at baseline	£ 31.00	0.33	£ 10.33	
20 minute telephone interview at 3 months	£ 31.00	0.33	£ 10.33	
Telephone Call Costs	£ 1.00	2	£ 2.00	
Subtotal Staff Time				£ 20.67
Subtotal Other Costs				£ 19.00
Resulting Cost estimate per person			£ 39.67	
Comparison with Australian Cost Estimate				
Australian $ 2007 estimate in published article			$ 33.00	
Conversion to UK £ factor			0.68	
Estimate UK 2007 Cost			£ 22.37	
Inflation factor at 3% * 5 years			1.16	
Implied UK cost			£ 25.93	

Table 3.218 Cost estimates for pedometer study Merom 2007 (Australia)

3.12.5 Costing Led Walking Interventions

Cost Evidence	
Intervention:	Led Walking
Study	Lamb 2001
Descriptions of Cost Items in Trial	
Recruiting to the Led Walking Scheme	
Trial took place in one GP practice with list size 26,500. Target population = 40-70 years olds who are 'inactive' (<2 hours moderate physical activity). 2000 people aged 40-70 were randomly invited. 483 responded as willing. When offered 260 were actually willing to be (and were) randomised. Cost is therefore Questionnaire mailed out to 2000 40-70 yr olds on GP list and analysed to see if 'inactive'	
"Advice" Arm of trial	
Physio advice for 10 to 20 people (30mins)	
General Written guidance	
Self-sought advice from their own GP through the time of the programme	
"Led walking" Arm of trial	
Physio advice for 10 to 20 people (30mins)	
General Written guidance	
Self-sought advice from their own GP through the time of the programme	
Telephone call from co-ordinator within 2 weeks	
Walks are led by trained volunteers	
"Walk pack" including routes and calibrated times (Information on Health Walks within local area with info on public transport, car parks and creche facilities)	
3 support telephone calls max per annum	

Table 3.229 Description of key cost items in Lamb 2001 led walking trial

Cost Evidence				
Intervention:	Led Walking			
Study	Lamb 2001			
Costs Assumptions / Calculations for Led Walking	Unit Cost	Number of Units	Implied Cost per particpant	No of people
Upfront Cost of Volunteer Training per Participant				
Assume a 3 hour session, 4 times a year to train the volunteers needed for 260 walkers	£ 31.00	12	£ 1.43	260
Upfront Cost of recruitment per Participant		Questionnaires		
Questionnaire mailed out to 2000 40-70 yr olds on GP list and analysed to see if 'inactive'. Of whom 260 took up the offer. Assumed cost per questionnaire of £2 in base case. Hence cost per uptaker = £2*2000/260. (Might consider using £5 as upper sensitivity)	£ 2.00	2000	£ 15.38	260
Direct Costs per Participant		Hrs		
Physio advice for 10 to 20 people for 30mins (Assumed 1 hour preparation / travel time for physio and 15 people in a session)	£ 31.00	1.50	£ 3.10	15
Self Sought advice from GP (Per surgery consultation lasting 11.7 minutes) NB No information reported in publication on how many took place. we assume this is zero i.e. Only takes place in GP consultations that would happen anyway for other reasons	£ 36.00	0	£ -	
Written Guidance Booklet	£ 5.00	1	£ 5.00	
Walk Pack	£ 5.00	1	£ 5.00	
3 support telephone calls max per annum (assumed 2 each at 15 mins)		Hrs		
2*15 minute telephone support call (staff time)	£ 31.00	0.50	£ 15.50	
Telephone Call Costs	£ 1.00	2	£ 2.00	
Subtotal Staff Time				£ 20.03
Subtotal Other Costs				£ 27.38
Resulting Cost estimate per person			£ 47.42	

Table 3.30 Estimate of costs per participant in Lamb 2001 led walking trial

Comparison with Cost estimate from Derbyshire	Unit Cost	Number of Units	Implied Cost per particpant	No of people
For a population of 750,000, approx half aged 40-70, Derbyshire PCT report spending £50,000 to recruit 1672 walkers through 8 local authorities. (NB Walkers did a total of 28,197 contracted walking hours in the year)				
Cost of scheme in Derbyshsire	£ 50,000.00	1	£ 29.90	1,672
Difference from 'bottom up' estimate			-£ 17.51	
			-37%	

Table 3.31 Comparison of estimated costs in Lamb 2001 led walking trial with Derbyshire PCT led walking programme 2011.

3.13 Monetary Valuation of Environmental Outcomes

Where the evidence was available, we estimated the change in distance driven, given changes in walking or cycling, using a regression model for the NTS data. This change in vehicle kilometres is the basis for the DfT monetary valuation of environmental outcomes (Department for Transport, TAG Unit 3.5.4 Cost Benefit Analysis).

For congestion, the NTM uses a set of speed-flow curves to calculate the time lost relative to free flow conditions for each additional vehicle using a road. When a road is relatively free of congestion, each additional vehicle has little effect on the average speed. As the road becomes more congested, extra vehicles have a much larger effect, and journey times increase. The NTM combines the delays with values of time for road users, to give a monetary cost of the delay caused by each additional vehicle.

Estimates of the marginal costs associated with accidents, infrastructure damage, noise air quality and greenhouse gases are taken from Sansom *et al.*(2001), and, like congestion costs, are expressed as the cost per vehicle kilometre. A summary of the costs used by the DfT is shown below.

Table A1: Marginal external costs for cars (p/km, 2010, 2002 prices)

		Conurbations			Other urban			Rural			
Cost type	Congestion band	M'ways	A roads	Other Rds	M'ways	A roads	Other Rds	M'ways	A roads	Other Rds	Weighted-Average
Congestion	Average	5.7	53.4	26.2	n/a	22.2	5.6	3.9	2.1	5.5	13.1
Infrastructure	All	0	0.1	0.1	n/a	0.1	0.1	0	0.1	0.1	0.1
Accident	All	0	2.9	2.9	n/a	2.9	2.9	0	0.7	0.7	1.5
Local Air	All	0.7	0.9	1	n/a	0.5	0.5	0.3	0.2	0.2	0.4
Noise	All	0.2	0.2	0.2	n/a	0.2	0.2	0	0	0.1	0.1
Greenhouse Gases	All	0.3	0.4	0.4	n/a	0.3	0.3	0.3	0.3	0.3	0.3
Indirect Taxation	All	-3.7	-4	-4.7	n/a	-3.3	-4.2	-3.9	-3.1	-3	-3.6
Total	All	3.2	54	26.2	n/a	22.9	5.5	0.6	0.3	3.8	11.9

Table 3.23 Extract from Department of Transport valuation

http://www.dft.gov.uk/webtag/documents/expert/unit3.9.5.php#04

QALYs and Discounting

Mean EQ5D by gender and 5-year age bands were taken from Kind et al.

Health costs were discounted by 3.5% per annum as indicated by NICE CPHE Method Manual.

3.14 Model to Integrate Data and Evidence

The HSE was used as a representative sample of the population of England. Individuals were used to populate the model with values for selected relevant demographic variables. These included age, gender, employment status, and whether the individual had access to a car. Also included were walking, and physical activity levels, together with a number of biometric indicators related to physical activity. A summary of individuals, grouped by age and gender, was also produced. This allowed the calculation of the percentage of active and inactive in each group, and the application, where appropriate, of effectiveness and relative risk evidence at group level.

The NTS provided data on individuals, with an associated week-long trip diary. Data for seven consecutive years of the survey were used. The individual data contained details of age, gender work status and access to a car, thus providing a link with the HSE. The trip diaries for each individual were aggregated to provide a summary of the number of weekly trips made, with average times and distances, by mode and purpose. The trip modes and purposes given in the NTS were concatenated to four modes and six purposes. Mode categories were grouped into walking, cycling, car, and other; with purposes grouped into commuting, business, education, escort education, shopping, and leisure/other.

3.15 Some Key Limitations on Model Approach

Clearly, some assumptions need to be made in producing a model from a large variety of evidence sources that publish different and partially reported outcomes.

The key assumptions / limitations are as follows.

- We assume the Anderson et al. Copenhagen study accurately represents the risk reductions in mortality for increased levels of physical activity longitudinally in England

- We assume that the effect is fairly rapid, and do not explicitly model time lags, *i.e.* increasing physical activity reduces mortality risk within the following year and vice versa. Decay in physical activity similarly increases the risk to former levels.

- We assume no effects in any of the scenarios modelled in the under 18s, or in the over 70s.

- For the pedometer and led walking scenarios examined, we have assumed that only those currently under two hours physical activity per week are offered the intervention.

- When mean changes in physical activity, walking or cycling are reported, we assume they apply to each age/sex group equally unless differential age/sex evidence is reported. (We do however have age/sex specific baseline levels of physical activity and walking and cycling, so the new levels after adjustment are different for each age/sex band.

- We have modelled various scenarios for decay of effect. For interventions that are more infrastructure based, or have evidence of sustained effect we have assumed 0% decay. For other interventions that are based more on encouraging physical exercise, and where there is direct evidence of a waning of effect, we have assumed a variety of decay of effect scenarios, including for some 100% reduction *i.e.* no continuing effect after year 1.

- In the environmental outcomes modelling, if there is no direct evidence of reduced driving, we have assumed that driving reduction when walking or cycling increases is equivalent to that shown in cross-sectional regression from the National Travel Survey.

4 RESULTS

4.1 Results: Multi-Component

The two main multi-component studies examined are Cycling Demonstration Towns and Sustainable Travel Towns.

Cost per QALY results for these two interventions are summarised in the table below.

Intervention	Scenario	Cost/QALY
Cycling Demonstration Towns	Individuals	£4,830
	Age and gender bands	£5,090
Sustainable Travel Towns	Trip evidence (DfT)	£997
	W & C evidence (Smarter Choice)	£951

Table 4.1 Multi-component results summary

For Cycling Demonstration Towns, the modelling undertaken suggests that the intervention appears cost-effective. The cost per QALY is estimated to be of the order of £5,000 for models runs applying the effectiveness evidence either individually or based on age and gender bands.

For Sustainable Travel Towns, the modelled cost-effectiveness is estimated to be of the order of £900 per QALY for models runs using either the percentage change in trips evidence from the DfT economic appraisal or the walking and cycling distance evidence from the Smarter Choice report.

4.1.1 Results: Multi-Component - Cycling Demonstration Towns

Intervention name		Model Run	1
Cycle Demonstration Towns		Scenario	1a
Key Evidence Study	Cycle Demonstration Towns		
Change in % Physically Active			2.60%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			0%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			100%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£30.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			Yes
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			>=0
Uptake Rule based on Random Proportion of those offered			100%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			53.9%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 1,568,292,630
Discounted QALYS	650,723,003	651,047,714	324,711
Incremental Cost per QALY gained			**£ 4,830**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			Yes
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			0%
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			27%
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	188,858,642,192	-190,196,818
Distance Travelled pa per person	3,616	3,613	-3.6
Valuing Congestion per annum			-£40,097,967
Saving on Congestion Per person per annum (-ve = saving)			-£0.77
Valuing Greenhouse Gas Reductions			-£918,274
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£36,424,870**
Difference in Number of Deaths at a Time Horizon of 10 years			-13,338
Value using DfT Value of Statistical Life i.e	£1,585,510	(-ve = saving)	-£21,148,182,578

Table 4.2 Results: multi-component - Cycling Demonstration Towns (Scenario 1a)

Intervention name		Model Run	2
Cycle Demonstration Towns		Scenario	1b
Key Evidence Study	Cycle Demonstration Towns		
Change in % Physically Active			2.60%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			0%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			100%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£30.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			Yes
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			>=0
Uptake Rule based on Random Proportion of those offered			100%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			53.9%
Model Used to Compute Mortality Effect:	6. Step Function Risk via % Active on Age/Sex banded Summary (Only valid for 100% uptake)		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 1,568,292,630
Discounted QALYS	650,723,003	651,031,107	308,104
Incremental Cost per QALY gained			**£ 5,090**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			Yes
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			0%
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			27%
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	188,858,642,192	-190,196,818
Distance Travelled pa per person	3,616	3,613	-3.6
Valuing Congestion per annum			-£40,097,967
Saving on Congestion Per person per annum (-ve = saving)			-£0.77
Valuing Greenhouse Gas Reductions			-£918,274
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£36,424,870**
Difference in Number of Deaths at a Time Horizon of 10 years			-12,574
Value using DfT Value of Statistical Life i.e	£1,585,510	(-ve = saving)	-£19,936,595,619

Table 4.3 Results: multi-component - Cycling Demonstration Towns (Scenario 1b)

4.1.2 *Results: Multi-Component – Sustainable Travel towns*

Intervention name		Model Run	3
Sustainable travel towns (using Trips		Scenario	2a
Key Evidence Study	Economic Appraisal of the Sustainable travel towns by DfT		
Change in % Physically Active			
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			5.9
Change in BikeTime (Mins per Week)			1.4
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			0%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			100%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£46.93
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			Yes
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			>=0
Uptake Rule based on Random Proportion of those offered			100%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			53.9%
Model Used to Compute Mortality Effect:	1. Continuous Risk via Biketime/Walktime		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 2,453,367,344
Discounted QALYS	650,723,003	653,004,659	2,281,656
Incremental Cost per QALY gained			**£ 1,075**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			Yes
% Change in Car Trips from direct evidence			-8.4%
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			-28.4
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			All
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			5.9
Change in BikeTime (Mins per Week)			1.4
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	179,877,428,428	172,145,739,226	-7,731,689,202
Distance Travelled pa per person	3,441	3,293	-147.9
Valuing Congestion per annum			-£1,630,022,088
Saving on Congestion Per person per annum (-ve = saving)			-£31.18
Valuing Greenhouse Gas Reductions			-£37,328,750
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£1,480,707,087**
Difference in Number of Deaths at a Time Horizon of 10 years			-91,769

Table 4.4 Results: multi-component – Sustainable Travel Towns using trips evidence for congestion estimate

Intervention name		Model Run	4
Sustainable travel towns (using Walk/Cycle Distance evidence)		Scenario	2b
Key Evidence Study	The Effects of Smarter Choice programmes in the Sustainable Travel towns: Summary Report		
Change in % Physically Active			
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			10.1
Change in BikeTime (Mins per Week)			1.6
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			0%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			100%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£46.93
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			Yes
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			>=0
Uptake Rule based on Random Proportion of those offered			100%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			53.9%
Model Used to Compute Mortality Effect:	1. Continuous Risk via Biketime/Walktime		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 2,453,367,344
Discounted QALYS	650,723,003	653,302,606	2,579,603
Incremental Cost per QALY gained			**£ 951**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			Yes
% Change in Car Trips from direct evidence			-9%
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			-3032%
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			All
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			10.1
Change in BikeTime (Mins per Week)			1.6
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	179,877,428,428	171,634,280,989	-8,243,147,439
Distance Travelled pa per person	3,441	3,283	-157.7
Valuing Congestion per annum			-£1,737,849,524
Saving on Congestion Per person per annum (-ve = saving)			-£33.24
Valuing Greenhouse Gas Reductions			-£39,798,081
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£1,578,657,201**

Table 4.5 Results: multi-component – Sustainable Travel towns (Scenario 2b) using Biketime and Walktime plus regression model to estimate congestion effects

4.2 Results: TravelSmart

The main personalised travel support intervention examined is TravelSmart, results are shown in the tables below.

For TravelSmart, the modelling undertaken suggests that the intervention appears cost-effective. The cost per QALY is estimated to be of the order of £300 using the continuous risk function, or £2,500 using the step risk function.

Intervention name	Model Run	5
TravelSmart	Scenario	3a
Key Evidence Study	TravelSmart Reports	
Change in % Physically Active		
Mean Change in Physical Activity Hours		
Change in Walktime (Mins per week)		4.9
Change in BikeTime (Mins per Week)		6.2
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1		0%
Is decay %Effect Relative or absoulte per annum		Absolute
Sustained long-term level of %effect after		100%
Cost of Offer (Year 1)		£0.00
Cost of Uptake per person Taking Up (Initial)		£25.00
Ongoing Costs per person Yr 2 Onwards		£0.00
Decay Rate for Ongoing Costs		0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)		No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2		>=0
Uptake Rule based on Random Proportion of those offered		20%

Offer and Uptake Results	
% of Total England Population Who Get benefit from Intervention	10.8%
Model Used to Compute Mortality Effect: 1. Continuous Risk via Biketime/Walktime	

Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 141,361,007
Discounted QALYS	650,723,003	651,250,110	527,107
Incremental Cost per QALY gained			**£ 268**

Congestion Assumptions Used	
Is effect car distance measured directly in the evidence?	Yes
% Change in Car Trips from direct evidence	-12.0%
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)	-127.9
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?	Uptakers
Does the change based on Walking and cycling depend on % change in trips / time	No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence	
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence	
Does change based on Walking/Cycling depend on absolute change in walk/bike time	No
Change in Walktime (Mins per week)	4.9
Change in BikeTime (Mins per Week)	6.2

Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	179,877,428,428	175,462,859,382	-4,414,569,046
Distance Travelled pa per person	3,441	3,356	-84.4

Valuing Congestion per annum	-£930,695,074
Saving on Congestion Per person per annum (-ve = saving)	-£17.80
Valuing Greenhouse Gas Reductions	-£21,313,628
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)	**-£845,440,563**

Table 4.6 Results: TravelSmart using continuous risk function for mortality

Intervention name		Model Run	6
TravelSmart		Scenario	3b
Key Evidence Study	TravelSmart Reports		
Change in % Physically Active			
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			4.9
Change in BikeTime (Mins per Week)			6.2
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			0%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			100%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£25.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			>=0
Uptake Rule based on Random Proportion of those offered			20%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			10.8%
Model Used to Compute Mortality Effect:	2. Step Function Risk via Biketime/Walktime		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 141,361,007
Discounted QALYS	650,723,003	650,779,399	56,397
Incremental Cost per QALY gained			**£ 2,507**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			Yes
% Change in Car Trips from direct evidence			-12.0%
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			-127.9
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			Uptakers
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			4.9
Change in BikeTime (Mins per Week)			6.2
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	179,877,428,428	175,462,859,382	-4,414,569,046
Distance Travelled pa per person	3,441	3,356	-84.4
Valuing Congestion per annum			-£930,695,074
Saving on Congestion Per person per annum (-ve = saving)			-£17.80
Valuing Greenhouse Gas Reductions			-£21,313,628
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£845,440,563**

Table 4.7 Results: TravelSmart using step function risk for mortality

4.3 Results: Pedometer

The main pedometer evidence modelled, comes from two UK studies by Baker et al., one a short term 4 week intervention, and the second with longer-term support to participants spread over a year.

For the short-term 4-week pedometer intervention, the modelling undertaken suggests that the intervention appears cost-effective, but less so than some of the multi-component interventions. The cost per QALY is estimated to be of the order of £2,900 using the continuous risk function, or £9,400 using the step risk function. Part of the reason for this is the decay in effect – we assume zero effect after year 1 because the Baker 2008a study showed a return almost to baseline walking levels at 12 months.

For the longer-term support pedometer intervention, the evidence from Baker 2008b suggests that an effect persists to 12 months. In the scenarios modelled, we assume that this level would be maintained in future years provided the support costs (advice and telephone support) are maintained. The results suggest that longer-term support to pedometers appears cost-effective. For a scenario where the continuing cost per participant is around £25, the cost per QALY is estimated to be of the order of £1,700 using the continuous risk function, or £7,800 using the step risk function. For a scenario where the continuing cost per participant is around £9, the cost per QALY is estimated to be of the order of £750 using the continuous risk function, or £3,400 using the step risk function. Further runs were undertaken using cost data from Shaw (2011) for minimal and maximal intervention with the step and continuous risk functions. Summary results are shown in the table below.

Intervention	Decay	Risk Function	
		Continuous	Step
Baker 2008a	100%	£2,903	£9,448
With sustained support (Baker 2008b)	13.2%	£1,731	£7,817
Lower cost plus support (Baker 2008b)	13.2%	£748	£3,380
Do minimum (Shaw 2011)	13.2%	£144	£650
Do maximum (Shaw 2011)	13.2%	£807	£3,646

Table 4.8 Pedometers results from studies by Baker

The Australian trial of pedometers (Merom 2007) was also modelled. This was also short-term with a 3-month follow up. The initial improvement in walking levels was higher than in Baker 2008a, and so the cost-effectiveness estimate is somewhat better. The cost per QALY is estimated to be of the order of £1,500 using the continuous risk function, or £1,900 using the step risk function.

Intervention name		Model Run	7
Pedometers (4 Week Intervention)		Scenario	4a
Key Evidence Study	Baker 2008a		
Change in % Physically Active			
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			146.7
Change in BikeTime (Mins per Week)			0.0
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			100%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£52.50
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	1. Continuous Risk via Biketime/Walktime		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 211,573,580
Discounted QALYS	650,723,003	650,795,878	72,875
Incremental Cost per QALY gained			**£ 2,903**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			Yes
Change in Walktime (Mins per week)			146.7
Change in BikeTime (Mins per Week)			0.0
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	186,141,741,727	-2,907,097,283
Distance Travelled pa per person	3,616	3,561	-55.6
Valuing Congestion per annum			-£612,884,540
Saving on Congestion Per person per annum (-ve = saving)			-£11.72
Valuing Greenhouse Gas Reductions			-£14,035,524
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£556,742,445**

Table 4.9 Pedometers results from short-term study by Baker using continuous risk function for mortality

Intervention name		Model Run	8
Pedometers (4 Week Intervention)		Scenario	4a2
Key Evidence Study	Baker 2008a		
Change in % Physically Active			
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			146.7
Change in BikeTime (Mins per Week)			0.0
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			100%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£52.50
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	2. Step Function Risk via Biketime/Walktime		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 211,573,580
Discounted QALYS	650,723,003	650,745,396	22,393
Incremental Cost per QALY gained			**£ 9,448**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			Yes
Change in Walktime (Mins per week)			146.7
Change in BikeTime (Mins per Week)			0.0
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	186,141,741,727	-2,907,097,283
Distance Travelled pa per person	3,616	3,561	-55.6
Valuing Congestion per annum			-£612,884,540
Saving on Congestion Per person per annum (-ve = saving)			-£11.72
Valuing Greenhouse Gas Reductions			-£14,035,524
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£556,742,445**

Table 4.10 Pedometers results using step-function risk for mortality

Intervention name		Model Run	9
Pedometers (with sustained support)		Scenario	4b
Key Evidence Study	Baker 2008b + Personal Communication on Longer Term Follow-Up		
Change in % Physically Active			
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			127.9
Change in BikeTime (Mins per Week)			0.0
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			13%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			87%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£46.75
Ongoing Costs per person Yr 2 Onwards			£25.25
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	1. Continuous Risk via Biketime/Walktime		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 2,502,488,813
Discounted QALYS	650,723,003	652,168,543	1,445,540
Incremental Cost per QALY gained			**£ 1,731**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			Yes
Change in Walktime (Mins per week)			127.9
Change in BikeTime (Mins per Week)			0.0
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	186,487,559,780	-2,561,279,230
Distance Travelled pa per person	3,616	3,567	-49.0
Valuing Congestion per annum			-£539,977,954
Saving on Congestion Per person per annum (-ve = saving)			-£10.33
Valuing Greenhouse Gas Reductions			-£12,365,907
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£490,514,325**

Table 4.11 Pedometers with continuing support/advice: results using continuous risk function for mortality

Intervention name		Model Run	10
Pedometers (with sustained support)		Scenario	4b2
Key Evidence Study	Baker 2008b + Personal Communication on Longer Term Follow-Up		
Change in % Physically Active			
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			127.9
Change in BikeTime (Mins per Week)			0.0
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			13%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			87%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£46.75
Ongoing Costs per person Yr 2 Onwards			£25.25
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	2. Step Function Risk via Biketime/Walktime		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 2,497,341,686
Discounted QALYS	650,723,003	651,042,475	319,472
Incremental Cost per QALY gained			**£ 7,817**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			Yes
Change in Walktime (Mins per week)			127.9
Change in BikeTime (Mins per Week)			0.0
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	186,487,559,780	-2,561,279,230
Distance Travelled pa per person	3,616	3,567	-49.0
Valuing Congestion per annum			-£539,977,954
Saving on Congestion Per person per annum (-ve = saving)			-£10.33
Valuing Greenhouse Gas Reductions			-£12,365,907
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£490,514,325**

Table 4.12 Pedometers with continuing support/advice: results using step-function risk for mortality

Intervention name		Model Run	11
Pedometers (with sustained support - lower level of cost)		Scenario	4c
Key Evidence Study	Baker 2008b + Personal Communication on Longer Term Follow-Up		
Change in % Physically Active			
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			127.9
Change in BikeTime (Mins per Week)			0.0
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			13%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			87%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£46.75
Ongoing Costs per person Yr 2 Onwards			£9.75
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	1. Continuous Risk via Biketime/Walktime		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 1,081,959,805
Discounted QALYS	650,723,003	652,168,543	1,445,540
Incremental Cost per QALY gained			**£ 748**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			Yes
Change in Walktime (Mins per week)			127.9
Change in BikeTime (Mins per Week)			0.0
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	186,487,559,780	-2,561,279,230
Distance Travelled pa per person	3,616	3,567	-49.0
Valuing Congestion per annum			-£539,977,954
Saving on Congestion Per person per annum (-ve = saving)			-£10.33
Valuing Greenhouse Gas Reductions			-£12,365,907
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£490,514,325**

Table 4.13 Pedometers with continuing support/advice: results using continuous risk function for mortality (lower continuing support cost scenario)

Intervention name		Model Run	12
Pedometers (with sustained support - lower level of cost)		Scenario	4c2
Key Evidence Study	Baker 2008b + Personal Communication on Longer Term Follow-Up		
Change in % Physically Active			
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			127.9
Change in BikeTime (Mins per Week)			0.0
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			13%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			87%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£46.75
Ongoing Costs per person Yr 2 Onwards			£9.75
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	2. Step Function Risk via Biketime/Walktime		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 1,079,972,301
Discounted QALYS	650,723,003	651,042,475	319,472
Incremental Cost per QALY gained			**£ 3,380**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			Yes
Change in Walktime (Mins per week)			127.9
Change in BikeTime (Mins per Week)			0.0
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	186,487,559,780	-2,561,279,230
Distance Travelled pa per person	3,616	3,567	-49.0
Valuing Congestion per annum			-£539,977,954
Saving on Congestion Per person per annum (-ve = saving)			-£10.33
Valuing Greenhouse Gas Reductions			-£12,365,907
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£490,514,325**

Table 4.14 Pedometers with continuing support/advice: results using step-function risk for mortality (lower continuing support cost scenario)

Intervention name		Model Run	13
Pedometers (Australian Study - Steps Evidence)		Scenario	5a
Key Evidence Study	Merom 2007		
Change in % Physically Active			
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			52.0
Change in BikeTime (Mins per Week)			0.0
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			40%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£39.67
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	1. Continuous Risk via Biketime/Walktime		

Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 159,855,594
Discounted QALYS	650,723,003	650,827,502	104,499
Incremental Cost per QALY gained			**£ 1,530**

Congestion Assumptions Used	
Is effect car distance measured directly in the evidence?	No
% Change in Car Trips from direct evidence	
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)	
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?	
Does the change based on Walking and cycling depend on % change in trips / time	No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence	
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence	
Does change based on Walking/Cycling depend on absolute change in walk/bike time	Yes
Change in Walktime (Mins per week)	52.0
Change in BikeTime (Mins per Week)	0.0

Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	187,961,468,387	-1,087,370,622
Distance Travelled pa per person	3,616	3,596	-20.8
Valuing Congestion per annum			-£229,243,324
Saving on Congestion Per person per annum (-ve = saving)			-£4.39
Valuing Greenhouse Gas Reductions			-£5,249,847
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£208,243,935**

Table 4.15 Pedometer results based on Australian study (continuous risk function)

Intervention name		Model Run	14
Pedometers (Australian Study - Phys Act Evidence)		Scenario	5b
Key Evidence Study	Merom 2007		
Change in % Physically Active			22.70%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			52.0
Change in BikeTime (Mins per Week)			0.0
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			40%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£39.67
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 159,855,594
Discounted QALYS	650,723,003	650,804,754	81,751
Incremental Cost per QALY gained			**£ 1,955**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			Yes
Change in Walktime (Mins per week)			52.0
Change in BikeTime (Mins per Week)			0.0
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	187,961,468,387	-1,087,370,622
Distance Travelled pa per person	3,616	3,596	-20.8
Valuing Congestion per annum			-£229,243,324
Saving on Congestion Per person per annum (-ve = saving)			-£4.39
Valuing Greenhouse Gas Reductions			-£5,249,847
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£208,243,935**

Table 4.16 Pedometer results based on Australian study (step-risk function)

4.4 Results: Led Walking and Encouraging Independent Community Walking

The main led-walking evidence modelled comes from a UK RCT by Lamb et al. Using this evidence has been a topic of debate and concern within the PDG, as the RCT shows no difference between led walking and a comparator arm of advice. The economic team planned to use the levels of walking before and after the intervention as the measure of effect (we do this in one of the scenarios below), but there was concern that some or even all of the effect was a regression to the mean, whereby only people who had been low on a physical activity questionnaire at around the start of the trial were eligible for the trial, and many of these would naturally have a higher level of physical activity later. As a consequence of this concern, we also model scenarios where the true effectiveness is either 50% or 10% of the effect apparent from the before and after evidence. Of course, if there is believed to be zero effect then the intervention would, by logic, not be cost-effective.

We also model scenarios where the costs of led walking in practice are somewhat lower, based on personal communication from a PCT rather than the costs implied by the resources discussed in the trial paper.

At the suggestion of the PDG, a number of further runs were carried out to investigate the influence of effectiveness decay.

Finally, we also model the ‘Get Walking Keep Walking’ intervention using evidence from an evaluation of a large UK study (CLES 2011).

For led walking using the Lamb *et al.* as evidence, the modelling undertaken suggests that the intervention appears cost-effective but is very sensitive to the level of effect assumed. The cost per QALY is estimated to be of the order of £1,900, using 100% of the apparent effect from the trial, £3,600 using 50% of the apparent effect, and £16,500 using 10% of the apparent effect. For this 10% of the apparent effect scenario, but using the slightly lower costs from the PCT, the cost per QALY is estimated to be of the order of £10,400.

For the ‘Get Walking Keep Walking’ intervention, the modelling undertaken suggests that the intervention appears cost-effective. The cost per QALY is estimated to be of the order of £2,700. Results are shown in the tables below.

Intervention name	Model Run	15
Led Walking (Full before and after effect)	Scenario	6a
Key Evidence Study	Lamb 2001	
Change in % Physically Active		28.70%
Mean Change in Physical Activity Hours		
Change in Walktime (Mins per week)		
Change in BikeTime (Mins per Week)		
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1		40%
Is decay %Effect Relative or absoulte per annum		Absolute
Sustained long-term level of %effect after		0%
Cost of Offer (Year 1)		£0.00
Cost of Uptake per person Taking Up (Initial)		£47.42
Ongoing Costs per person Yr 2 Onwards		£0.00
Decay Rate for Ongoing Costs		0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)		No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2		<2
Uptake Rule based on Random Proportion of those offered		40%

Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 191,082,718
Discounted QALYS	650,723,003	650,821,750	98,747
Incremental Cost per QALY gained			**£ 1,935**

Congestion Assumptions Used	
Is effect car distance measured directly in the evidence?	No
% Change in Car Trips from direct evidence	
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)	
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?	
Does the change based on Walking and cycling depend on % change in trips / time	No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence	
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence	
Does change based on Walking/Cycling depend on absolute change in walk/bike time	No
Change in Walktime (Mins per week)	
Change in BikeTime (Mins per Week)	

Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**

Table 4.17 Led walking results assuming Lamb et al. before and after results are representative of effect in practice

Intervention name		Model Run	16
Led Walking (50% before and after effect)		Scenario	6b
Key Evidence Study	Lamb 2001		
Change in % Physically Active			14.35%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			40%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£47.42
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 191,082,718
Discounted QALYS	650,723,003	650,775,245	52,242
Incremental Cost per QALY gained			**£ 3,658**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**

Table 4.18 Led walking results assuming 50% of the effectiveness seen in Lamb et al. before and after Results

Intervention name	Model Run	17
Led Walking (10% before and after effect)	Scenario	6c
Key Evidence Study	Lamb 2001	
Change in % Physically Active		2.87%
Mean Change in Physical Activity Hours		
Change in Walktime (Mins per week)		
Change in BikeTime (Mins per Week)		
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1		40%
Is decay %Effect Relative or absoulte per annum		Absolute
Sustained long-term level of %effect after		0%
Cost of Offer (Year 1)		£0.00
Cost of Uptake per person Taking Up (Initial)		£47.42
Ongoing Costs per person Yr 2 Onwards		£0.00
Decay Rate for Ongoing Costs		0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)		No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2		<2
Uptake Rule based on Random Proportion of those offered		40%

Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 191,082,718
Discounted QALYS	650,723,003	650,734,531	11,528
Incremental Cost per QALY gained			**£ 16,576**

Congestion Assumptions Used	
Is effect car distance measured directly in the evidence?	No
% Change in Car Trips from direct evidence	
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)	
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?	
Does the change based on Walking and cycling depend on % change in trips / time	No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence	
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence	
Does change based on Walking/Cycling depend on absolute change in walk/bike time	No
Change in Walktime (Mins per week)	
Change in BikeTime (Mins per Week)	

Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0

Valuing Congestion per annum	£0
Saving on Congestion Per person per annum (-ve = saving)	£0.00
Valuing Greenhouse Gas Reductions	£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)	**£0**

Table 4.19 Led walking results assuming 10% of the effectiveness seen in Lamb et al. before and after results

Intervention name		Model Run	20
Led Walking (10% before and after effect)			
Lower Costs from Derbyshire PCT		Scenario	6f
Key Evidence Study	Lamb 2001		
Change in % Physically Active			2.87%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			40%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£29.90
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 120,513,545
Discounted QALYS	650,723,003	650,734,531	11,528
Incremental Cost per QALY gained			**£ 10,454**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**

Table 4.20 Led walking Results assuming 10% of the effectiveness seen in Lamb et al. before and after results and lower costs per participant from Derbyshire PCT

4.4.1 Extra Runs Requested by NICE/PDG

Intervention name		Model Run	39
Led Walking (10% before and after effect)		Scenario	6h
Key Evidence Study	Lamb 2001		
Change in % Physically Active			2.87%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			50%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£47.42
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 191,082,718
Discounted QALYS	650,723,003	650,732,651	9,649
Incremental Cost per QALY gained			**£ 19,804**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**
Difference in Number of Deaths at a Time Horizon of 10 years			-691

Table 4.21 Led walking result: Lamb with base cost and 50% annual decay

Intervention name		Model Run	40
Led Walking (10% before and after effect)		Scenario	6j
Key Evidence Study	Lamb 2001		
Change in % Physically Active			2.87%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			75%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£47.42
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 191,082,718
Discounted QALYS	650,723,003	650,731,073	8,070
Incremental Cost per QALY gained			**£ 23,678**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**
Difference in Number of Deaths at a Time Horizon of 10 years			-573

Table 4.22 Led walking result: Lamb with base cost and 75% annual decay

Intervention name		Model Run	41
Led Walking (10% before and after effect)		Scenario	6k
Key Evidence Study	Lamb 2001		
Change in % Physically Active			2.87%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			100%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£47.42
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 191,082,718
Discounted QALYS	650,723,003	650,729,494	6,491
Incremental Cost per QALY gained			**£ 29,436**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**
Difference in Number of Deaths at a Time Horizon of 10 years			-455

Table 4.23 Led walking result: Lamb with base cost and 100% annual decay

Intervention name		Model Run	42
Led Walking (10% before and after effect)		Scenario	6l
Key Evidence Study	Lamb 2001		
Change in % Physically Active			2.87%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			50%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£29.90
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 120,513,545
Discounted QALYS	650,723,003	650,732,651	9,649
Incremental Cost per QALY gained			**£ 12,490**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**
Difference in Number of Deaths at a Time Horizon of 10 years			-691

Table 4.24 Led walking result: Lamb with lower cost and 50% annual decay

Intervention name		Model Run	43
Led Walking (10% before and after effect)		Scenario	6m
Key Evidence Study	Lamb 2001		
Change in % Physically Active			2.87%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			75%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£29.90
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 120,513,545
Discounted QALYS	650,723,003	650,731,073	8,070
Incremental Cost per QALY gained			**£ 14,934**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**
Difference in Number of Deaths at a Time Horizon of 10 years			-573

Table 4.25 Led walking result: Lamb with lower cost and 75% annual decay

Intervention name		Model Run	44
Led Walking (10% before and after effect)		Scenario	6n
Key Evidence Study	Lamb 2001		
Change in % Physically Active			2.87%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			100%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£29.90
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 120,513,545
Discounted QALYS	650,723,003	650,729,494	6,491
Incremental Cost per QALY gained			**£ 18,565**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**
Difference in Number of Deaths at a Time Horizon of 10 years			-455

Table 4.26 Led walking result: Lamb with lower cost and 100% annual decay

Intervention name		Model Run	45
Led Walking (10% before and after effect)		Scenario	6o
Key Evidence Study	Lamb 2001		
Change in % Physically Active			2.87%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			50%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£47.42
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 191,082,718
Discounted QALYS	650,723,003	650,732,651	9,649
Incremental Cost per QALY gained			**£ 19,804**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**
Difference in Number of Deaths at a Time Horizon of 10 years			-691

Table 4.27 Led walking result: Lamb with 50% annual decay and 1.5% annual benefit discount

Intervention name		Model Run	46
Led Walking (10% before and after effect)		Scenario	6p
Key Evidence Study	Lamb 2001		
Change in % Physically Active			2.87%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			75%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£47.42
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 191,082,718
Discounted QALYS	650,723,003	650,731,073	8,070
Incremental Cost per QALY gained			**£ 23,678**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**
Difference in Number of Deaths at a Time Horizon of 10 years			-573

Table 4.28 Led walking result: Lamb with 75% annual decay and 1.5% annual benefit discount

Intervention name		Model Run	47
Led Walking (10% before and after effect)		Scenario	6q
Key Evidence Study	Lamb 2001		
Change in % Physically Active			2.87%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			100%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£47.42
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 191,082,718
Discounted QALYS	884,649,590	884,657,934	8,344
Incremental Cost per QALY gained			**£ 22,901**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	738,930,635	-188,309,908,374
Distance Travelled pa per person	3,616	14	-3,602.2
Valuing Congestion per annum			-£39,700,161,501
Saving on Congestion Per person per annum (-ve = saving)			-£759.43
Valuing Greenhouse Gas Reductions			-£909,164,004
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£36,063,505,485**
Difference in Number of Deaths at a Time Horizon of 10 years			-455

Table 4.29 Led walking result: Lamb with 100% annual decay and 1.5% annual benefit discount

4.4.2 Get Walking Keep Walking

Intervention name		Model Run	21
Get Walking keep Walking		Scenario	6g
Key Evidence Study	Evaluation of Get Walking Keep Walking by CLES (Centre for Local Economic Strategies)		
Change in % Physically Active			22.40%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			40%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£55.22
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 222,536,587
Discounted QALYS	650,723,003	650,803,815	80,812
Incremental Cost per QALY gained			**£ 2,754**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**

Table 4.30 Results for Get Walking Keep Walking

4.5 Results: What-If Analyses

To understand the dynamics of the model and the levels of walking and cycling improvements that would be considered cost-effective at particular costs per participant, we have undertaken a series of what-if analyses. These focus in particular on the dimensions of:

- A 1% increase in the population who are physically active
- Encouraging those who are not physically active to walk an extra 10mins per week on average
- Encouraging those who are not physically active to cycle an additional 10mins per week
- Considering levels of decay ranging from the effect continuing forever, through annual decay rates of 25, 50%, 75%, and 100% (*i.e.* no effect after year one).

4.5.1 What ifs on Threshold Costs for 1% of the Population Becoming Physical Active Forever (>2 Hours Moderate Exercise Per Week)

The results suggest that interventions that could achieve a permanent shift in physical activity of 1% of the population shifting from under 2 hours to over 2 hours physical activity per week would have a substantial effect.

The cost per QALY estimates for a range of different costs are:

Investment per person currently not-physically active	Cost per QALY
£1	£118
£50	£4,733
£100	£9,465
£1,000	£94,650

Table 4.31 Threshold costs for 1% of the population becoming physical active forever

Intervention name		Model Run	22
What If @£1 (1% more active forever)		Scenario	7a
Key Evidence Study	"What-If"		
Change in % Physically Active			1.00%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			0%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£1.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			100%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			18.9%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 9,906,247
Discounted QALYS	650,723,003	650,807,274	84,271
Incremental Cost per QALY gained			**£ 118**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**

Table 4.32 What if 1% more physically active forever at a cost of £1 per person

Intervention name		Model Run	23
What If @ £100 (1% more active forever)		Scenario	7b
Key Evidence Study	"What-If"		
Change in % Physically Active			1.00%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			0%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£100.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 402,997,296
Discounted QALYS	650,723,003	650,765,578	42,576
Incremental Cost per QALY gained			**£ 9,465**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**

Table 4.33 What if 1% more physically active forever at a cost of £100 per person

Intervention name		Model Run	24
What If @ £1,000 (1% more active forever)		Scenario	7c
Key Evidence Study	"What-If"		
Change in % Physically Active			1.00%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			0%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£1,000.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 4,029,972,958
Discounted QALYS	650,723,003	650,765,578	42,576
Incremental Cost per QALY gained			**£ 94,655**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**

Table 4.34 What if 1% more physically active forever at a cost of £1,000 per person

4.5.2 What ifs on Threshold Decay Rates for 1% of the Population Becoming Physical Active at a Cost of £50 Per Person

The results suggest that interventions which could achieve a permanent shift in physical activity of 1% of the population shifting from under 2 hours to over 2 hours physical activity per week would be cost-effective if maintained.

However, decay rates in effectiveness have a substantial influence on cost-effectiveness.

For a £50 per person intervention, the cost per QALY estimates for a range of decay rates costs are:

Annual Decay Rate in Effect	Cost per QALY
0%	£4,733
25%	£40,068
50%	£66,255
100%	£99,199

Table 4.35 Threshold Decay for 1% of the population becoming physical active at a cost of £50 per person

Intervention name		Model Run	25
What If @ £50 (1% more active 0% decay)		Scenario	7d
Key Evidence Study	"What-If"		
Change in % Physically Active			1.00%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			0%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£50.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 201,498,648
Discounted QALYS	650,723,003	650,765,578	42,576
Incremental Cost per QALY gained			**£ 4,733**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**

Table 4.36 What-if 1% more physically active at cost £50 per person with decay = 0%

Intervention name		Model Run	26
What If @ £50 (1% more active 25% decay)		Scenario	7e
Key Evidence Study	"What-If"		
Change in % Physically Active			1.00%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			25%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£50.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 201,498,648
Discounted QALYS	650,723,003	650,728,032	5,029
Incremental Cost per QALY gained			**£ 40,068**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**

Table 4.37 What-if 1% more physically active at cost £50 per person with decay = 25%

Intervention name	Model Run	27
What If @ £50 (1% more active 50% decay)	Scenario	7f
Key Evidence Study	"What-If"	
Change in % Physically Active		1.00%
Mean Change in Physical Activity Hours		
Change in Walktime (Mins per week)		
Change in BikeTime (Mins per Week)		
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1		50%
Is decay %Effect Relative or absoulte per annum		Absolute
Sustained long-term level of %effect after		0%
Cost of Offer (Year 1)		£0.00
Cost of Uptake per person Taking Up (Initial)		£50.00
Ongoing Costs per person Yr 2 Onwards		£0.00
Decay Rate for Ongoing Costs		0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)		No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2		<2
Uptake Rule based on Random Proportion of those offered		40%

Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 201,498,648
Discounted QALYS	650,723,003	650,726,044	3,041
Incremental Cost per QALY gained			**£ 66,255**

Congestion Assumptions Used	
Is effect car distance measured directly in the evidence?	No
% Change in Car Trips from direct evidence	
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)	
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?	
Does the change based on Walking and cycling depend on % change in trips / time	No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence	
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence	
Does change based on Walking/Cycling depend on absolute change in walk/bike time	No
Change in Walktime (Mins per week)	
Change in BikeTime (Mins per Week)	

Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0

Valuing Congestion per annum	£0
Saving on Congestion Per person per annum (-ve = saving)	£0.00
Valuing Greenhouse Gas Reductions	£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)	**£0**

Table 4.38 What -if 1% more physically active at cost £50 per person with decay = 50%

Intervention name		Model Run	28
What If @ £50 (1% more active 100% decay)		Scenario	7g
Key Evidence Study	"What-If"		
Change in % Physically Active			1.00%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			100%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£50.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 201,498,648
Discounted QALYS	650,723,003	650,725,036	2,033
Incremental Cost per QALY gained			**£ 99,119**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**

Table 4.39 What -if 1% more physically active at cost £50 per person with decay = 100%

4.5.3 What ifs on Threshold Decay Rates for 1% of the Population Becoming Physical Active at a Cost of £10 Per Person

The results suggest that interventions which could achieve a permanent shift in physical activity of 1% of the population shifting from under 2 hours to over 2 hours physical activity per week would be cost-effective if maintained.

However, decay rates in effectiveness have a substantial influence on cost-effectiveness.

For a £10 per person intervention, the cost per QALY estimates for a range of decay rates costs are:

Annual Decay Rate in Effect	Cost per QALY (assuming a £10 intervention)
0%	£947
25%	£8.014
50%	£13,251
100%	£19,824

Table 4.40 Threshold decay for 1% of the population becoming physical active at a cost of £10 per person

Intervention name		Model Run	29
What If @ £10 (1% more active 0% decay)		Scenario	7h
Key Evidence Study	"What-If"		
Change in % Physically Active			1.00%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			0%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£10.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 40,299,730
Discounted QALYS	650,723,003	650,765,578	42,576
Incremental Cost per QALY gained			**£ 947**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**

Table 4.41 What -if 1% more physically active at cost £10 per person with decay = 0%

Intervention name		Model Run	30
What If @ £10 (1% more active 25% decay)		Scenario	7i
Key Evidence Study	"What-If"		
Change in % Physically Active			1.00%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			25%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£10.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 40,299,730
Discounted QALYS	650,723,003	650,728,032	5,029
Incremental Cost per QALY gained			**£ 8,014**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**

Table 4.42 What -if 1% more physically active at cost £10 per person with decay = 25%

Intervention name		Model Run	31
What If @ £10 (1% more active 50% decay)		Scenario	7j
Key Evidence Study	"What-If"		
Change in % Physically Active			1.00%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			50%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£10.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 40,299,730
Discounted QALYS	650,723,003	650,726,044	3,041
Incremental Cost per QALY gained			**£ 13,251**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**

Table 4.43 What -if 1% more physically active at cost £10 per person with decay = 50%

Intervention name		Model Run	32
What If @ £10 (1% more active 100% decay)		Scenario	7k
Key Evidence Study	"What-If"		
Change in % Physically Active			1.00%
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			100%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£10.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	5. Step Function Risk via % Active on individuals accounting for uptake		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 40,299,730
Discounted QALYS	650,723,003	650,725,036	2,033
Incremental Cost per QALY gained			**£ 19,824**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			No
Change in Walktime (Mins per week)			
Change in BikeTime (Mins per Week)			
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,048,839,010	0
Distance Travelled pa per person	3,616	3,616	0.0
Valuing Congestion per annum			£0
Saving on Congestion Per person per annum (-ve = saving)			£0.00
Valuing Greenhouse Gas Reductions			£0
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**£0**

Table 4.44 What -if 1% more physically active at cost £10 per person with decay = 100%

4.5.4 What ifs on Walking: Threshold Decay for an Average Increase of 10 Minutes a week Walking at a Cost of £10.

The results suggest that interventions that achieve a permanent shift in walking of 10 minutes per week in those who are currently under 2 hours physical activity per week would have a substantial effect. If this could be maintained, the modelling suggests that such an intervention would be very cost-effective (using the continuous risk function approach). Again, these results are sensitive to the rate of decay in effect, but the interventions would remain cost-effective under the modelling assumptions used.

For a £10 per person intervention, the cost per QALY estimates for a range of decay rates costs are:

Annual Decay Rate in Effect	Cost per QALY (assuming a £10 walking intervention)
0%	£43
25%	£405
50%	£666
100%	£991

Table 4.45 What if analyses for a 10 minute increase in walking in those not currently physical active at a cost of £10 per person

Intervention name		Model Run	33
What If @£10 (10mins more walktime forever)		Scenario	8a
Key Evidence Study	"What-If"		
Change in % Physically Active			
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			10.0
Change in BikeTime (Mins per Week)			0.0
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			0%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£10.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	1. Continuous Risk via Biketime/Walktime		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 40,299,730
Discounted QALYS	650,723,003	651,661,797	938,794
Incremental Cost per QALY gained			**£ 43**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			Yes
Change in Walktime (Mins per week)			10.0
Change in BikeTime (Mins per Week)			0.0
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,034,560,062	-14,278,948
Distance Travelled pa per person	3,616	3,616	-0.3
Valuing Congestion per annum			-£3,010,338
Saving on Congestion Per person per annum (-ve = saving)			-£0.06
Valuing Greenhouse Gas Reductions			-£68,939
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£2,734,582**

Table 4.46 What -if 10 minutes more walking for those not physically active. decay = 0%

Intervention name		Model Run	34
What If @£10 (10mins walktime 50% decay)		Scenario	8b
Key Evidence Study	"What-If"		
Change in % Physically Active			
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			10.0
Change in BikeTime (Mins per Week)			0.0
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			50%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£10.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	1. Continuous Risk via Biketime/Walktime		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 40,299,730
Discounted QALYS	650,723,003	650,783,525	60,523
Incremental Cost per QALY gained			**£ 666**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			Yes
Change in Walktime (Mins per week)			10.0
Change in BikeTime (Mins per Week)			0.0
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,034,560,062	-14,278,948
Distance Travelled pa per person	3,616	3,616	-0.3
Valuing Congestion per annum			-£3,010,338
Saving on Congestion Per person per annum (-ve = saving)			-£0.06
Valuing Greenhouse Gas Reductions			-£68,939
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£2,734,582**

Table 4.47 What -if 10 minutes more walking for those not physically active. decay = 50%

Intervention name		Model Run	35
What If @£10 (10mins walktime 100% decay)		Scenario	8c
Key Evidence Study	"What-If"		
Change in % Physically Active			
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			10.0
Change in BikeTime (Mins per Week)			0.0
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			100%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£10.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	1. Continuous Risk via Biketime/Walktime		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 40,299,730
Discounted QALYS	650,723,003	650,763,666	40,663
Incremental Cost per QALY gained			**£ 991**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			Yes
Change in Walktime (Mins per week)			10.0
Change in BikeTime (Mins per Week)			0.0
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	189,034,560,062	-14,278,948
Distance Travelled pa per person	3,616	3,616	-0.3
Valuing Congestion per annum			-£3,010,338
Saving on Congestion Per person per annum (-ve = saving)			-£0.06
Valuing Greenhouse Gas Reductions			-£68,939
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£2,734,582**

Table 4.48 What -if 10 minutes more walking for those not physically active. decay = 100%

4.5.5 What ifs on Threshold Decay for an Average Increase of 10 Minutes a Week Cycling for those not Physical Active at a Cost of £10.

The results suggest that interventions that achieve a permanent shift in cycling of 10 minutes per week in those who are currently under 2 hours physical activity per week would have a substantial effect. If this could be maintained, the modelling suggests that such an intervention would be very cost-effective (using the continuous risk function approach). Again, these results are sensitive to the rate of decay in effect, but the interventions would remain cost-effective under the modelling assumptions used.

For a £10 per person intervention, the cost per QALY estimates for a range of decay rates costs are:

Annual Decay Rate in Effect	Cost per QALY (assuming a £10 walking intervention)
0%	£40
25%	£375
50%	£617
100%	£918

Table 4.49 What if analyses for a 10 minute increase in cycling in those not currently physical active at a cost of £10 per person

Intervention name		Model Run	36
What If @£10 (10mins more biketime forever)		Scenario	9a
Key Evidence Study	"What-If"		
Change in % Physically Active			
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			0.0
Change in BikeTime (Mins per Week)			10.0
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			0%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£10.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	1. Continuous Risk via Biketime/Walktime		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 40,299,730
Discounted QALYS	650,723,003	651,739,698	1,016,695
Incremental Cost per QALY gained			**£ 40**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			Yes
Change in Walktime (Mins per week)			0.0
Change in BikeTime (Mins per Week)			10.0
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	188,848,661,396	-200,177,614
Distance Travelled pa per person	3,616	3,613	-3.8
Valuing Congestion per annum			-£42,202,153
Saving on Congestion Per person per annum (-ve = saving)			-£0.81
Valuing Greenhouse Gas Reductions			-£966,462
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£38,336,307**

Table 4.50 What -if 10 minutes more cycling for those not physically active; decay = 0%

Intervention name		Model Run	37
What If @£10 (10mins biketime 50% decay)		Scenario	9b
Key Evidence Study	"What-If"		
Change in % Physically Active			
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			0.0
Change in BikeTime (Mins per Week)			10.0
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			50%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£10.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	1. Continuous Risk via Biketime/Walktime		

Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 40,299,730
Discounted QALYS	650,723,003	650,788,361	65,358
Incremental Cost per QALY gained			**£ 617**

Congestion Assumptions Used	
Is effect car distance measured directly in the evidence?	No
% Change in Car Trips from direct evidence	
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)	
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?	
Does the change based on Walking and cycling depend on % change in trips / time	No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence	
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence	
Does change based on Walking/Cycling depend on absolute change in walk/bike time	Yes
Change in Walktime (Mins per week)	0.0
Change in BikeTime (Mins per Week)	10.0

Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	188,848,661,396	-200,177,614
Distance Travelled pa per person	3,616	3,613	-3.8
Valuing Congestion per annum			-£42,202,153
Saving on Congestion Per person per annum (-ve = saving)			-£0.81
Valuing Greenhouse Gas Reductions			-£966,462
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£38,336,307**

Table 4.51 What -if 10 minutes more cycling for those not physically active; decay = 50%

Intervention name		Model Run	38
What If @£10 (10mins biketime 100% decay)		Scenario	9c
Key Evidence Study	"What-If"		
Change in % Physically Active			
Mean Change in Physical Activity Hours			
Change in Walktime (Mins per week)			0.0
Change in BikeTime (Mins per Week)			10.0
Annual %Decay in effectiveness (0% = full ongoing effect, 100% = no effect after year 1			100%
Is decay %Effect Relative or absoulte per annum			Absolute
Sustained long-term level of %effect after			0%
Cost of Offer (Year 1)			£0.00
Cost of Uptake per person Taking Up (Initial)			£10.00
Ongoing Costs per person Yr 2 Onwards			£0.00
Decay Rate for Ongoing Costs			0%
Does the Cost Of Uptake Simply Apply to the Whole Population? (1=Yes,0=No)			No
Offer Rule based on Phsical Activity? Enter Criterion based on weekly hours e.g. <2			<2
Uptake Rule based on Random Proportion of those offered			40%
Offer and Uptake Results			
% of Total England Population Who Get benefit from Intervention			7.7%
Model Used to Compute Mortality Effect:	1. Continuous Risk via Biketime/Walktime		
Health benefits Results Summary	No Intervention	With Intervention	Difference
Intervention Costs			£ 40,299,730
Discounted QALYS	650,723,003	650,766,912	43,909
Incremental Cost per QALY gained			**£ 918**
Congestion Assumptions Used			
Is effect car distance measured directly in the evidence?			No
% Change in Car Trips from direct evidence			
Mean Change in Car Distance travelled (1/10ths of mile/week as per NTS)			
Does change in Travel from Direct Evidence Apply to All or Just Uptakers?			
Does the change based on Walking and cycling depend on % change in trips / time			No
% Change in Walking Trips / Time to Apply to NTS Travel if using indirect evidence			
% Change in Biking Trips / Time to Apply to NTS Travel if using indirect evidence			
Does change based on Walking/Cycling depend on absolute change in walk/bike time			Yes
Change in Walktime (Mins per week)			0.0
Change in BikeTime (Mins per Week)			10.0
Congestion Results Summary	No Intervention	With Intervention	Difference
Total Expected Car Distance pa (miles)	189,048,839,010	188,848,661,396	-200,177,614
Distance Travelled pa per person	3,616	3,613	-3.8
Valuing Congestion per annum			-£42,202,153
Saving on Congestion Per person per annum (-ve = saving)			-£0.81
Valuing Greenhouse Gas Reductions			-£966,462
Total Marginal External Costs per Annum (Incl. Reduced Indirect taxation)			**-£38,336,307**

Table 4.52 What -if 10 minutes more cycling for those not physically active; decay = 100%

4.6 Comparison of Results Across Interventions in Terms of Health Benefits and Cost Per QALY

The incremental cost per QALY results for each intervention versus 'do nothing' suggest that each of the interventions modelled could be considered more cost-effective than 'do nothing' from a health economic perspective because the cost per QALY gained estimates are less than the typical threshold of £20,000. The cost-effectiveness is heavily dependent on the persistence of the effect (*i.e.* the decay), and is influenced by uptake rates and of course costs.

To illustrate the important influence of the decay in effectiveness, a number of additional model runs were performed on the Cycling Demonstration Towns and the Sustainable Travel Towns, as shown below

Annual decay in effectiveness	Scenario			
	1a	1b	2a	2b
0	£4,830	£5,090	£997	£951
5%	£9,111	£9,608	£1,905	£1,818
10%	£13,936	£14,764	£2,953	£2,819
20%	£24,124	£25,611	£5,166	£4,933
30%	£34,498	£36,684	£7,420	£7,086
40%	£45,022	£47,874	£9,690	£9,254
50%	£55,657	£59,135	£11,969	£11,433
75%	£82,487	£87,387	£17,687	£16,897
100%	£109,406	£115,622	£23,412	£22,367

Table 4.53 The influence of effectiveness decay

Scenarios:
1a , CDT with effects applied individually.
1b. CDT with effect applied to summary age and gender bands.
2a. STT using economic appraisal from the DfT.
2b. STT using Smarter Choice Summary Report.

This shows that, even for the most optimistic scenarios, cost per QALY will rise above £20,000 should the full effect be lost after the first year, while for more expensive scenarios, this threshold is reached with only small levels of decay.

For decision makers considering which of interventions to implement given limited resources or considering what mix of a variety of interventions to invest in, it might be useful to consider comparison across interventions rather than each intervention versus 'do nothing'. This is most easily done in health economic terms by calculating the incremental 'net benefit' of each intervention, which is simply a way of estimating the monetary value of the QALYs gained (assuming 1 QALY is 'worth' £20,000) and netting off the cost of the intervention. That is, Incremental Net benefit = £20,000 * QALYs gained by intervention – cost of intervention Table 4.53 in the final column shows these calculations for each intervention. We can see that in each case the incremental net benefit (INB) is greater than zero, signifying that the cost per QALY is less than £20,000 *i.e*. the monetary value of the QALYs gained outweighs the costs of the intervention.

Error! Reference source not found. Comparison of results across interventions

Comparing net benefit estimates across the interventions reveals several points that may be of use to decision makers. The intervention with the highest estimated expected net benefit is the Sustainable Travel Towns. This appears to achieve the highest QALYs gained. The estimate of QALYs gained is in turn dependent on the evidence used concerning the increases in the mean walking trips (+13.1%) and cycling trips (+26.1%) respectively, the assumption of no decay in effect over time, and the regression modelling which estimates the increased physical activity and hence reduced mortality risk (using the continuous risk function) as a result. Note also that for interventions where the effectiveness data allows the use of both the continuous and the step-risk function for mortality (for example, TravelSmart), using the continuous risk function model gives results that are more beneficial, because the continuous method allows for benefits to accrue to those individuals who increase their physical activity, but not by enough to move them to the higher level (> 2 hours per week) used in the step-function.

Cycling Demonstration Towns also has a relatively high incremental net benefit. Here the step function for mortality risk was used as the main evidence available on level of effect concerned the percentage of people achieving 2 hours physical activity level.

The TravelSmart intervention has lower estimated net benefit than that for Sustainable travel towns (£10,401m for TravelSmart compared with say £46,751m for STT). Again the use of continuous versus step function risk model makes a difference (£10,401m for continuous function TravelSmart compared with £987m for step function TravelSmart). We might also compare TravelSmart using the step function versus Cycling Demonstration Towns using the step function, and this comparison suggests that the composite intervention of cycling demonstration towns has a higher estimated net benefit than the TravelSmart programme as modelled here. This does not necessarily mean that decision makers should only implement Cycling Demonstration Towns projects rather than TravelSmart as clearly local context issues, feasibility and timing of implementations, the value of a mix of measures to encourage different subgroups within the population etc. are all going to be important. It does however mean that decision makers should begin to consider, estimate, and monitor the effectiveness of the measures they put in place to encourage walking and cycling and their costs.

For the pedometer interventions examined, one can see that an intervention which decays immediately by the end of the first year (as in the Baker 2008a study) has lower estimated net benefit than most of the other interventions examined *(e.g.* £236m using step function). Clearly, if sustained effect can be achieved (for example as assumed in our modelling of the Baker 2008b study assuming some continued support and encouragement), then higher net benefits would be achieved (e.g. £3,892m for the sustained effect with an additional annual support cost of £25.25 per annum - model run 10). The net benefits estimated for the modelled Australian pedometer study evidence (£1,930m Merom) are slightly lower than those for the Baker 2008b sustained effect scenario.

As discussed earlier, the led walking evidence has been much debated during the NICE guidance development. The estimated net benefits for each led walking scenario are generally lower than for the other interventions examined. If one does not believe that 100% of the before and after effect seen in some of the studies would accrue in practice then the estimated net benefits are lower still (e.g. 50% effect £854m, 10% effect £39m). Again, this does not mean that decision makers should ignore led walking as an option within a mix of interventions but, at least from a health economics interpretation, one would probably not want to see it as the single intervention used by decision makers to achieve cost-effective sustained behaviour change in walking and cycling.

Table 4.55 summarises a similar framework of results for the “what if” scenarios.

Run	Intervention	Risk function	Decay	Notes	QALY gain	Cost	Cost per QALY	INB at £20,000 threshold (x106)
22	£1 pp: 1% become active	Step	Nil	18.9% uptake	84,271	£9,906,247	£118	1,676
23	£100pp: 1% become active			7.7% uptake	42,575	£402,997,296	£9,465	449
24	£1000pp: 1% become active					£4,029,972,958	£94,655	-3,178
25	£50pp: 1% become active	Step	Nil	7.7% uptake	42,575	£201,498,648	£4,733	650
26			25%		5,029		£40,068	-101
27			50%		3,041		£66,255	-141
28			100%		2,033		£99,119	-161
29	£10pp: 1% become active	Step	Nil	7.7% uptake	42,575	£40,299,730	£947	811
30			25%		5,029		£8,014	60
31			50%		3,041		£13,251	21
32			100%		2,033		£19,824	0
33	£10pp: Ten minutes more walking per week	Continuous	Nil	7.7% uptake	938,794	£40,299,730	£43	18,736
34			50%		60,522		£666	1,170
35			100%		40,663		£991	773
36	£10pp: Ten minutes more cycling per week	Continuous	Nil	7.7% uptake	1,016,695	£40,299,730	£40	20,294
37			50%		65,358		£617	1,267
38			100%		43,909		£918	838

Table 4.55 Cost benefit comparison across ‘what if’ scenarios

Summary

Again, to emphasis the point, the implication of these analyses is not that decision makers should only implement the intervention suggested as having the lowest cost per QALY (or highest incremental net benefit) because clearly local context issues, feasibility and timing of implementations, the value of a mix of measures to encourage different subgroups within the population and local setting are all going to be important. It does however mean that local decision makers should begin to consider, estimate and monitor the effectiveness of the measures they put in place to encourage walking and cycling and their costs, based on their local needs and existing resources.

4.7 Comparison of Results across Interventions in Terms of Environmental Effects

The DfT methodology for deriving environmental benefits, involves putting a monetary value on marginal car use, directly linked to the distance travelled. For the purpose of modelling, it was therefore necessary to estimate the change in car distance resulting from each intervention, and a number of methods were used. For Sustainable Travel Towns and TravelSmart, direct evidence was available on the reduction in the number of car trips made, and for these, a corresponding distance was calculated using the average car-trip distance from the NTS. For the Cycling Demonstration Towns, evidence was available on the increase in the number of cycle journeys made. From this, a mean time spent cycling per week was derived, and used in the NTS regression to derive an expected change in car distance. This method was repeated using the mode and purpose regression, to obtain the corresponding reduction if the observed increase in cycle trips applied only to commuting. Finally, the pedometer interventions provided data on the increase in walking time, which was applied directly in the NTS regression; the approach repeated for the hypothetical scenarios that produce ten minutes more cycling or walking from a £10 per person intervention using the respective input variable.

For comparison, a ten-year time-horizon was adopted, with future benefits discounted at an annual rate of 3.5%. These future benefits were accrued in line with the available evidence on the level of decay in effect. Thus, the pedometers study with no sustained effect (Baker 2008a) had no benefit after year 1,and the pedometers study with a sustained effect (Baker 2008b) declined to 87% effect after year 1, and remained at that level. For the Australian pedometer evidence (Merom), we estimated a decline by 40% of the original effect per year to zero, while for the hypothetical cases of ten minutes increase in walking or cycling we assumed full effectiveness for the ten years. Cycle Demonstration Towns, Sustainable Travel Towns and TravelSmart were also assumed to remain at full effectiveness over ten years.

Results, showing a weighted average reflecting the road mix across the country, are tabulated below in **Error! Reference source not found.**. The Cycle Demonstration Towns, for example, is estimated to save over 190 million vehicle kilometres each year (using the regression method from **Error! Reference source not found.** and **Error! Reference source not found.**). With congestion benefits valued at 13.1 pence per vehicle kilometre (see **Error! Reference source not found.**2), this translates to a discounted monetary value of £343 million over ten years. Other environmental outcomes were treated in the same manner, using their corresponding values. Indirect taxation shows a negative value, reflecting the loss in tax revenue from fuel duty and vehicle registrations. Also shown is the amount of carbon emissions saved, estimated at 112,336 tonnes over ten years for Cycling Demonstration Towns, and computed using DfT assumptions directly relating to the vehicle distance via fleet mixture and fuel-efficiency data. Including the cost of each intervention allows the cost per kilometre saved, cost per tonne of carbon saved, and an illustrative benefit-cost ratio to be calculated. The cost of the Cycling Demonstration Towns intervention, if implemented all across England (modelled by uplifting the local costs on a pro-rata population basis to England), was estimated at £1,568m. The cost per km saved over ten years was estimated at £1.33 and the cost per tonne of carbon saved over ten years at £13,961. The benefit-cost ratio shown has as numerator the total transport related valued benefits over ten years (£311m) divided by the denominator of the intervention cost over ten years (£1,568m) giving a cost-benefit ratio estimated for Cycling Demonstration Towns of 0.20.

It should be noted that the benefit-cost ratios shown here are for illustration, using the full cost of each intervention applied to only the specific subset of transport-related outcomes listed in the table, and they should therefore be interpreted only within this context. They are very different from, and much lower than, values that would be obtained from a more comprehensive cost-benefit analysis. This fuller analysis would include health benefits (assessed here using the QALY and cost per QALY framework used by NICE), and other wider economic and societal benefits and losses. This is an important issue when considering interventions with a large infrastructure cost, or those where the benefits are expected to come mainly from health improvements.

When comparing across the table, it is important to recognise that we have had to use different methods to estimate the annual car distance reduction for different interventions because of the different evidence available. Thus, the results comparison across interventions is not like-for-like. In particular, it can be seen that the Cycling Demonstration Towns car distance reduction estimates are an order of magnitude lower than those for Sustainable Travel Towns. That could be because for Cycling Demonstration Towns we have linked percentage increase in cycling trips to a mean increased bike-time per cyclist per week (assuming no effect on non-cyclists), and hence to a reduced car distance using the regressions.

In the second column of results in Table 4.57, we show the effect of assuming that all of the increased cycling is commuting based. For this, we used the more detailed regression that estimates effects on car distance dependent on the different purposes of the cycling journeys as shown in Tables 3.6 and 3.7. The effect of this would be to increase the estimated car miles reduction to 553m from 190m, which in turn would increase the estimated benefit-cost ratio from 0.20 to 0.58.

The results show much larger estimated reductions in car distance travelled for Sustainable Travel Towns and TravelSmart (7,7731, and 4,414 respectively), again potentially because more direct evidence was available rather than using the regressions. The resulting costs per km. saved are much lower than those estimated for Cycling Demonstration Towns, and the benefit-cost ratios are more favourable, i.e. 5.17 for Sustainable Travel Towns, and 51,22 for TravelSmart. TravelSmart has such a high benefit-cost ratio estimate here because the costs estimated (£141m) are an order of magnitude lower than those estimated for Sustainable Travel towns (£2,453m). These results appear to suggest that, if only these environmental outcomes were considered, TravelSmart would be the most cost-effective intervention, followed by the Sustainable Travel Towns programme.

The three pedometer intervention scenarios examined show substantial reductions in car distance. These are estimated indirectly assuming the NTS overall regression is applied given increases in walk time for every individual taking up the intervention. The pedometer interventions produce estimated benefit-cost ratios around 1.49 to 2.63 depending on the evidence and assumptions used. Here, as the additional benefits of the sustained effect (Baker b versus Baker a) are calculated, the costs also rise (due to the costs of maintaining support to continue encouraging pedometer use and increased walking behaviours), and these two effects balance each other out, leaving a benefit-cost ratio of similar order of magnitude.

The following table, Table 4.57 shows a set of sensitivity analyses that illustrates the different results that would apply if the reduced vehicle distances were applied solely to each individual road type. For the subsets of roads considered, removing traffic from A roads in conurbations has the greatest environmental benefit. For example, a 3.5 fold increase in the value of transport-related benefits for Cycling Demonstration Towns, raising the associated benefit-cost ratio to 0.90, from the 0.20 in Table 4.56. Removing traffic from other roads in conurbations is the next beneficial, followed by A roads in other urban areas. Interventions that remove vehicular traffic from minor roads in rural areas have a much lower, and below average, benefit. This effect is mainly due to the differential value placed on congestion reduction (see Table 3.32).

	Cycling Demonstation Towns	Sustainable Travel Towns (DfT)	Sustainable Travel Towns (Smarter Choice)	TravelSmart	Baker a	Baker b	Merom	10 minutes more walking (£10)	10 minutes more cycing (£10)
Model run	1&2	3	4	5&6	7&8	9,10,11 &12	13&14	33	36
Method for estimating car distance	B	C	A	A	A	D	D	D	D
Annual car distance reduction(miles)	190,196,818	7,731,689,202	8,243,147,439	4,414,569,046	2,907,097,283	2,561,279,230	1,087,370,622	14,278,948	200,177,614
Vehicle kilometres saved per year	118,183,117	4,804,260,878	5,122,067,083	2,743,092,849	1,806,390,994	1,591,509,084	675,662,459	8,872,549	124,384,912
Congestion	£40,097,966	£1,630,022,088	£1,737,849,524	£930,695,074	£612,884,540	£539,977,954	£229,243,324	£3,010,338	£42,202,153
Infrastucture	£306,091	£12,442,917	£13,266,027	£7,104,543	£4,678,508	£4,121,969	£1,749,949	£22,980	£322,154
Accident	£4,591,370	£186,643,751	£198,990,403	£106,568,138	£70,177,619	£61,829,537	£26,249,236	£344,695	£4,832,308
Local air quality	£1,224,365	£49,771,667	£53,064,108	£28,418,170	£18,714,032	£16,487,876	£6,999,796	£91,919	£1,288,615
Noise	£306,091	£12,442,917	£13,266,027	£7,104,543	£4,678,508	£4,121,969	£1,749,949	£22,980	£322,154
Greenhouse gases	£918,274	£37,328,750	£39,798,081	£21,313,628	£14,035,524	£12,365,907	£5,249,847	£68,939	£966,462
Indirect Tax	-£11,019,288	-£447,945,001	-£477,576,968	-£255,763,532	-£168,426,286	-£148,390,888	-£62,998,165	-£827,269	-£11,597,538
Total environmental benefits	£36,424,870	£1,480,707,087	£1,578,657,201	£845,440,563	£556,742,445	£490,514,325	£208,243,935	£2,734,582	£38,336,307
Intervention cost	£1,568,292,630	£2,453,367,344	£2,453,367,344	£141,361,007	£211,573,580	£2,502,488,813	£159,855,594	£40,299,730	£40,299,730
Cost per km saved	£13.27	£0.51	£0.48	£0.05	£0.12	£1.57	£0.24	£4.54	£0.32
Net saving/cost	-£1,531,867,760	-£972,660,257	-£874,710,143	£704,079,556	£345,168,865	-£2,011,974,488	£48,388,341	-£37,565,148	-£1,963,423
Benefit/cost ratio	0.02	0.60	0.64	5.98	2.63	0.20	1.30	0.07	0.95
Tonnes of carbon saved per year	13,118	533,268	568,544	304,480	200,507	176,656	74,998	985	13,807
Cost per tonne of carbon	£119,551	£4,601	£4,315	£464	£1,055	£14,166	£2,131	£40,920	£2,919

Table 4.54 Comparison of results across Interventions in terms of environmental effects and cost-benefit

Method used to estimate car distance saving:

A – direct evidence is available on reduced car trips, and we assume the average NTS car trip distance

B – indirect evidence on increase in cycling trips -□ increase in mean biketime -□ increase in car distance via NTS overall regression

C – indirect evidence on increase in cycling trips -□ increase in mean biketime -□ car distance via NTS purpose=commuting regression

D – indirect evidence on increase walktime or biketime -□ increase in car distance via NTS overall regression

	Cycling Demonstation Towns	CDT: cycling increase applied to commuting	Sustainable Travel Towns (DfT)	Sustainable Travel Towns (Smarter Choice)	TravelSmart	Baker a	Baker b	Merom	10 minutes more walking (£10)	10 minutes more cycing (£10)
Conurbation: A roads										
Ten year environmental benefits	£1,412,811,438	£4,111,308,901	£57,432,185,523	£61,231,376,565	£32,792,102,972	£2,521,715,780	£16,841,080,128	£1,665,018,856	£106,066,238	£1,486,950,337
Intervention cost	£1,568,292,630	£1,568,292,630	£2,453,367,344	£2,453,367,344	£141,361,007	£211,573,580	£2,502,488,813	£159,855,594	£40,299,730	£40,299,730
Discounted benefit/cost ratio	0.90	2.62	23.41	24.96	231.97	11.92	6.73	10.42	2.63	36.90
Tonnes of carbon saved (ten years)	149,781	435,866	6,088,755	6,491,532	3,476,502	267,343	1,785,431	176,519	11,245	157,641
Cost per tonne of carbon saved	£10,471	£3,598	£403	£378	£41	£791	£1,402	£906	£3,584	£256
Conurbation: other roads										
Ten year environmental benefits	£684,125,761	£1,990,819,338	£27,810,390,393	£29,650,072,882	£15,878,921,847	£1,221,090,573	£8,154,957,168	£806,252,174	£51,360,461	£720,026,044
Intervention cost	£1,568,292,630	£1,568,292,630	£2,453,367,344	£2,453,367,344	£141,361,007	£211,573,580	£2,502,488,813	£159,855,594	£40,299,730	£40,299,730
Discounted benefit/cost ratio	0.44	1.27	11.34	12.09	112.33	5.77	3.26	5.04	1.27	17.87
Tonnes of carbon saved (ten years)	149,781	435,866	6,088,755	6,491,532	3,476,502	267,343	1,785,431	176,519	11,245	157,641
Cost per tonne of carbon saved	£10,471	£3,598	£403	£378	£41	£791	£1,402	£906	£3,584	£256
Other urban: A roads										
Ten year environmental benefits	£600,248,273	£1,746,734,208	£24,400,687,356	£26,014,814,904	£13,932,080,854	£1,071,378,319	£7,155,115,676	£707,401,332	£45,063,393	£631,746,989
Intervention cost	£1,568,292,630	£1,568,292,630	£2,453,367,344	£2,453,367,344	£141,361,007	£211,573,580	£2,502,488,813	£159,855,594	£40,299,730	£40,299,730
Discounted benefit/cost ratio	0.38	1.11	9.95	10.60	98.56	5.06	2.86	4.43	1.12	15.68
Tonnes of carbon saved (ten years)	112,336	326,900	4,566,567	4,868,649	2,607,376	200,507	1,339,073	132,390	8,434	118,231
Cost per tonne of carbon saved	£13,961	£4,797	£537	£504	£54	£1,055	£1,869	£1,207	£4,778	£341
Rural: other roads										
Ten year environmental benefits	£102,225,688	£297,478,752	£4,155,575,576	£4,430,470,661	£2,372,712,460	£182,461,810	£1,218,556,818	£120,474,463	£7,674,552	£107,590,099
Intervention cost	£1,568,292,630	£1,568,292,630	£2,453,367,344	£2,453,367,344	£141,361,007	£211,573,580	£2,502,488,813	£159,855,594	£40,299,730	£40,299,730
Discounted benefit/cost ratio	0.07	0.19	1.69	1.81	16.78	0.86	0.49	0.75	0.19	2.67
Tonnes of carbon saved (ten years)	112,336	326,900	4,566,567	4,868,649	2,607,376	200,507	1,339,073	132,390	8,434	118,231
Cost per tonne of carbon saved	£13,961	£4,797	£537	£504	£54	£1,055	£1,869	£1,207	£4,778	£341

Table 4.55 Sensitivity analysis for congestion results if kilometres driven reductions were on different road types

4.8 What-If Analyses to Investigate Trade-Offs Between Narrow Interventions with Higher Effects per Person, Versus Wider Interventions with Smaller Effects per Person

In this section, we consider the balance of costs and effects that accrue for interventions designed for small numbers of people, having a large effect per person, versus interventions designed for much wider populations and having a smaller effect per person. In particular, we also consider the issue of the proportion of people achieving uptake of the intervention from the wider population to whom it is offered.

<u>Example scenario</u>

To illustrate the effects we have developed an example scenario. This consists of:

- An intervention to encourage walking and cycling which achieves an overall increase in physical activity of X minutes per week for each individual who takes up the offer of the intervention.
- We let the effect of the effectiveness of the intervention, which is gained only by those who take up the offer range from X=5 minutes up to X=60 minutes extra physical activity per week in the analyses.
- We let the proportion of people responding to the offer and taking up the intervention (and hence getting the individual benefit of X minutes per week physical activity) range from 0.5% of the population aged 18 or over (1 in 200) all the way up to 100% of the over 18's.
- For illustration, we assume that if 100% uptake were achieved then the cost per person would be £40 for the intervention. This cost is split into two parts – the cost of the offer made to the whole population, and the cost of the intervention provided to those who take it up. So for example, one scenario would be it costs £4 per person to make the offer of the intervention widely known (e.g. by leafleting and advertising), and £36 per person taking up the offer (e.g. a guided walks / cycling advice leaflet and interactive taster session tailored to the local area).
- We analyse 7 scenarios for the balance of costs between the offer and the uptake cost per person with the (offer cost, uptake cost) set at (£0,£40), (£4,£36), (£10,£30), (£20:£20), (£30,£10), (£36,£4), (£40,£0).
- These 7 scenarios are examined with 3 different levels of decay i.e.

- 0% decay – the effect in terms of extra physical activity is sustained for a lifetime,
- 50% - the effect is diminished in year 2 and disappeared by the end of year 3
- 100% decay – the effect has disappeared after year 1.

Table 4.56, Table 4.57, and Table 4.60 show the Cost per QALY gained for each of these what if scenarios for 0%, 50% and 100% decay respectively.

Table 4.56 for 0% decay shows 7 sub-tables starting at the top when all the costs are related to the offer i.e. offer cost = £0, uptake cost = £40, through to the bottom where the balance between the offer component and uptake component of costs is reversed i.e. £40 offer cost, £0 uptake cost.

When the offer cost is small (e.g. in the topmost sub-table where offer cost = £0) then the effect of uptake is negligible. The cost per QALY remains around £300 to £600 for all of the scenarios, whether the uptake is as low as 0.5% or as high as 100%.

Looking across the rows in the topmost sub-table, one sees a trend whereby the higher the level of effect, the lower the cost-per QALY i.e. the greater the effect the more cost-effective the intervention. This is not a linear relationship however, because of the relative risk function used. The continuous logarithmic relative risk function – (see Figure 3.4) means that increasing levels of physical activity by 5 minutes is more beneficial for those who are not physically active than for those who are. Therefore, increasing physical activity by say 60 minutes is not twice as beneficial as increasing physical activity by 30 minutes; a kind of diminishing returns.

As we move down through the sub-tables, and the offer cost becomes a higher component of the total cost, then it becomes clear how important the level of uptake is. For example when the offer cost is 50% of the total cost i.e. both offer cost and uptake cost are £20, then cost per QALY becomes sensitive to uptake and in these scenarios an uptake of 1**%** or less would not be cost effective (i.e. cost per QALY increases to higher than a threshold of £20,000). If the offer cost were 100% of the total cost e.g. media campaigns with no direct cost for uptake then an uptake of 2**%** or less would possibly not be cost effective.

The equivalent pattern of effects is seen when decay is 50% or 100%, only more so.

At 50% decay, when both offer cost and uptake cost are £20, then cost per QALY becomes very sensitive to uptake and in these scenarios an uptake of 10**%** or less would not be cost effective (i.e. cost per QALY increases to higher than a threshold of £20,000). If the offer cost is 100% of the cost with no direct cost for uptake then an uptake of 25**%** or less would possibly not be cost effective.

At 100% decay, when both offer cost and uptake cost are £20, then cost per QALY becomes very sensitive to uptake and in these scenarios an uptake of 25% or less would not be cost effective (i.e. cost per QALY increases to higher than a threshold of £20,000). If the offer cost were 100% of the cost with no direct cost for uptake then an uptake of 50% or less would possibly not be cost effective.

What If Analyses on Offer Cost and Uptake						Decay =	0%	
Cost/person	% cost that is Offer							
£ 40.00	0%	Offer Cost per person	£ -	Uptake cost per person	£ 40.00		Total Offer Cost	£ -
% Uptake achieved	Total Cost	5 mins extra Physical activity	10 mins extra Physical activity	15 mins extra Physical activity	20 mins extra Physical activity	30 mins extra Physical activity	45 mins extra Physical activity	60 mins extra Physical activity
100.0%	£ 1,680,000,000	£ 587	£ 504	£ 464	£ 437	£ 403	£ 372	£ 352
50.0%	£ 840,000,000	£ 585	£ 503	£ 462	£ 436	£ 402	£ 372	£ 352
25.0%	£ 420,000,000	£ 635	£ 548	£ 505	£ 477	£ 440	£ 407	£ 385
10.0%	£ 168,000,000	£ 513	£ 443	£ 409	£ 386	£ 357	£ 331	£ 314
5.0%	£ 84,000,000	£ 496	£ 428	£ 395	£ 373	£ 345	£ 320	£ 304
2.0%	£ 33,600,000	£ 422	£ 365	£ 337	£ 319	£ 297	£ 277	£ 263
1.0%	£ 16,800,000	£ 703	£ 614	£ 569	£ 539	£ 500	£ 465	£ 441
0.5%	£ 8,400,000	£ 573	£ 493	£ 454	£ 428	£ 394	£ 364	£ 344
£ 40.00	10%	Offer Cost/pers	£ 4.00	Uptake cost pp	£ 36.00		Total Offer Cost	£ 168,000,000
100.0%	£ 1,680,000,000	£ 587	£ 504	£ 464	£ 437	£ 403	£ 372	£ 352
50.0%	£ 924,000,000	£ 643	£ 553	£ 509	£ 480	£ 443	£ 409	£ 387
25.0%	£ 546,000,000	£ 825	£ 713	£ 656	£ 620	£ 572	£ 529	£ 501
10.0%	£ 319,200,000	£ 975	£ 842	£ 776	£ 734	£ 679	£ 629	£ 596
5.0%	£ 243,600,000	£ 1,440	£ 1,242	£ 1,145	£ 1,082	£ 1,002	£ 929	£ 881
2.0%	£ 198,240,000	£ 2,489	£ 2,153	£ 1,989	£ 1,885	£ 1,751	£ 1,631	£ 1,554
1.0%	£ 183,120,000	£ 7,668	£ 6,697	£ 6,203	£ 5,879	£ 5,455	£ 5,064	£ 4,806
0.5%	£ 175,560,000	£ 11,972	£ 10,311	£ 9,480	£ 8,940	£ 8,237	£ 7,598	£ 7,181
£ 40.00	25%	Offer Cost/pers	£ 10.00	Uptake cost pp	£ 30.00		Total Offer Cost	£ 420,000,000
100.0%	£ 1,680,000,000	£ 587	£ 504	£ 464	£ 437	£ 403	£ 372	£ 352
50.0%	£ 1,050,000,000	£ 731	£ 629	£ 578	£ 545	£ 503	£ 465	£ 440
25.0%	£ 735,000,000	£ 1,111	£ 959	£ 884	£ 834	£ 770	£ 712	£ 674
10.0%	£ 546,000,000	£ 1,668	£ 1,440	£ 1,328	£ 1,255	£ 1,161	£ 1,076	£ 1,020
5.0%	£ 483,000,000	£ 2,855	£ 2,462	£ 2,270	£ 2,146	£ 1,986	£ 1,841	£ 1,747
2.0%	£ 445,200,000	£ 5,589	£ 4,834	£ 4,468	£ 4,233	£ 3,933	£ 3,664	£ 3,489
1.0%	£ 432,600,000	£ 18,115	£ 15,821	£ 14,655	£ 13,890	£ 12,886	£ 11,963	£ 11,354
0.5%	£ 426,300,000	£ 29,070	£ 25,038	£ 23,020	£ 21,707	£ 20,002	£ 18,451	£ 17,437
£ 40.00	50%	Offer Cost/pers	£ 20.00	Uptake cost pp	£ 20.00		Total Offer Cost	£ 840,000,000
100.0%	£ 1,680,000,000	£ 587	£ 504	£ 464	£ 437	£ 403	£ 372	£ 352
50.0%	£ 1,260,000,000	£ 877	£ 754	£ 694	£ 654	£ 604	£ 558	£ 528
25.0%	£ 1,050,000,000	£ 1,587	£ 1,371	£ 1,262	£ 1,192	£ 1,101	£ 1,017	£ 963
10.0%	£ 924,000,000	£ 2,822	£ 2,437	£ 2,247	£ 2,124	£ 1,965	£ 1,820	£ 1,726
5.0%	£ 882,000,000	£ 5,213	£ 4,496	£ 4,145	£ 3,918	£ 3,626	£ 3,362	£ 3,190
2.0%	£ 856,800,000	£ 10,757	£ 9,304	£ 8,598	£ 8,147	£ 7,570	£ 7,051	£ 6,714
1.0%	£ 848,400,000	£ 35,526	£ 31,027	£ 28,740	£ 27,240	£ 25,273	£ 23,462	£ 22,267
0.5%	£ 844,200,000	£ 57,567	£ 49,583	£ 45,587	£ 42,987	£ 39,610	£ 36,538	£ 34,531
£ 40.00	75%	Offer Cost/pers	£ 30.00	Uptake cost pp	£ 10.00		Total Offer Cost	£ 1,260,000,000
100.0%	£ 1,680,000,000	£ 587	£ 504	£ 464	£ 437	£ 403	£ 372	£ 352
50.0%	£ 1,470,000,000	£ 1,023	£ 880	£ 809	£ 763	£ 704	£ 651	£ 616
25.0%	£ 1,365,000,000	£ 2,063	£ 1,782	£ 1,641	£ 1,549	£ 1,431	£ 1,323	£ 1,252
10.0%	£ 1,302,000,000	£ 3,977	£ 3,435	£ 3,166	£ 2,992	£ 2,768	£ 2,565	£ 2,433
5.0%	£ 1,281,000,000	£ 7,571	£ 6,531	£ 6,019	£ 5,690	£ 5,267	£ 4,883	£ 4,633
2.0%	£ 1,268,400,000	£ 15,925	£ 13,774	£ 12,729	£ 12,061	£ 11,206	£ 10,438	£ 9,940
1.0%	£ 1,264,200,000	£ 52,937	£ 46,233	£ 42,826	£ 40,590	£ 37,659	£ 34,961	£ 33,181
0.5%	£ 1,262,100,000	£ 86,064	£ 74,128	£ 68,154	£ 64,266	£ 59,218	£ 54,625	£ 51,624
£ 40.00	90%	Offer Cost/pers	£ 36.00	Uptake cost pp	£ 4.00		Total Offer Cost	£ 1,512,000,000
100.0%	£ 1,680,000,000	£ 587	£ 504	£ 464	£ 437	£ 403	£ 372	£ 352
50.0%	£ 1,596,000,000	£ 1,111	£ 955	£ 878	£ 829	£ 765	£ 707	£ 669
25.0%	£ 1,554,000,000	£ 2,349	£ 2,028	£ 1,868	£ 1,764	£ 1,629	£ 1,506	£ 1,425
10.0%	£ 1,528,800,000	£ 4,670	£ 4,033	£ 3,717	£ 3,514	£ 3,250	£ 3,012	£ 2,856
5.0%	£ 1,520,400,000	£ 8,986	£ 7,751	£ 7,144	£ 6,754	£ 6,251	£ 5,796	£ 5,499
2.0%	£ 1,515,360,000	£ 19,025	£ 16,455	£ 15,207	£ 14,409	£ 13,388	£ 12,471	£ 11,875
1.0%	£ 1,513,680,000	£ 63,384	£ 55,357	£ 51,278	£ 48,600	£ 45,090	£ 41,860	£ 39,728
0.5%	£ 1,512,840,000	£ 103,163	£ 88,855	£ 81,694	£ 77,034	£ 70,983	£ 65,477	£ 61,880
£ 40.00	100%	Offer Cost/pers	£ 40.00	Uptake cost pp	£ -		Total Offer Cost	£ 1,680,000,000
100.0%	£ 1,680,000,000	£ 587	£ 504	£ 464	£ 437	£ 403	£ 372	£ 352
50.0%	£ 1,680,000,000	£ 1,170	£ 1,006	£ 925	£ 872	£ 805	£ 744	£ 704
25.0%	£ 1,680,000,000	£ 2,539	£ 2,193	£ 2,020	£ 1,907	£ 1,761	£ 1,628	£ 1,541
10.0%	£ 1,680,000,000	£ 5,132	£ 4,432	£ 4,085	£ 3,861	£ 3,572	£ 3,310	£ 3,139
5.0%	£ 1,680,000,000	£ 9,929	£ 8,565	£ 7,894	£ 7,463	£ 6,907	£ 6,404	£ 6,076
2.0%	£ 1,680,000,000	£ 21,092	£ 18,243	£ 16,859	£ 15,975	£ 14,842	£ 13,826	£ 13,165
1.0%	£ 1,680,000,000	£ 70,349	£ 61,439	£ 56,912	£ 53,940	£ 50,045	£ 46,460	£ 44,094
0.5%	£ 1,680,000,000	£ 114,562	£ 98,673	£ 90,720	£ 85,546	£ 78,826	£ 72,712	£ 68,718

Table 4.56: What-If Analysis Results Examining Offer Cost and Uptake Cost for a Range of levels of Effect and Uptake: Scenarios with No Decay

What If Analyses on Offer Cost and Uptake					Decay =	50%		
Cost/person	% cost that is Offer							
£ 40.00	0%	Offer Cost per person	£ -	Uptake cost per person	£ 40.00		Total Offer Cost	£ -
% Uptake achieved	Total Cost	5 mins extra Physical activity	10 mins extra Physical activity	15 mins extra Physical activity	20 mins extra Physical activity	30 mins extra Physical activity	45 mins extra Physical activity	60 mins extra Physical activity
100.0%	£ 1,680,000,000	£ 7,226	£ 6,229	£ 5,733	£ 5,411	£ 4,994	£ 4,614	£ 4,366
50.0%	£ 840,000,000	£ 7,190	£ 6,198	£ 5,705	£ 5,386	£ 4,972	£ 4,596	£ 4,350
25.0%	£ 420,000,000	£ 7,600	£ 6,576	£ 6,062	£ 5,727	£ 5,291	£ 4,893	£ 4,632
10.0%	£ 168,000,000	£ 6,310	£ 5,460	£ 5,036	£ 4,762	£ 4,406	£ 4,083	£ 3,871
5.0%	£ 84,000,000	£ 6,182	£ 5,339	£ 4,921	£ 4,651	£ 4,302	£ 3,985	£ 3,778
2.0%	£ 33,600,000	£ 5,364	£ 4,645	£ 4,293	£ 4,068	£ 3,777	£ 3,515	£ 3,344
1.0%	£ 16,800,000	£ 8,041	£ 7,014	£ 6,492	£ 6,148	£ 5,698	£ 5,283	£ 5,010
0.5%	£ 8,400,000	£ 6,567	£ 5,669	£ 5,218	£ 4,924	£ 4,542	£ 4,194	£ 3,966
£ 40.00	10%	Offer Cost/pers	£ 4.00	Uptake cost pp	£ 36.00		Total Offer Cost	£ 168,000,000
100.0%	£ 1,680,000,000	£ 7,226	£ 6,229	£ 5,733	£ 5,411	£ 4,994	£ 4,614	£ 4,366
50.0%	£ 924,000,000	£ 7,909	£ 6,818	£ 6,276	£ 5,924	£ 5,469	£ 5,056	£ 4,786
25.0%	£ 546,000,000	£ 9,880	£ 8,549	£ 7,881	£ 7,445	£ 6,878	£ 6,361	£ 6,022
10.0%	£ 319,200,000	£ 11,990	£ 10,374	£ 9,569	£ 9,047	£ 8,371	£ 7,757	£ 7,355
5.0%	£ 243,600,000	£ 17,927	£ 15,482	£ 14,271	£ 13,488	£ 12,475	£ 11,556	£ 10,955
2.0%	£ 198,240,000	£ 31,647	£ 27,407	£ 25,331	£ 23,999	£ 22,285	£ 20,739	£ 19,732
1.0%	£ 183,120,000	£ 87,648	£ 76,454	£ 70,758	£ 67,016	£ 62,108	£ 57,588	£ 54,604
0.5%	£ 175,560,000	£ 137,247	£ 118,485	£ 109,060	£ 102,918	£ 94,929	£ 87,650	£ 82,888
£ 40.00	25%	Offer Cost/pers	£ 10.00	Uptake cost pp	£ 30.00		Total Offer Cost	£ 420,000,000
100.0%	£ 1,680,000,000	£ 7,226	£ 6,229	£ 5,733	£ 5,411	£ 4,994	£ 4,614	£ 4,366
50.0%	£ 1,050,000,000	£ 8,988	£ 7,748	£ 7,131	£ 6,732	£ 6,215	£ 5,745	£ 5,438
25.0%	£ 735,000,000	£ 13,300	£ 11,509	£ 10,608	£ 10,022	£ 9,259	£ 8,563	£ 8,106
10.0%	£ 546,000,000	£ 20,509	£ 17,744	£ 16,368	£ 15,475	£ 14,319	£ 13,269	£ 12,581
5.0%	£ 483,000,000	£ 35,545	£ 30,698	£ 28,296	£ 26,743	£ 24,736	£ 22,913	£ 21,722
2.0%	£ 445,200,000	£ 71,072	£ 61,549	£ 56,888	£ 53,895	£ 50,048	£ 46,576	£ 44,314
1.0%	£ 432,600,000	£ 207,058	£ 180,613	£ 167,157	£ 158,317	£ 146,722	£ 136,046	£ 128,997
0.5%	£ 426,300,000	£ 333,266	£ 287,710	£ 264,824	£ 249,909	£ 230,509	£ 212,834	£ 201,272
£ 40.00	50%	Offer Cost/pers	£ 20.00	Uptake cost pp	£ 20.00		Total Offer Cost	£ 840,000,000
100.0%	£ 1,680,000,000	£ 7,226	£ 6,229	£ 5,733	£ 5,411	£ 4,994	£ 4,614	£ 4,366
50.0%	£ 1,260,000,000	£ 10,786	£ 9,298	£ 8,558	£ 8,078	£ 7,458	£ 6,894	£ 6,526
25.0%	£ 1,050,000,000	£ 19,000	£ 16,441	£ 15,155	£ 14,317	£ 13,227	£ 12,233	£ 11,580
10.0%	£ 924,000,000	£ 34,708	£ 30,029	£ 27,699	£ 26,189	£ 24,232	£ 22,455	£ 21,291
5.0%	£ 882,000,000	£ 64,909	£ 56,056	£ 51,671	£ 48,836	£ 45,169	£ 41,841	£ 39,666
2.0%	£ 856,800,000	£ 136,780	£ 118,453	£ 109,483	£ 103,723	£ 96,319	£ 89,637	£ 85,283
1.0%	£ 848,400,000	£ 406,076	£ 354,212	£ 327,823	£ 310,487	£ 287,747	£ 266,809	£ 252,984
0.5%	£ 844,200,000	£ 659,966	£ 569,751	£ 524,430	£ 494,893	£ 456,477	£ 421,474	£ 398,577
£ 40.00	75%	Offer Cost/pers	£ 30.00	Uptake cost pp	£ 10.00		Total Offer Cost	£ 1,260,000,000
100.0%	£ 1,680,000,000	£ 7,226	£ 6,229	£ 5,733	£ 5,411	£ 4,994	£ 4,614	£ 4,366
50.0%	£ 1,470,000,000	£ 12,583	£ 10,847	£ 9,984	£ 9,425	£ 8,701	£ 8,043	£ 7,613
25.0%	£ 1,365,000,000	£ 24,700	£ 21,373	£ 19,701	£ 18,612	£ 17,196	£ 15,902	£ 15,054
10.0%	£ 1,302,000,000	£ 48,906	£ 42,314	£ 39,030	£ 36,902	£ 34,146	£ 31,641	£ 30,001
5.0%	£ 1,281,000,000	£ 94,272	£ 81,415	£ 75,047	£ 70,928	£ 65,603	£ 60,769	£ 57,610
2.0%	£ 1,268,400,000	£ 202,488	£ 175,358	£ 162,078	£ 153,551	£ 142,589	£ 132,697	£ 126,253
1.0%	£ 1,264,200,000	£ 605,093	£ 527,811	£ 488,489	£ 462,656	£ 428,771	£ 397,572	£ 376,971
0.5%	£ 1,262,100,000	£ 986,665	£ 851,791	£ 784,035	£ 739,878	£ 682,444	£ 630,115	£ 595,883
£ 40.00	90%	Offer Cost/pers	£ 36.00	Uptake cost pp	£ 4.00		Total Offer Cost	£ 1,512,000,000
100.0%	£ 1,680,000,000	£ 7,226	£ 6,229	£ 5,733	£ 5,411	£ 4,994	£ 4,614	£ 4,366
50.0%	£ 1,596,000,000	£ 13,662	£ 11,777	£ 10,840	£ 10,233	£ 9,447	£ 8,733	£ 8,266
25.0%	£ 1,554,000,000	£ 28,120	£ 24,332	£ 22,429	£ 21,190	£ 19,576	£ 18,104	£ 17,138
10.0%	£ 1,528,800,000	£ 57,425	£ 49,684	£ 45,829	£ 43,330	£ 40,094	£ 37,152	£ 35,227
5.0%	£ 1,520,400,000	£ 111,890	£ 96,631	£ 89,072	£ 84,184	£ 77,863	£ 72,126	£ 68,376
2.0%	£ 1,515,360,000	£ 241,913	£ 209,500	£ 193,635	£ 183,447	£ 170,352	£ 158,534	£ 150,834
1.0%	£ 1,513,680,000	£ 724,503	£ 631,970	£ 584,889	£ 553,957	£ 513,386	£ 476,029	£ 451,363
0.5%	£ 1,512,840,000	£ 1,182,685	£ 1,021,016	£ 939,799	£ 886,868	£ 818,024	£ 755,299	£ 714,266
£ 40.00	100%	Offer Cost/pers	£ 40.00	Uptake cost pp	£ -		Total Offer Cost	£ 1,680,000,000
100.0%	£ 1,680,000,000	£ 7,226	£ 6,229	£ 5,733	£ 5,411	£ 4,994	£ 4,614	£ 4,366
50.0%	£ 1,680,000,000	£ 14,381	£ 12,397	£ 11,410	£ 10,771	£ 9,944	£ 9,192	£ 8,701
25.0%	£ 1,680,000,000	£ 30,400	£ 26,305	£ 24,248	£ 22,908	£ 21,164	£ 19,572	£ 18,528
10.0%	£ 1,680,000,000	£ 63,105	£ 54,598	£ 50,362	£ 47,616	£ 44,059	£ 40,826	£ 38,712
5.0%	£ 1,680,000,000	£ 123,636	£ 106,774	£ 98,422	£ 93,021	£ 86,037	£ 79,698	£ 75,554
2.0%	£ 1,680,000,000	£ 268,196	£ 232,262	£ 214,673	£ 203,378	£ 188,860	£ 175,758	£ 167,222
1.0%	£ 1,680,000,000	£ 804,110	£ 701,410	£ 649,155	£ 614,825	£ 569,796	£ 528,335	£ 500,958
0.5%	£ 1,680,000,000	£ 1,313,365	£ 1,133,832	£ 1,043,641	£ 984,862	£ 908,411	£ 838,755	£ 793,189

Table 4.57: What-If Analysis Results Examining Offer Cost and Uptake Cost for a Range of levels of Effect and Uptake: Scenarios with 50% Decay per annum

What If Analyses on Offer Cost and Uptake						Decay =	100%	
Cost/person	% cost that is Offer							
£ 40.00	0%	Offer Cost per person	£ -	Uptake cost per person	£ 40.00		Total Offer Cost	£ -
% Uptake achieved	Total Cost	5 mins extra Physical activity	10 mins extra Physical activity	15 mins extra Physical activity	20 mins extra Physical activity	30 mins extra Physical activity	45 mins extra Physical activity	60 mins extra Physical activity
100.0%	£ 1,680,000,000	£ 14,174	£ 12,225	£ 11,254	£ 10,623	£ 9,806	£ 9,062	£ 8,576
50.0%	£ 840,000,000	£ 14,118	£ 12,175	£ 11,209	£ 10,582	£ 9,770	£ 9,033	£ 8,550
25.0%	£ 420,000,000	£ 14,862	£ 12,865	£ 11,860	£ 11,206	£ 10,354	£ 9,576	£ 9,066
10.0%	£ 168,000,000	£ 12,407	£ 10,738	£ 9,906	£ 9,366	£ 8,667	£ 8,031	£ 7,615
5.0%	£ 84,000,000	£ 12,134	£ 10,483	£ 9,664	£ 9,134	£ 8,449	£ 7,827	£ 7,420
2.0%	£ 33,600,000	£ 10,551	£ 9,139	£ 8,448	£ 8,003	£ 7,432	£ 6,916	£ 6,580
1.0%	£ 16,800,000	£ 15,578	£ 13,586	£ 12,574	£ 11,908	£ 11,036	£ 10,233	£ 9,702
0.5%	£ 8,400,000	£ 12,841	£ 11,092	£ 10,213	£ 9,641	£ 8,896	£ 8,216	£ 7,772
£ 40.00	10%	Offer Cost/pers	£ 4.00	Uptake cost pp	£ 36.00		Total Offer Cost	£ 168,000,000
100.0%	£ 1,680,000,000	£ 14,174	£ 12,225	£ 11,254	£ 10,623	£ 9,806	£ 9,062	£ 8,576
50.0%	£ 924,000,000	£ 15,530	£ 13,393	£ 12,329	£ 11,640	£ 10,747	£ 9,936	£ 9,405
25.0%	£ 546,000,000	£ 19,321	£ 16,724	£ 15,419	£ 14,568	£ 13,460	£ 12,449	£ 11,786
10.0%	£ 319,200,000	£ 23,573	£ 20,402	£ 18,821	£ 17,796	£ 16,467	£ 15,259	£ 14,469
5.0%	£ 243,600,000	£ 35,188	£ 30,399	£ 28,025	£ 26,489	£ 24,502	£ 22,697	£ 21,517
2.0%	£ 198,240,000	£ 62,248	£ 53,920	£ 49,841	£ 47,220	£ 43,849	£ 40,806	£ 38,822
1.0%	£ 183,120,000	£ 169,795	£ 148,091	£ 137,052	£ 129,802	£ 120,292	£ 111,535	£ 105,752
0.5%	£ 175,560,000	£ 268,370	£ 231,826	£ 213,461	£ 201,490	£ 185,917	£ 171,722	£ 162,433
£ 40.00	25%	Offer Cost/pers	£ 10.00	Uptake cost pp	£ 30.00		Total Offer Cost	£ 420,000,000
100.0%	£ 1,680,000,000	£ 14,174	£ 12,225	£ 11,254	£ 10,623	£ 9,806	£ 9,062	£ 8,576
50.0%	£ 1,050,000,000	£ 17,648	£ 15,219	£ 14,011	£ 13,227	£ 12,213	£ 11,291	£ 10,688
25.0%	£ 735,000,000	£ 26,009	£ 22,513	£ 20,756	£ 19,610	£ 18,120	£ 16,759	£ 15,866
10.0%	£ 546,000,000	£ 40,323	£ 34,898	£ 32,194	£ 30,440	£ 28,168	£ 26,101	£ 24,749
5.0%	£ 483,000,000	£ 69,769	£ 60,275	£ 55,567	£ 52,521	£ 48,581	£ 45,003	£ 42,663
2.0%	£ 445,200,000	£ 139,795	£ 121,092	£ 111,931	£ 106,044	£ 98,474	£ 91,640	£ 87,185
1.0%	£ 432,600,000	£ 401,121	£ 349,847	£ 323,770	£ 306,641	£ 284,176	£ 263,489	£ 249,828
0.5%	£ 426,300,000	£ 651,665	£ 562,927	£ 518,333	£ 489,265	£ 451,448	£ 416,981	£ 394,425
£ 40.00	50%	Offer Cost/pers	£ 20.00	Uptake cost pp	£ 20.00		Total Offer Cost	£ 840,000,000
100.0%	£ 1,680,000,000	£ 14,174	£ 12,225	£ 11,254	£ 10,623	£ 9,806	£ 9,062	£ 8,576
50.0%	£ 1,260,000,000	£ 21,177	£ 18,263	£ 16,813	£ 15,873	£ 14,655	£ 13,549	£ 12,825
25.0%	£ 1,050,000,000	£ 37,156	£ 32,162	£ 29,651	£ 28,015	£ 25,885	£ 23,941	£ 22,665
10.0%	£ 924,000,000	£ 68,238	£ 59,058	£ 54,482	£ 51,514	£ 47,668	£ 44,172	£ 41,883
5.0%	£ 882,000,000	£ 127,404	£ 110,067	£ 101,470	£ 95,908	£ 88,713	£ 82,179	£ 77,906
2.0%	£ 856,800,000	£ 269,039	£ 233,045	£ 215,414	£ 204,085	£ 189,517	£ 176,363	£ 167,790
1.0%	£ 848,400,000	£ 786,664	£ 686,108	£ 634,967	£ 601,374	£ 557,315	£ 516,745	£ 489,953
0.5%	£ 844,200,000	£ 1,290,489	£ 1,114,761	£ 1,026,453	£ 968,889	£ 894,001	£ 825,745	£ 781,079
£ 40.00	75%	Offer Cost/pers	£ 30.00	Uptake cost pp	£ 10.00		Total Offer Cost	£ 1,260,000,000
100.0%	£ 1,680,000,000	£ 14,174	£ 12,225	£ 11,254	£ 10,623	£ 9,806	£ 9,062	£ 8,576
50.0%	£ 1,470,000,000	£ 24,707	£ 21,307	£ 19,615	£ 18,518	£ 17,098	£ 15,807	£ 14,963
25.0%	£ 1,365,000,000	£ 48,303	£ 41,810	£ 38,546	£ 36,419	£ 33,651	£ 31,124	£ 29,465
10.0%	£ 1,302,000,000	£ 96,154	£ 83,218	£ 76,770	£ 72,588	£ 67,169	£ 62,242	£ 59,017
5.0%	£ 1,281,000,000	£ 185,039	£ 159,859	£ 147,373	£ 139,295	£ 128,845	£ 119,356	£ 113,150
2.0%	£ 1,268,400,000	£ 398,284	£ 344,998	£ 318,896	£ 302,125	£ 280,559	£ 261,086	£ 248,395
1.0%	£ 1,264,200,000	£ 1,172,207	£ 1,022,369	£ 946,164	£ 896,107	£ 830,455	£ 770,001	£ 730,079
0.5%	£ 1,262,100,000	£ 1,929,313	£ 1,666,596	£ 1,534,572	£ 1,448,513	£ 1,336,554	£ 1,234,510	£ 1,167,732
£ 40.00	90%	Offer Cost/pers	£ 36.00	Uptake cost pp	£ 4.00		Total Offer Cost	£ 1,512,000,000
100.0%	£ 1,680,000,000	£ 14,174	£ 12,225	£ 11,254	£ 10,623	£ 9,806	£ 9,062	£ 8,576
50.0%	£ 1,596,000,000	£ 26,824	£ 23,133	£ 21,296	£ 20,105	£ 18,563	£ 17,162	£ 16,245
25.0%	£ 1,554,000,000	£ 54,991	£ 47,599	£ 43,883	£ 41,462	£ 38,310	£ 35,433	£ 33,545
10.0%	£ 1,528,800,000	£ 112,904	£ 97,714	£ 90,143	£ 85,232	£ 78,869	£ 73,084	£ 69,298
5.0%	£ 1,520,400,000	£ 219,620	£ 189,734	£ 174,915	£ 165,328	£ 152,924	£ 141,661	£ 134,296
2.0%	£ 1,515,360,000	£ 475,830	£ 412,170	£ 380,986	£ 360,950	£ 335,184	£ 311,920	£ 296,758
1.0%	£ 1,513,680,000	£ 1,403,533	£ 1,224,126	£ 1,132,882	£ 1,072,947	£ 994,338	£ 921,955	£ 874,155
0.5%	£ 1,512,840,000	£ 2,312,608	£ 1,997,697	£ 1,839,444	£ 1,736,287	£ 1,602,085	£ 1,479,769	£ 1,399,725
£ 40.00	100%	Offer Cost/pers	£ 40.00	Uptake cost pp	£ -		Total Offer Cost	£ 1,680,000,000
100.0%	£ 1,680,000,000	£ 14,174	£ 12,225	£ 11,254	£ 10,623	£ 9,806	£ 9,062	£ 8,576
50.0%	£ 1,680,000,000	£ 28,236	£ 24,351	£ 22,417	£ 21,164	£ 19,540	£ 18,065	£ 17,100
25.0%	£ 1,680,000,000	£ 59,449	£ 51,459	£ 47,442	£ 44,824	£ 41,417	£ 38,306	£ 36,265
10.0%	£ 1,680,000,000	£ 124,070	£ 107,378	£ 99,058	£ 93,662	£ 86,670	£ 80,312	£ 76,151
5.0%	£ 1,680,000,000	£ 242,675	£ 209,651	£ 193,277	£ 182,682	£ 168,977	£ 156,532	£ 148,393
2.0%	£ 1,680,000,000	£ 527,528	£ 456,952	£ 422,379	£ 400,166	£ 371,601	£ 345,810	£ 329,000
1.0%	£ 1,680,000,000	£ 1,557,751	£ 1,358,630	£ 1,257,361	£ 1,190,840	£ 1,103,594	£ 1,023,257	£ 970,205
0.5%	£ 1,680,000,000	£ 2,568,138	£ 2,218,431	£ 2,042,692	£ 1,928,137	£ 1,779,106	£ 1,643,274	£ 1,554,386

Table 4.60: What-If Analysis Results Examining Offer and Uptake Cost for a Range of levels of Effect and Uptake: Scenarios with 100% Decay i.e. no effect after year 1.

5 DISCUSSION

5.1 Limitations and Implications

There are several limitations and considerations in the modelling and its interpretation.

- In the health related benefits modelling, the key evidence used is the Copenhagen study relating level of physical activity to relative risk of mortality from all causes. We assume that such risk reductions occur within a year of the increased physical activity and are removed similarly quickly of the physical activity levels are reduced.

- Throughout we have not examined effects on under 18s, partly because a lack of direct evidence on children's behaviour in many of the studies and partly because we did not feel that the Copenhagen study on relative mortality risk reduction could be extrapolated to younger age groups.

- The transport/ congestion modelling has used different methods to estimate reductions in car distance and may not mean that direct comparison across the interventions is like for like. When considering the monetary values of the congestion benefits, it should be noted that these forecasts were made in 2002, and traffic growth has been lower than thought. This would result in the calculated benefits being over-estimated. The DfT is currently updating its forecasts. The benefit to cost ratios shown in the congestion tables, apply only to the environmental outcomes listed, the DfT would normally consider congestion benefits as only one part of the overall assessment of a project. These benefit-cost ratios here are not directly comparable with those typically used by DfT which usually also, include environmental and health benefits.

- A number of the interventions considered in this report were part of multi- component programmes, requiring either new or existing infrastructure to realise their full potential benefit. Investors should consider whether such interventions would be appropriate in their own areas.

- Care must be taken with interventions where the offer cost is a large proportion of the total, as these will require significant take-up rates to become cost-effective. In addition, given the sensitivity of the benefits to costs, uptake, and decay, it would be sensible to monitor these factors during the lifetime of any intervention

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7 APPENDICES

7.1 Appendix on Literature Search Methods for Cost-Effectiveness Evidence

7.1.1 List of Data Sources

NHS Economic Evaluation Database via Wiley (No study filter applied)

EconLit via Ovid

Medline and Medline in Process via OVID

ASSIA via Proquest

Embase via OVID

CINAHL via EBSCO

British Nursing Index via OVID

Science Citation Index via Web of Knowledge

Sociological Abstracts

Social Science Citation Index via Web of Knowledge

PsycINFO via OVID

EPPI Centre Databases – Bibliomap, DoPHER, TRoPHI, The database on Obesity and Sedentary behaviour studies
http://eppi.ioe.ac.uk/cms/

The Transport Database

Social Policy and Practice

Websites

Department for Transport

www.dft.gov.uk/

Transport Research Laboratory

www.trl.co.uk/

Institute for Road Safety Research (SWOV)

http://www.swov.nl/index_uk.htm

7.1.2 Example Search Strategies

Database: Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R) <1948 to Present>

Search Strategy:

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1 Bicycling/ or walking/

2 (walk$ or bike$ or bicycl$ or biking).ti.

3 Travel/ or transportation/mt

4 (active transport or travel mode or active travel or travelling actively or multimodal transport or active commute or green commute or green transport or green travel or ecological commute or ecological transport or ecological travel or non-motori#ed or auto or environmentally friendly transport or travel behavio?r or carbon neutral transport).ti.

5 (carbon emission* or carbon emit* or congestion or Co2 or pC02 or carbon dioxide or pC0 or carbon monoxide or greenhouse gas or air pollut* or noise pollut* or traffic volume).ti,ab.

6 1 or 2 or 3 or 4 or 5

7 Health promotion/mt

8 *Health behavior/

9 (health behavio?r or health education or health promotion).ti.

10 *Recreation/

11 7 or 8 or 9 or 10

12 6 and 11

13 ((recreation* or leisure or intervention or interventions or inform* or educat* or promot* or encourage* or advice or advis* or uptake or increas* or adhere* or aware* or encourage* or facilitat* or habit or impact* or pattern* or program* or campaign* or project or activit* or initiative* or scheme or start*) adj5 (Walk* or bike* or bicycl* or biking or active travel or active commut* or modal shift* or pedestrian* or non-motori?ed)).ti.

14 12 or 13

15 Economics/

16 "costs and cost analysis"/

17 Cost-benefit analysis/

18 Cost control/

19 Cost savings/

20 Cost of illness/

21 Cost sharing/

22 "deductibles and coinsurance"/

23 Medical savings accounts/

24 Health care costs/

25 Direct service costs/

26 Drug costs/

27 Employer health costs/

28 Hospital costs/

29 Health expenditures/

30 Capital expenditures/

31 Value of life/

32 exp economics, hospital/

33 exp economics, medical/

34 Economics, nursing/

35 Economics, pharmaceutical/

36 exp "fees and charges"/

37 exp budgets/

38 (low adj cost).mp.

39 (high adj cost).mp.

40 (health?care adj cost$).mp.

41 (fiscal or funding or financial or finance).tw.

42 (cost adj estimate$).mp.

43 (cost adj variable).mp.

44 (unit adj cost$).mp.

45 (economic$ or pharmacoeconomic$ or price$ or pricing).tw.

46 or/15-45

47 14 and 46

48 limit 47 to (english language and humans and yr="1990 -Current")

Database: Econlit <1961 to August 2011>

Search Strategy:

----

1 (carbon emission* or carbon emit* or congestion or Co2 or pC02 or carbon dioxide or pC0 or carbon monoxide or greenhouse gas or air pollut* or noise pollut* or traffic volume).ti,ab.

2 (Walk* or cycling or bike* or bicycl* or biking or active travel or active commut* or modal shift* or active transport* or pedestrian* or non-motori?ed).ti,ab.

3 1 or 2 (9863)

4 (cost-benefit analysis or cost benefit analysis).mp.

5 3 and 4

6 limit 5 to yr="1990 -Current"

Econ Lit to inform development of Economic Model

Database: Econlit <1969 to March 2011>

Search Strategy:

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1 (carbon emission* or carbon emit* or congestion or Co2 or pC02 or carbon dioxide or pC0 or carbon monoxide or greenhouse gas* or air pollut* or noise pollut* or traffic volume).ti,ab.

2 economic model*.ti,ab.

3 1 and 2

4 ((recreation* or leisure or interven* or inform* or educat* or promot* or encourage*or advice or advis* or uptake or increas* or adhere* or aware* or encourage* or facilitat* or habit or impact* or pattern* or program* or campaign* or project or activit* or initiative* or scheme or start*) adj5 (Walk* or cycling or bike* or bicycl* or biking or active travel or active commut* or modal shift* or active transport* or pedestrian* or non-motori?ed)).ti,ab.

5 3 or 4

References used to inform search strategy development:

Ogilvie, D., Foster, C.E., Rothnie, H., Cavill, N., Hamilton, V., Fitzsimons, C.F., & Mutrie, N. (2007). Interventions to promote walking: systematic review. British Medical Journal, 334, (7605) 1204-1207

Yang, L., Sahlqvist, S., McMinn, A., Griffin, S.J., & Ogilvie, D. (2010). Interventions to promote cycling: systematic review. British Medical Journal, 341 (5293).

York Health Economics Consortium (2007). A Rapid Review of Economic Literature Related to Environmental Interventions that Increase Physical Activity Levels in the General Population. National Institute for Health and Clinical Excellence, PDG Report

7.2 Appendix on Studies identified as Possible for Inclusion but Rejected after Full Reading – and Reasons for Rejection

7.2.1 Studies Identified by Economic Searches and Rejected after Full Reading – and Reasons for Rejection.

Stevens (1998)	Walking and cycling measured as part of a self-administered questionnaire, and subsumed into a measure of level of activity, and although recorded, not reported separately.
Zheng (2010)	Meta-analysis of studies that linked level of walking to CHD risk to produce relative risk equations to apply to population and put monetary value on to changes in prevalence of walking. No specific interventions included or intervention costs considered.
Graves (2009)	Exercise and diet; exercise self monitored with pedometer. Setting; Australia.
Hagberg (2006)	Review of studies of interventions affecting general physical activity levels. Home-based exercise, only one has walking as an outcome, no figures for cost-effectiveness provided
Müller (2009)	Systematic review, explicitly excluding studies that had cost-utility or cost-benefit analysis.
Gordon (2007)	All exercise is general and predominantly associated with morbidities, e.g. cardiac rehabilitation exercises.
Shaw (2011)	U.K. pedometer study of walking, only cost-effectiveness reported, no QALYs.
Gusi (2008)	Exercise intervention specifically for overweigh or depressed elderly females, therefore not applicable to the general population.
Moodie:	Children 5-7, part of prevention of diabetes programme. Walking School Bus Not a trial, no data on uptake, no measure of effectiveness and no benefits considered.

7.2.2 Inclusion and Exclusion for Papers Supplied by NICE / PDG / Others (Independently Double Reviewed by LB and ABr)

Author (Year)	Included Yes/No	Reason for inclusion or exclusion
Gotschi (2011)	No	US study. Already identified in economic database, and excluded on the basis that it was a study of the effects of investment in infrastructure.
Avineri and Goodwin (2010)	No	Think-piece on behaviour change commissioned by the UK Department for Transport. A discussion document on encouraging behavioural change, mainly by reducing car use rather than increasing walking and cycling. No specific interventions analysed
Buehler et al. (2011)	No	Analysis of prevalence of walking and cycling in Germany related to physical activity levels. Active Travel in Germany and the U.S. Contributions of Daily Walking and Cycling to Physical Activity No specific interventions analysed
Department for Transport (2010)	Yes	Cycling Demonstration Towns Development of Benefit-Cost Ratios Included
de Hartog et al. (2010)	No	Analysis of health benefits of increased cycling in terms all cause mortality using a hypothetical behaviour change with no discussion of means or cost. No specific interventions analysed

European Cyclists Federation (2011)	No	Quantifying CO_2 savings of Cycling A discussion of the environmental benefits of a mode shift to cycling. No monetary costs or specific interventions considered. No specific interventions analysed & no cost-effectiveness
Grabow et al (2011)	No	U.S. What if analysis of benefits of increased physical activity if 50% of short trips were made by bicycle using HEAT. No specific interventions analysed
Graham-Rowe et al. (2011)	No	Can we reduce car use and, if so, how? A systematic review of studies interventions designed to reduce car use. No costing of individual studies included. No cost-effectiveness
Hankey et al. (2011)	No	Health Impacts of the Built Environment: Within-urban Variability in Physical Inactivity, Air Pollution, and Ischemic Heart Disease Mortality. Modelling estimated IHD mortality risks among US neighbourhoods based on "walkability" scores No specific interventions analysed & no cost-effectiveness
Jones & Eaton (1994)	No	US simulation to evaluate cost-benefit of walking, varying level of benefit from exercise, frequency of exercise to achieve benefit, participation rates, and costs of exercise (shoes & physician physical examination for exercise-related counselling). Assessment of the potential benefits of an increase in walking. No specific interventions to achieve behaviour change evaluated
Woodcock et al (2007)	No	Lancet series paper on links between fossil-fuel-based transportation, greenhouse-gas emissions, and health. Linking car use to air pollution. No specific interventions analysed & no cost-effectiveness

Woodcock (2007) Webappend 3	No	Londoners' physical activity discussion paper No specific interventions analysed & no cost-effectiveness
Various (2009) Woodcock et al (2009)	No	Health and Climate Change 2009 Special Focus in the Lancet with papers on household energy, urban transport, electricity generation, agriculture, and short-lived greenhouse pollutants Most have no specific interventions analysed & no cost-effectiveness Comparative Risk Assessment methods to estimate the health effects of alternative urban land transport scenarios for London and Delhi comparing a business-as-usual 2030 projection with lower-carbon-emission motor vehicles, increased active travel, and a combination of the two Broad policy of CO2 reduction and active travel encouragement, not specific analyses of community walking / cycling promotion interventions.
LSE	No	The British cycling economy. 'Gross Cycling Product' Report. Mainly a consideration of the cycling industry in the economy. Some health benefits considered, but no interventions to promote cycling presented as a cost-benefit analysis. No specific interventions analysed & no cost-effectiveness
Fordham & Barton (2008)	Yes	NICE project on Promoting physical activity for children: Cost effectiveness analysis – included the walking bus analysis but not other interventions.
Nordic Council of Ministers, Copenhagen (2005)	No	CBA of Cycling Mostly discussion of methods and some general assessments in Nordic countries, much focussed on infrastructure

Sælensminde (2004)	No	Cost–benefit analyses of walking and cycling track networks in three Norwegian cities Focus is infrastructure
Scarborough et al (2011)	No	Economic burden of ill health due to diet, physical inactivity, smoking, alcohol and obesity in the UK: an update to 2006–07 NHS costs No specific interventions analysed & no cost-effectiveness
Bekkum, Williams & Morris (2011)	No	Perceptions of cycle commuting barriers in relation to stage of change, gender and occupational role No specific interventions analysed & no cost-effectiveness
Weichenthal (2011)	No	Traffic-Related Air Pollution and Acute Changes in Heart Rate Variability and Respiratory Function in Urban Cyclists No specific interventions analysed & no cost-effectiveness

7.3 Appendix: Evidence Tables for Included Studies in Health Economic Literature Review

Authors: Gusi Year: 2008 **Aim of study:** Assessment of a walking programme Type of economic analysis: Cost utility Economic perspective: Quality score: +	**Population:** **O**verweight or depressed elderly females. Setting: Spain **Data source:** Primary research	Intervention description: Supervised walking and exercise groups by qualified exercise leaders. Three 50-minute sessions per week for six months. Comparator/control/description: Randomised control receiving best care in general practice Sample size: Total: 106 Intervention: 55 Control:51	**Primary outcomes:** EQ5-D relating to anxiety and depression **Secondary outcomes:** Health care resource usage, BMI changes. Time horizon: six months Discount rates: N/A Modelling method: N/A	Primary analysis: Benefits Costs ICER Secondary analysis:	Limitations identified by authors: Too small a sample to compare healthcare usage Possible selection bias favouring low education levels and low earners Limitations identified by review team: Narrow selection criteria restricting application of results to general population Evidence gaps and/or recommendations for future research: N/A Source of funding: European Social Fund Government of Extremadura

Authors: Roux Year:2008 Aim of study: Community based physical activity interventions Type of economic analysis: Cost-benefit Economic perspective: societal Quality score: +	Population: Simulated cohort representative of the population Setting: U.S. Data source: Three underlying studies	Intervention description: Organised walking groups Comparator/control/description: From underlying studies Sample size: **Total:** Various from underlying studies Intervention: Control:	Primary outcomes: Increase in physical activity and associated decrease in risk of mortality and morbidities Secondary outcomes: Time horizon: 40 years Discount rates: 3% per year Modelling method: Markov	Primary analysis: Benefits Costs ICER Secondary analysis:	Limitations identified by authors: Uses utility values for entire population rather than subgroup Limitations identified by review team: Evidence gaps and/or recommendations for future research: Source of funding: Not stated

Authors: Cobiac Year:2009 Aim of study: Modelling interventions to promote physical activity Type of economic analysis: Cost utility Economic perspective: Not stated Quality score:+	Source Population: General population Setting: Australia Data source: Published studies 8 RCTs on pedometers 21 TravelSmart sites.	Intervention description: Pedometer interventions TravelSmart programme Comparator/control/description: From underlying studies Sample size: Total: Various from underlying studies Intervention:	Primary outcomes: Increase in steps taken Increase in active travel trips made Secondary outcomes: Time horizon: One year intervention Lifetime model Discount rates: 3% per year Modelling method:	Primary analysis: Benefits Costs ICERs Secondary analysis:	Limitations identified by authors: Reliance on observational studies Time lag in change in physical activity affecting risk Limitations identified by review team: Evidence gaps and/or recommendations for future research: Source of funding: Australian National Health and Medical Research Council Health Services

		Control:	MCMC		
Authors: Pringle Year:2010 Aim of study: Modelling interventions to improve physical activity Type of economic analysis: Cost utility Economic perspective: Not stated	Population: General population Setting: U.K. Data source: Underlying studies	Intervention description: Promotion of walking and cycling by printed media and led walking groups Comparator/control/description: Not stated Sample size: Total: Printed maps: 14 Walking groups: 8 Intervention: Control:	Primary outcomes: Increase in physical activity Secondary outcomes: Time horizon: Lifetime Discount rates: Implicit to model used Modelling method: Matrix model	Primary analysis: Benefits Costs ICERs Secondary analysis:	Limitations identified by authors: Difficulties in collecting data Wide range of field-based settings Low sample size Model sensitive to presumptions Limitations identified by review team: Evidence gaps and/or recommendations for future research: Source of funding: Department for Health Natural England Sport England

Quality score:+					
Authors: Cycling Demonstration Towns Year:2010 Aim of study: Promotion of cycling Type of economic analysis: Cost utility Economic	Population: General urban population Setting: 8 U.K. towns Data source: Study monitoring	Intervention description: Infrastructure and personalised travel advice Comparator/control/description: Before and after Sample size: No sample Total: Intervention:	Primary outcomes: Increase in cycling Secondary outcomes: Time horizon: Three years intervention 10-20 years appraisal Discount rates: Rate not stated	Primary analysis: Reduced mortality Decongestion Costs Benefit/cost ratio Secondary analysis:	Limitations identified by authors: Difficulty in measuring changes in cycling behaviour Limitations identified by review team: Evidence gaps and/or recommendations for future research: Design data collection with benefit cost analysis in mind Assess the persistence of intervention effects Source of funding: Department for Transport

perspective: Not Stated Quality score:+		Control:	Modelling method: No modelling explicitly stated Direct analysis of results		
Authors: Fordham Year:2008 Aim of study: NICE guidelines Type of economic analysis: Cost utility Economic perspective:	Population: Schoolchildren Setting: Schools Data source: Published studies	Intervention description: Provision of supervised walking buses Comparator/control/description: None Sample size **Total:** 3-16 per bus Intervention: Control:	Primary outcomes: Increase in number of walking journeys to school Secondary outcomes: Time horizon: One year Discount rates: None	Primary analysis: QoL Benefits Costs ICERs Secondary analysis:	Limitations identified by authors: Range of uncertainty in costs QoL measure and take-up Limitations identified by review team: Evidence gaps and/or recommendations for future research: Source of funding: NICE

Not stated Quality score:+ Applicability:			Modelling method: No model		