Estimating Return on Investment for interventions and strategies to increase physical activity

Technical Report

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Contents

NICE Disclaimer

This tool is intended to help users to understand the return on investment of their chosen package of interventions. Where relevant, the comparative figures are based on two different 'packages' of interventions, one of which could be 'baseline' defined as a hypothetical situation where 'there are no interventions' at present. It is left to the users to select which interventions will make up a package and decide which packages of interventions they would like to compare.

Readers are asked to read the accompanying User Guide and Technical Report before they use this tool.

NICE has provided this tool to aid decision-making. NICE cannot be held liable for any investment or other decisions that are made using information and results obtained from this tool. Implementation of NICE guidance is the responsibility of local commissioners and/or providers. Commissioners and providers are reminded that it is their responsibility to implement NICE guidance, in their local context, in light of their duties to avoid unlawful discrimination and to have regard to promoting equality of opportunity. Nothing in this tool should be interpreted in a way that would be inconsistent with compliance with those duties.

If one of more custom interventions are included in a package of interventions NICE recommend this be made clear in any communications regarding the results

1.0 Introduction

On behalf of the National Institute for Health and Care Excellence (NICE), Matrix Knowledge, in collaboration with LeLan Ltd, have produced this Return on Investment (ROI) tool to help facilitate decision making at local level in physical activity policy. As part of this programme to support local decision making, two other tools – in the areas of Tobacco Control and Alcohol Misuse – have been developed.

The tools have been developed with the aim of enabling users to assess the ROI of implementing a package of interventions. The tools allow users to estimate benefits that could be achieved through physical activity programmes in their geographical area (e.g. region county or local authorities). This required estimating the costs of the interventions as well as their impact. The purpose was to develop a tool to support commissioners and policy makers in their investment decision by enabling them to explore the costs and impact of different interventions packages.

2.0 Features of the Physical Activity ROI tool

The tool has a number of useful features for commissioners and planners of local services to promote physical activity:

- There are 13 physical activity interventions in the tool, including:
    - 11 adult interventions consisting of:
        - 3 one to one interventions
        - 1 group intervention
        - 1 community intervention
        - 3 workplace interventions
        - 3 environmental interventions
    - 2 groups based interventions for children under the age of 15.
- A full list and descriptions of these interventions is provided in **Appendix 4**. In addition, the tool includes functionality to allow users to incorporate customised (new) interventions.
- Most of the interventions and model parameters were drawn from collective NICE Guidance on physical activity.[1] In addition, a literature search was undertaken to include additional interventions not included in NICE Guidance and to fill data gaps. A list of the key parameters used to populate the model can be found in **Appendix 6**.
- Users can choose their own local authority or Clinical Commissioning Group (CCG) area, which has been pre-populated with local-level population data and prevalence of different levels of physical activity split.[2]
- Each intervention has the following variables attached:

[1] NICE guidance PH2, PH8, PH13, PH17, PH41 and PH44
[2] The calculations of the number of people in the model are estimates based on 2011 Census data and are split by region. Regions are defined as the former Government Office Regions, described at: http://www.ons.gov.uk/ons/guide-method/geography/beginner-s-guide/administrative/england/government-office-regions/index.html. The numbers presented in the downloadable word report are rounded to the nearest 1000.

  - The **allocation** of the intervention (defined as the percentage of the population that receives or would receive the intervention). Depending on the intervention, the population allocated can be either from the inactive population or the general population. By default, all interventions have a 0% allocation rate assigned. Therefore, allocation rates need to be set by the user based on actual or desired level in their local authority or CCG area.
  - The **effect** of the intervention, defined as the percentage increase in people who move from inactive to either low active (30-149 minutes of moderate exercise per week) or meeting recommendations (150 minutes or more of moderate exercise per week). All interventions have a pre-populated effectiveness rate attached (**Appendix 4**). However, these values can be modified by the user if they have appropriate evidence of effectiveness from local data or, newly published studies.[3]
  - The **cost** of the intervention (defined as either the cost of delivery per person or the total cost of the intervention). As with effect, the cost per person has been pre-populated for all interventions (**Appendix 4**), but they can be modified by the user to adjust, for example, for variances in regional or local prices.

- Custom interventions can be created for interventions that have not been included in the model by default if the three key variables mentioned previously (allocation, effect and cost) are available to the user from local level data or future publications. Custom interventions are automatically saved in the tool for future use.

- The tool has the ability to group interventions into packages. Packages can include any combination of interventions. This allows the tool to be used flexibly by users to design services with different intervention mixes as needed.

- As all allocation rates are set to 0% by default, the starting point (Baseline) represents a scenario of 'no service provision'. The tool then allows users to build two packages of interventions:

  - **The current package**. This will typically be used to represent the 'current scenario'. To that end, the user must change the allocation of the interventions (from 0%) to the current level of provision in their local population area.[4] The ROI metrics of the current package will then compare the current package against the Baseline – i.e. the 'value for money' of the 'current scenario' compared with 'no service provision'.
  - **The alternate package**. This will be defined by the user by changing the allocation of the interventions (from the percentages applied in the current package) to reflect desired levels of service provision.[5] The ROI metrics of the alternate package will then compare:

    - **The alternate package against the Baseline** – i.e. 'desired scenario' compared with 'no service provision'.
    - **The alternate package against the current package** – i.e. 'desired scenario' compared with 'current scenario'.

[3] We do not recommend making changes to effectiveness rates for interventions unless you have local data or newly published evidence that is presented - or can be converted to - the effectiveness measure used in the tool. If effectiveness rates are not expressed in the same measure, estimates produced by the tool will not be accurate and may be invalid.
[4] As mentioned previously, users can also change the effect and cost of the interventions.
[5] Users can also change the cost and effect of the interventions at this stage. However, note that these changes will only apply the alternate package (and the cost and effect for the current package will remain as previously defined).

- A number of cost savings and ROI metrics are included in the tool. These are: cost savings, Incremental Cost Effectiveness Ratio (ICER), net present value (NPV), and benefit-cost ratio. A glossary of these terms is included in **Appendix 1**: References

Anokye, N. K., Lord, J., & Fox-Rushby, J. (2014). Is brief advice in primary care a cost-effective way to promote physical activity?. *British journal of sports medicine*, *48*(3), 202-206.

Araújo-Soares, V., McIntyre, T., MacLennan, G., & Sniehotta, F. F. (2009). Development and exploratory cluster-randomised opportunistic trial of a theory-based intervention to enhance physical activity among adolescents. *Psychology and Health*, *24*(7), 805-822.

Baker G., Gray S.R., Wright A., Fitzsimons C., Nimmo M., Lowry R. (2008). The effect of a pedometer-based community walking intervention "Walking for Wellbeing in the West" on physical activity levels and health outcomes: a 12-week randomised controlled trial. *International Journal of Behavioral Nutrition and Physical Activity 2008*; 5

Department of Health (2008) '*Health Survey for England',* NHS: London

Department for Transport (2011) '*National Travel Survey*'. London

NICE (2006) Four Commonly used methods to increase physical activity. Public health guidance 2

NICE (2008) Physical activity and the environment. Public health guidance 8

NICE (2009) Promoting physical activity for children and young people. Public health guidance 17

NICE (2013) Physical activity: brief advice for adults in primary care. Public health guidance 44

NICE (2012) Walking and cycling. Public health guidance 41

Office for National Statistics, http://www.ons.gov.uk/ons/guide-method/geography/beginner-s-guide/administrative/england/government-office-regions/index.html, accessed on 30/07/2013

Pokhrel, S., Owen, L., Lester-George, A., Coyle, K., Coyle D., Trapero-Bertran M. (2012). Tobacco Control Return on Investment Tool. London: National Institute for Health and Clinical Excellence.

Sport England (2012) '*Active People Survey',* London

- Appendix 2.
- The cost and ROI metrics are provided for different perspectives or, in other words, sets of benefits; for example: all cost savings and value of health gains included, all cost savings included (but no monetary value of health benefits), health care cost savings and value of health gains, only health care cost savings, only social care cost savings, only productivity gains, and only transport cost savings. Specific definitions of these metrics are included in **Appendix 3**.
- For each package the tool calculates the health gains. Health gains are measured in terms of Quality Adjusted Life Years (QALY) gained.[6]
- The value of the health gains generated by the package is calculated as the QALYs generated by the package times the 'value' of a QALY. The 'value' of a QALY is set by default at £20,000/QALY [7]. However this can be modified by the user, to reflect what they are willing to pay for a QALY.[8]
- Flexible timescales of between one and 48 (lifetime) years are included to allow policy makers ultimate flexibility in seeing the level of return on investment of the packages of interventions and how this changes over time.
- The tool only provides point estimates (i.e. the average value often called the 'base results'[9]) no uncertainties around the point estimate are provided within the tool. This is because given the breadth of the model outputs (i.e. a large number of metrics that the tool produces), incorporating such 'sensitivity analysis[10]' in each run would significantly prolong the run time. However, it is critically important to establish the extent to which the model results would be sensitive to input parameters if they were to change. In order to address this important issue, this report includes a number of sensitivity analyses carried out by the model developers.

[6] A QALY is a year lived in full health, i.e. a year lived without any limitation or disability.
[7] NICE considers interventions that cost the NHS less than £20,000 per QALY good value for money
[8] Please note that changing this value will delay the calculation running time.
[9] Base results are the estimated results using the expected value for each parameter within the model.
[10] Sensitivity analysis is a form of analysis which assesses whether the interpretation of the results of an analysis will change if parameter inputs are varied.

3.0 Method

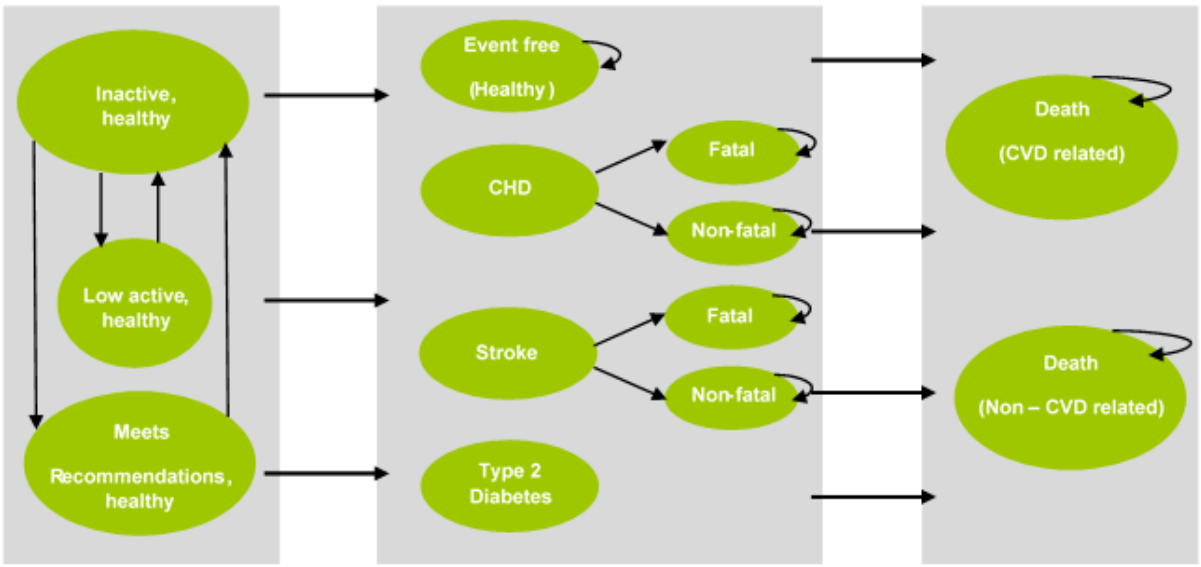
3.1 Economic model

The Physical Activity ROI model is built in Microsoft Excel 2013 and the graphical user interface (GUI) programmed in Visual Basic 6 software. The tool can be used in all versions of Microsoft Excel from version 2003. Two economic models, one for adults and one for children, were built to estimate the cost-effectiveness of each intervention and subsequently, of the package of interventions.[11]

3.2 Physical activity model for adults

The economic model used in this tool is based on the Markov model developed by Anokye et al (2012) for the NICE Public Health Intervention Guidance on Physical Activity – Brief advice for adults in primary care. **Figure 1** presents the path the cohort takes once it is exposed (or not) to an intervention.

Figure 1: Physical activity Markov model structure



The model splits the population into three groups:

- Percentage of the population who are inactive, that is doing less than 30 minutes of moderate intensity physical activity per week.
- Percentage of the population who are low active, which is doing between 30 to 149 minutes of moderate intensity physical activity per week.
- Percentage of the population who meet the Department of Health's (DH) guidelines on physical activity (150 minutes of moderate intensity physical activity per week).

[11] The economic model is adapted from a previous model built for NICE by the Health Economics Research Group (HERG), Economic modelling of brief advice on physical activity for adults in primary care.

At year 0 (cycle 1), the starting age at which the cohort is exposed to an intervention is 33 years[12]. By the end of the first cycle, people can sit in one of the three activity states and can remain healthy, have one of 3 events (non-fatal CHD, non-fatal stroke, type 2 diabetes) or die either from CVD or non-CVD related causes. The model estimates and discounts costs and benefits associated with each of the health states for 48 annual cycles.

The effect of the interventions is measured as the change in the percentage of people who become low active and the percentage who meet the DH guidelines.
Baseline data at local level was drawn from the Local Sport Profile tool published by Sport England. The data refers to self-reported levels of physical activity collected through the Active People Survey (2012).

Data on the cost and effect of the interventions was drawn from NICE Guidance and a wider review of the literature (see **Appendix 5** for details)

Health benefits

Physical inactivity is associated with a number of diseases. The model estimates the number of cases of these diseases that could be prevented if levels of physical activity were increased due to a package of interventions. Based on the prevented number of disease cases, the model estimates the impact of the package of interventions in terms of health related quality of life (expressed in Quality Adjusted Life Years, QALYs[13]) and health care costs savings.

The diseases included in the model are:

- Chronic heart disease (CHD)
- Stroke
- Type II diabetes

The probabilities of experiencing these diseases vary with levels of physical activity. Those who increase their physical activity generally have reduced probabilities of experiencing the diseases, which results in corresponding improvements in health related quality of life and health care cost savings.

Productivity benefits

Physical inactivity is assumed to be associated with productivity losses due to morbidity and life years lost.

Social care benefits - strokes

Physical inactivity is assumed to be associated with increased probability of having a stroke. Stroke can result in severe disability which may require residential or informal care (at home) provided by the local authority in a small number of cases

Transport benefits

[12] Anokye et al used a starting age of 33 for the Markov model to reflect the evidence on the effectiveness of brief advice. 48 annual cycles were run for the model, resulting in the model ending at age 81.
[13] A QALY is a year lived in full health, i.e. a year lived without any limitation or disability.

Those who increase their level of physical activity may reduce the number of kilometres (km) they travel in a car, thus reducing congestion, accidents and greenhouse gases and improving air quality and noise pollution. Detailed data parameters for the above outlined benefits are provided in Table A5.4 in **Appendix 6**.

3.3 Physical activity model for children

The model splits the population into two groups:

- Percentage of the population who are inactive, that is doing less than 1 hour per day per week of physical activity.
- Percentage of the population who meet recommendations, that is doing more than 1 hour per day per week of moderate intensity physical activity.

The effect of the interventions is measured as the change in the percentage of children who meet the recommendations for physical activity.

Baseline data at regional level was drawn from the Physical activity and fitness report published by the Health and Social Care Information Centre. The data refers to self-reported levels of physical activity collected through the Health Survey for England (2008).

Data on the cost and effect of the interventions was drawn from NICE Guidance and a wider review of the literature (see **Appendix 5** for details)

Health benefits

Data on the health benefits associated with increased physical activity for children is limited, as not much is known about the long term effects of a physically active child becoming a physically active adults, and the subsequent reduction in risk of developing different diseases associated with physical inactivity. As such, the tool only estimates the QALY gain for achieving the recommended guidelines of physical activity for one year.

Education benefits

There is some evidence linking physical activity to improved educational outcomes but given that the evidence is inconsistent, the model does not incorporate these potential benefits.

There are a number of input parameters (e.g. unit cost of disease) which users are not allowed to change. These are presented in Tables A5.1 to A5.4 in **Appendix 6**.

The children's interventions that are included in the tool may not be cost effective due to the limitations (as outlined above) in estimating the long term effects of physical activity for this population group. The interventions for children are included in the tool to give users guidance around the costs and effects of these types of interventions. Users are encouraged to interpret the results bearing in mind these methodological limitations.

3.4 Model outputs

The results of the model are present for two packages of interventions:

- **The current package**. This will typically be used to represent the 'current scenario'. To that end, the user must change the allocation of the interventions (from 0%) to the current level of provision in their local population area.[14] The ROI metrics of the current package will then compare the current package against the Baseline – i.e. the 'value for money' of the 'current scenario' compared with 'no service provision'.
- **The alternate package**. This will be defined by the user by changing the allocation of the interventions (from the percentages applied in the current package) to reflect the desired levels of service provision.[15] The ROI metrics of the alternate package will then compare:
    - **The alternate package against the Baseline** – i.e. 'desired scenario' compared with 'no service provision'.
    - **The alternate package against the current package** – i.e. 'desired scenario' compared with 'current scenario'.

The baseline serves as the first line comparator for any intervention package. However, users can run the model for any two packages of interventions, and compare results between the two packages.

The results are organised as follows (see **Appendix 3** for the definition of the metrics below).

Interventions overview window

- Interventions are presented under three separate menus:
    - Individual-level adult interventions
    - Population-level adult interventions
    - Individual-level child interventions

  Allocation, effectiveness and unit costs are displayed for each intervention within each group.
- Total cost of ALL interventions in the current package and the alternate package.
- Number of people increasing their level of physical activity as a result of ALL interventions in the current package and the alternate package.

Exercise referral was not recommended in NICE guidance PH2. NICE is currently updating guidance on exercise referral schemes and the results should be available in September 2014. We have excluded exercise referral in the tool based on the recommendation. However, users can use the custom intervention function[16] in the tool to estimate the ROI of their exercise referral schemes.

[14] As mentioned previously, users can also change the effect and cost of the interventions.
[15] Users can also change the cost and effect of the interventions at this stage. However, note that these changes will only apply the alternate package (and the cost and effect for the current package will remain as previously defined).
[16] When creating a custom intervention, effect sizes used must be input using the same definitions of effectiveness as the other interventions which is the % increase in Low active from inactive (30-149 minutes of physical activity per week) or % increase in meeting DH guidelines (greater than 150 minutes of physical activity per week) from inactive

Top level results overview

Once run the model gives an overview of the results from a high level for the packages. The metrics shown are as follows:

- Breakdown of Costs
    - This gives the overview of the potential cost savings to be generated from the package in each cost domain, productivity, health and transport.
    - The comparisons given are the current package against Baseline, The alternate package against Baseline, and The current package vs. the alternate package.
- Total Costs
    - This gives the overview of the total cost savings against the total cost of the interventions.
    - The comparisons given are the current package against Baseline, The alternate package against Baseline, and The current package vs. the alternate package.

Return on investment metrics

The return on investment metrics give the key analysis of the tool. They are split into four categories, and each category is further split into the key perspectives of interest to commissioners:

- Benefit-Cost Ratio
    - All cost savings and value of health gains included
    - All cost savings included
    - Only health care costs and value of health gains included
    - Only health care cost savings included
    - Only social care cost savings included
    - Only productivity cost savings included
    - Only transport cost savings included
- Net Present Value
    - All cost savings and the value of health gains included
    - All cost savings included
    - Only health care costs and value of health gains included
    - Only health care cost savings included
    - Only social care cost savings included
    - Only productivity cost savings included
    - Only transport cost savings included
- Avoidable Burden of Disease (number of QALYs)
- ICER
    - All cost savings included.
    - Only health care cost savings included.

3.5 Key assumptions

The model relies on a number of assumptions to estimate the economic impact of interventions to increase physical activity. These assumptions are described below.

General modelling assumptions

The economic model is adapted from a previous model built for NICE by the Health Economics Research Group (HERG), Economic modelling of brief advice on physical activity for adults in primary care.

Costs and benefits are both discounted at 3.5%, in line with NICE Methods for the development of public health guidance second edition (2009)[17]. Costs are presented in £2012/13 prices. Where necessary, these have been updated using the HM Treasury GDP Deflators (2013). Sensitivity analysis has been done on the NICE Methods for development of NICE public health guidance[18] rate of 1.5% for both costs and benefits.

Costs are presented in £2012/13 prices. Where necessary, these have been updated using the Office of National Statistics GDP Deflators (2013).

Physical activity data

Physical activity data is self-reported and no adjustment to these data has been made. However we acknowledge that research is currently being undertaken to calculate a multiplier that will allow adjustment of self-reported levels of physical activity in order to estimate the true prevalence in the population.

Calculation of morbidity and mortality

The user assigns a proportion of the population to be allocated to different interventions that make up the package. Based on the effectiveness of the interventions in the package, after one year a proportion of the population will:

- Stay inactive
- Become low active
- Meet DH recommendations for physical activity

Those who increase their activity will have reduced probabilities of developing CHD, stroke and type II diabetes relative to those who are inactive. This impact is assumed to last for ten years[19], at which point the probabilities of developing the diseases becomes the same as for inactive person. This assumption was based on the follow up periods used in the cohort studies for which the relative risks of the diseases measured in the model produced by Anokye et al (2012) for the NICE guidance, PH44. As such, the same time period has been applied in our model as it uses the same relative risks. Please see Table A5.2 and A5.3 in **Appendix 6** for baseline and post intervention relative risks of disease.

Based on the above outlined probabilities, the model estimates the numbers of people who are healthy, have an event of CHD and stroke and the number of people who develop type II diabetes for each activity level per year over a 48 year (lifetime) period.

Calculation of health care costs

As previously mentioned, the model estimates the number of people who move to the various health states and the number of deaths per year. Based on this, annual treatment costs per person associated with the health states in the model are taken from the National Clinical Guideline Centre (2011) for each disease and applied to the cohort in order to calculate the total healthcare costs per year. The costs are made up of the following:

- 1st CHD event cost

[17] National Institute of Health and Clinical Evidence (2009) Methods for the development of NICE public health guidance (second edition)
[18] NICE (2012) Methods for development of NICE public health guidance (third edition) Available at: http://publications.nice.org.uk/methods-for-the-development-of-nice-public-health-guidance-third-edition-pmg4 Last accessed: 25/11/2013

- Post CHD event cost
- 1st stroke event cost
- Post stroke event cost
- Annual treatment cost for type II diabetes

Please refer to Table A5.4 in **Appendix 6** for more details on the unit costs and sources of data.

Calculation of productivity cost savings

The model estimates the number of inactive people who become either low active or who meet DH recommendations and of those the number that are employed. It is estimated that an employed person who increases their activity will avoid 5.23 days of absenteeism per year for ten years. The total number of days of avoided absence associated with the intervention is thus calculated by multiplying the number of employed people who have increased their activity by 5.23 days per year for 10 years.

This figure is then multiplied by the average daily wage rate to give the total productivity cost savings associated with the intervention. Please refer to Table A5.4 in **Appendix 6** for more details of unit costs and sources of data.

As a result of the number of days of absenteeism associated with physical inactivity and the value attached to these days, productivity cost savings are the biggest driver of the total cost savings associated with a package of interventions.

Calculation of social care costs - stroke

The model estimates the number of people who will experience non-fatal events of stroke for all levels of physical activity. It is estimated that approximately 4% of these people will require informal care provided by the local authority at a cost of £1,656 per year. Please refer to Table A5.4 in **Appendix 6** for more details and sources of data.

Calculation of transport cost savings

It is assumed that if a person increases their physical activity, they reduce the amount of kilometres (km) they travel in a car per year as result. Data on average annual distance travelled in a car was taken from the National Travel Survey (2011).

The percentage reduction in the annual distance travelled by car was assumed to 0.05% for people who are low active and 0.1% for people who meet recommendations for physical activity. These figures were based on expert opinion, as it has been suggested that if people increase their physical activity, the amount they travel in a car may not reduce by much as they may use the car to get to recreation parks or gyms to exercise, but replace small car journeys with walking and cycling.

Transport cost savings are made of the following components:

- Congestion
- Infrastructure
- Accidents
- Local air quality
- Noise
- Greenhouse gases
- Indirect taxation

The reduction in the number of km travelled in a car per year is then multiplied by transport cost saving per km to give total transport cost savings for the selected intervention. Please refer to Table A5.4 in **Appendix 6** for more details and sources of data.

3.6 Key limitations

There are a number of limitations for specific elements of the model that the user should be aware of when making decisions based on its outputs. These have been highlighted in previous sections of the report. The key limitations that need to be considered when viewing the model as a whole are described below:

- Benefits are calculated on the number of people who increase their physical activity levels above the low activity and recommended levels of activity thresholds. The model is unable to calculate benefits for people who achieve marginal increases in physical activity.
- Due to the scope of the tool, this version of the model does not include population subgroups by sex, age, ethnicity and socioeconomic factors.
- For any given local area, there will be some level of infrastructure already available to help increase physical activity. However robust estimates for this parameter were limited and therefore the model is unable to provide a baseline analysis of infrastructure at a local level
- The children's interventions that are included in the tool may not be cost effective due to the short timescale over which the impact of the package of interventions is being assessed, and also because long term data on the health and educational benefits associated with increased physical activity is limited.

3.7 Sensitivity analysis

The tool is intended as a simple decision aid for local decision makers who use their own local data to estimate the ROI for their selected package of interventions. As such, only point estimates (i.e. the average value often called the "base results"[20]) of the estimated impact can be obtained, i.e. no uncertainties around the point estimate are provided in the tool. This is because given the breadth of the outputs (i.e. a large number of metrics that the tool produces), incorporating such 'sensitivity analysis'[21] in each run would undermine the simplicity of the tool by prolonging the run time significantly. The tool is intended to produce the results in real time.

However, it is critically important to establish the extent to which the model results would be sensitive to input parameters if they were to change (say, if users have improved estimates for inactivity levels or costs of interventions in their local area). In order to address this important issue, a sensitivity analysis was carried out by the model developers. The results are described below.

The intention of this analysis is to show that it is reasonable for users to use the estimates of the tool outputs, even though there may be uncertainty around key input parameters. The sensitivity of the model outputs are assessed relating to the following key parameters:

- Discount rate

[20] Base results are the estimated results using the expected value for each parameter within the model.
[21] Sensitivity analysis is a form of analysis which assesses whether the interpretation of the results of an analysis will change if parameter inputs are varied.

- Intervention cost and effectiveness

This analysis is based on East Staffordshire Local Authority. East Staffordshire has an adult population of 92,096 of which 48.67% (44.823) are inactive. This LA has been selected as it is representative of an average LA in terms of its inactivity levels. The average adult population across English LAs is 171,839 (range 6,799 - 1.2 million), average inactivity prevalence is 48.7% (range 39.0% - 62.6%). This was assessed by looking at the variation in these factors across all local authorities using ONS population statistics (population) and the Active People Survey (inactivity prevalence).

The sensitivity analysis focused on the incremental cost effectiveness ratio (ICER) for health care costs only[22] over different time horizons. If the user is interested in total costs, the required effect sizes of the interventions could be lower and still be cost effective due to the additional benefits included in the total ICER calculation.

Base results

The base results (i.e. the estimated results using the expected value for each parameter within the model) are shown in **Table 1**. For a willingness to pay of £20,000 per QALY gained[23] in East Staffordshire:

- The current package vs. the baseline can be considered cost-effective
- The alternate package vs. the baseline can be considered cost-effective
- The alternate package vs. the current package can be considered cost-effective and in the long run it is dominant[24].

Table 1: Base results for East Staffordshire – Incremental cost effectiveness ratio (health care costs only) using 3.5% discount rate

Intervention package	Time horizon			
	2 years	5 years	10 years	Lifetime
The current package vs. Baseline	£1,764	£1,687	£1,493	The current package is dominant
The alternate package vs. Baseline	£1,438	£1,363	£1,176	The alternate package is dominant
The alternate package vs. The current package	£1,392	£1,317	£1,131	The alternate package is dominant

Impact of discount rate

In economic evaluation, future costs and benefits are discounted to reflect time preference for benefits -i.e. the greater weighting placed on costs and benefits occurring in the present rather than the future.

[22] This particular metric for the sensitivity analysis was chosen as this includes both resource use (incremental costs, i.e. differences in costs between the two intervention packages) and the resulting health outcomes (incremental QALYs, i.e. differences in QALYs between the two intervention packages). Therefore, if the results on this metric are not found sensitive to the changes in input parameters, it is unlikely that other metrics would be sensitive either.
[23] The decision maker's willingness to pay for a QALY gained is usually referred to the 'threshold'. Currently, the threshold for the NHS used by NICE for public health interventions is £20,000/QALY gained.
[24] If the package is both less costly and more beneficial than the comparator it is dominant and therefore cost saving. Please refer to Appendix 2 for further technical details.

To allow for this time preference, future costs and benefits are discounted at a specific rate relative to the number of years in the future they occur. The rate used to discount is called the discount rate.

In the base case analysis, a 3.5% rate was used for costs and benefits. NICE guidelines on economic evaluations of public health interventions require that the analysis needs to be re-done for 1.5% rate for QALYs to ascertain the level of uncertainty posed by discount rates (NICE 2012). Therefore, one way sensitivity analysis was conducted adopting a 1.5% rate for future benefits. The impact of this on the results is minimal. Where a package of interventions is not dominant (i.e. when the package is not less costly and does not produce more QALYs that the comparator), the incremental cost per QALY gained was reduced by a modest amount (e.g. from £1,687 to £1,648 for the current package vs. Baseline on a 5-year time horizon). More importantly, the interpretation of whether a package was cost-effective[25] did not alter in any comparison.

Table 2: Results for East Staffordshire – Incremental cost per QALY gained (health care costs only) using 1.5% discount rate

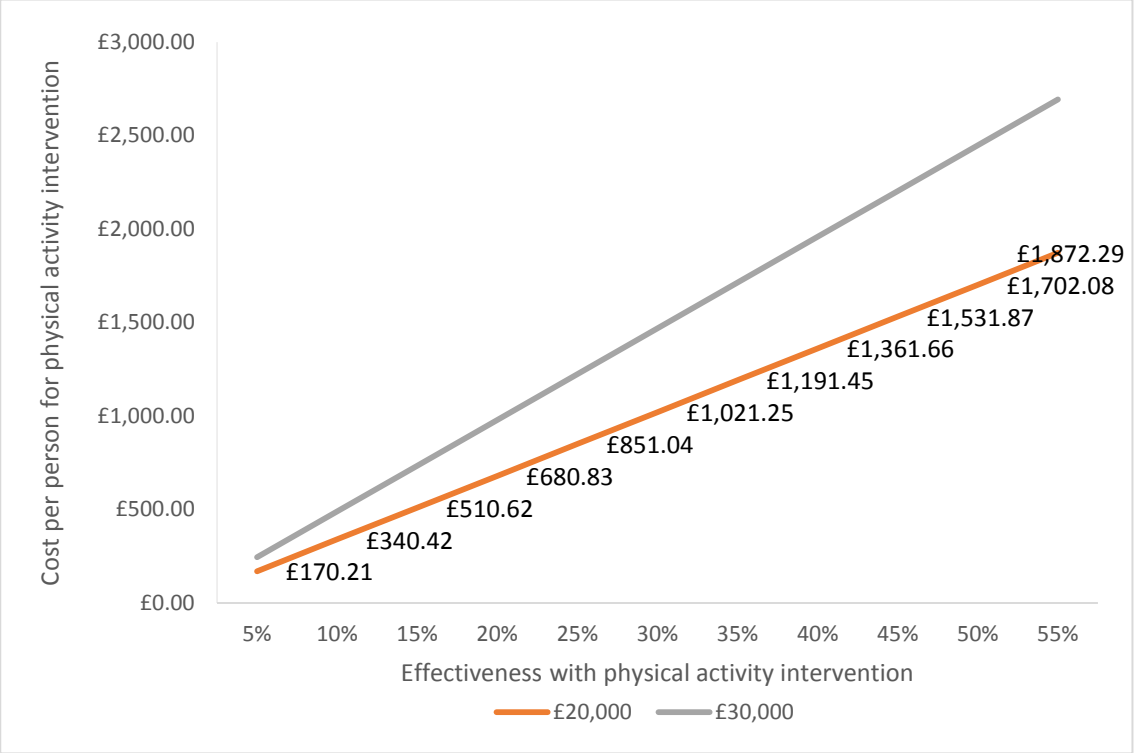
Intervention package	Time horizon			
	2 years	5 years	10 years	Lifetime
The current package vs. Baseline	£1,730	£1,648	£1,427	The current package is dominant
The alternate package vs. Baseline	£1,410	£1,330	£1,117	The alternate package is dominant
The alternate package vs. The current package	£1,365	£1,285	£1,073	The alternate package is dominant

Impact of intervention's costs and effectiveness

A two way analysis was used to explore the impact of interventions' cost and effectiveness on the cost-effectiveness of the package as a whole. Two threshold values for the ICER (£20,000 and £30,000) and effectiveness rates ranging from 1% to 55% were used. For each threshold value and effectiveness rate, we estimated the maximum cost per person that can be paid for the intervention for it to remain cost effective at the given threshold. The results are presented in **Figure 2**. For example, for an effectiveness rate of 9% (equivalent to brief advice), an intervention can cost up to £306 per person and still be cost effective based on a threshold of £20,000 per QALY.

[25] According to NICE, an intervention is cost-effective if the incremental cost per QALY gained is less than or equal to £20,000 to £30,000.

Figure 2: Threshold costs per person of physical activity interventions by effect



Conclusion from the sensitivity analysis

The above sensitivity analysis suggests that the results with respect to the cost-effectiveness of intervention package as a whole are fairly robust. The discount rate has minimal impact on the results and it is unlikely that the conclusion of the analysis changes due to changes in the discount rate. Analysis around the cost and effect of an intervention indicate that even with a low effectiveness rate and a higher cost per person, an intervention can still fall within the ICER threshold for cost-effectiveness. Therefore any local variations around these two parameters are unlikely to change the results of the analysis.

4.0 Appendices

4.1 Appendix 1: References

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4.2 Appendix 2: Glossary

Benefit-Cost Ratio– an indicator used in the formal discipline of cost-benefit analysis which attempts to summarise the overall value for money of a project by dividing the benefit by the cost.

Burden of Disease – the impact of a health problem in an area measured by financial cost, mortality, morbidity, or other indicators. It is often quantified in terms of QALYs or DALYs, which combine the burden due to both death and morbidity into one index.

Disability Adjusted Life Year (DALY) – Disability adjusted life year is a measure of overall disease burden expressed as the number of years lost due to ill-health disability or early death

Discount Rate – The rate, per year, at which future values are diminished to make them comparable to values in the present

Health Inequalities – inequalities in respect of life expectancy or general state of health which are wholly or partly a result of differences in respect of general health determinants.

Incremental Cost-Effectiveness Ratio (ICER) – difference in the expected cost of two interventions, divided by the difference in the expected effect produced by the two interventions.

Net Present Value (NPV) – The present value of an investment's future net benefits minus the initial investment.

Productivity Gains – The impact of an intervention on the productivity / income of those receiving the intervention.

Quality Adjusted Life Year (QALY) – a measure of disease burden, including both the quality and the quantity of life lived. It is used in assessing the value for money of health interventions.

Return on Investment (ROI) – A general term encompassing the techniques for comparing the costs and benefits generated by an investment.

4.3 Appendix 3: Definitions of the ROI metrics in the tool[26]

Metric	Description
Avoidable burden of disease (QALYs)	The product of the number of QALYs gained per person and the population benefiting from the package. This provides an indication of the scale of the health problem that can be resolved by the package.
Benefit-Cost Ratio (including all cost savings and value of health gains)	The sum of all cost savings and value of health gains (monetary value of QALY multiplied by the number of QALYs gained) divided by the cost of the package. A value greater than 1 indicates that the benefits of the package exceed its costs.
Benefit-Cost Ratio (including all cost savings)	The sum of all cost savings divided by the cost of the package. A value greater than 1 indicates that the benefits of the package exceed its costs.
Benefit-Cost Ratio (including only health care cost savings and value of health gains)	The health care cost savings and value of health gains (monetary value of QALY multiplied by the number of QALYs gained) divided by the cost of the package. A value greater than 1 indicates that the benefits of the package exceed its costs.
Benefit-Cost Ratio (including only health care cost savings)	The health care cost savings divided by the cost of the package. A value greater than 1 indicates that the benefits of the package exceed its costs.
Benefit-Cost Ratio (including only social care cost savings)	The social care cost savings divided by the cost of the package. A value greater than 1 indicates that the benefits of the package exceed its costs.
Benefit-Cost Ratio (including only productivity cost savings)	The productivity cost savings divided by the cost of the package. A value greater than 1 indicates that the benefits of the package exceed its costs.
Benefit-Cost Ratio (including only transport benefits)	The transport benefits divided by the cost of the package. A value greater than 1 indicates that the benefits of the package exceed its costs.
ICER (including all cost savings savings)	The incremental cost of the package minus the sum of all cost savings divided by the number of QALYs gained. The ICER can be either: • A positive number. • Dominant: if cost of the package minus the sum of all cost savings<0 and QALYs gained>0. • Dominated: if cost of the package minus the sum of all cost savings>0 and QALYs gained<0. Dominated if cost of the package minus the sum of all cost savings<0, QALYs gained<0, and value of QALYs<cost of the package minus the sum of all cost saving.

[26] The benefits and costs are summed for the time horizon selected by the user and annual discounts of 3.5% are applied in keeping with NICE's methods and HM Treasury 'Green Book' guide (2011).

Metric	Description
ICER (including only health care cost savings)	The incremental cost of the package minus the health care cost savings divided by the number of QALYs gained. The ICER can be either: • A positive number. • Dominant: if cost of the package minus health care cost savings<0 and QALYs gained>0. • Dominated: if cost of the package minus health care cost savings>0 and QALYs gained<0. Dominated if cost of the package minus the health care cost savings<0, QALYs gained<0, and value of QALYs<cost of the package minus the sum of all cost saving.
NPV (including all cost savings and value of health gains)	The sum of all cost savings and value of health gains (monetary value of QALY multiplied by the number of QALYs gained) minus the cost of the package. A positive value indicates that the value of the benefits of the package exceed its costs. .
NPV (including all cost savings)	The sum of all cost savings minus the cost of the package. A positive value indicates that the value of the benefits of the package exceed its costs. .
NPV (including only health care cost savings and value of health gains)	The health care cost savings and value of health gains (monetary value of QALY multiplied by the number of QALYs gained) minus the cost of the package. A positive value indicates that the value of the benefits of the package exceed its costs. .
NPV (including only health care cost savings)	The health care cost savings minus the cost of the package. A positive value indicates that the value of the benefits of the package exceed its costs. .
NPV (including only social care cost savings)	The social care cost savings minus the cost of the package. A positive value indicates that the value of the benefits of the package exceed its costs. .
NPV (including only productivity cost savings)	The productivity cost savings minus the cost of the package. A positive value indicates that the value of the benefits of the package exceed its costs. .
NPV (including only transport benefits)	The transport benefits minus the cost of the package. A positive value indicates that the value of the benefits of the package exceed its costs. .

4.4 Appendix 4: Physical activity interventions included in the tool

Table A3.1 Physical activity interventions (adults) included in the tool

Intervention type	Intervention	Description	% increase in people who become low active	% increase in people who meet recommendations	Cost per person	Source
One to one	Brief advice	Verbal advice, discussion, negotiation or encouragement with or without written or other support or follow up. It could be opportunistic and can take between 1-20 minutes.	0%	8.7%	£9.92	NICE PH44 (2012)
One to one	Transport advice	Travel Smart 'Individualised travel marketing' (ITM) which highlights travel choices 'people may not know they have' by providing locally relevant information and support to households	4.1%	7.6%	£10.87	Calculation based on evidence from NICE PH41 (2012)
One to one	Pedometer	Physical activity consultation plus 12 week pedometer walking programme	0%	54%	£52.50	Baker et al (2008)
Group	Walking programmes	Health walks - organised led walking groups - telephone calls (1 call from co-ordinator and then 3 follow up calls) - "Walk pack" : information on health walks within local area with info on public transport, car parks and creche facilities.	9.2%	4.3%	£47.42	Calculation based on evidence from NICE PH41 (2012)

Intervention type	Intervention	Description	% increase in people who become low active	% increase in people who meet recommendations	Cost per person	Source
Community	Information/ Media campaigns	Project STRIDE - email containing tips on how to achieve 30 minutes of moderate physical activity per day, 5 days a week -Regular email surveys regarding level of physical activity, motivational readiness and self-efficacy sent after the first 4 weeks, then monthly for 3 months and bi-monthly for 6 months - Participants mail in physical activity logs and brief surveys each month for 12 months. The return of each survey is reinforced with a monetary incentive ($10 in study). - Feedback forms based on survey results are generated containing theory based counselling messages which can be mailed to participants	1.6%	3%	£23.06	Sevick et al (2007)
Environment	Environmental cycling programmes	Cycling demonstration town -Investment in towns to promote cycling -Infrastructure improvements such as building cycle paths -Education and marketing	6.8%	3.1%	£30.00[27]	Calculation based on evidence from NICE PH41 (2012)

[27] Cost per person is based on an £18 million investment into 6 cycling demonstration towns, covering a total population of 600,000 people of 3 years. In the original economic evaluation by Cope et al, an assumption was made that costs would only be incurred in the first 3 years. Therefore no calculation was made for capital maintenance costs.

Intervention type	Intervention	Description	% increase in people who become low active	% increase in people who meet recommendations	Cost per person	Source
Environment	Environmental walking & cycling programmes	Sustainable travel towns -Investment in walking and cycling infrastructure -Personalised travel planning -Education and marketing	4.1%	7.5%	£46.93[28]	Calculation based on evidence from NICE PH41 (2012)
Environment	Urban planning	Introduction of walking cycling routes/ paths	7.1%	15.4%	£50.61[29]	Calculation based on evidence from NICE PH8 (2008)
Workplace	Health information & counselling	Physical activity counselling - One 30 minute health promotion consultation; - One 30 minute follow-up telephone call consultation conducted by an occupational nurse.	0%	36.6%	£64.15	NICE PH13 (2008)
Workplace	Walking programmes	Physical activity walking programme - Occupational nurses providing employees with programme services and resources for the promotion of walking.	0%	13%	£63.03	NICE PH13 (2008)

[28] Cost per person is based on the total of scheme costs over 4 years (discounted and adjusted for market price) for a population of 316,000 people. No calculation was made for capital maintenance costs.
[29] Average cost per user calculated based on the capital and maintenance costs of 4 trails ranging between 3.1-4.6 miles with between 2-3 bridges over a 30 year period

Intervention type	Intervention	Description	% increase in people who become low active	% increase in people who meet recommendations	Cost per person	Source
Workplace	Multicomponent	Physical activity counselling and fitness tests - One 11 hr training session per nurse; - One 30 minute physical activity counselling session; - Two 30 minute fitness tests performed by a Physiotherapist - One 30 minute physical activity follow-up counselling session.	0%	21%	£153.28	NICE PH13 (2008)

Table A2.2 Physical activity interventions (children) included in the tool

Intervention type	Intervention	Description	% increase in children who become active	Cost per child	Source
Group	Walking programme	Walking buses - groups of children walk along a set route collecting other children along the way at "bus stops", escorted by several adult volunteers.	29.7%	£135.98	Calculation based on evidence from NICE PH17 (2009)
Group	Health information/ counselling	Children aged 10-16 receive twelve 90 minute weekly sessions with a trained psychologist and sports education teacher. The initial session includes parents, then an introduction session with the children and two sessions based on a standardised manual. The manual covers topics such as: -physical activity concepts -physical, psychological and social benefits of PA The remaining sessions cover other goals such as healthy eating, prevention on sexually transmitted diseases, smoking, alcohol and illicit drugs. Pupils are asked to keep a diary in which they document their daily physical activity.	4%	£77.45	Araujo-Soares et al (2009)

4.5 Appendix 5: Literature review

The literature review was developed in consultation with NICE. The objectives of the review were to:

- Identify any updates or new interventions within the areas covered by NICE guidance for increasing physical activity since they were published.
- Identify any new interventions for increasing physical activity outside the areas covered by NICE guidance.

Search strategy

The following databases were used to implement the search strategy:

- Medline
- Embase
- PsycINFO
- HMIC
- Global health
- Cochrane library
- Cochrane CENTRAL
- Web of Science
- EPPI centre
- DoPHER
- TRID
- ERIC
- Planex
- Article First

Various search strategies were developed for the different databases that were searched. Below is an example of one of the strategies that was used in Medline.

1. (sport$3 or exertion$1 or walk$3 or bicycl$3 or bike$1 or biking or cyclist$ or (exercis$3 adj5 aerobic$1) or rollerblading or rollerskating or skat$ or athletics or baseball or basketball or boxing or football$ or soccer or golf$ or gymnastics or aerobics or recreation or playground$ or "martial arts" or hockey or racquet$ or swimm$ or volleyball or runn$ or jog$ or yoga or pilates or weightlifting or wrestling or tennis or gardening or recreation$1 or dancing or stairs or (stair$ adj2 climb$)).tw.

2. exp Physical Exertion/ or Exercise/ or Physical Fitness/ or exp "Physical Education and Training"/ or exp Dancing/ or exp Sports/ or exp Yoga/ or Exercise Therapy/ or exp Fitness Centers/ or Recreation/ or "Play and Playthings"/ or Gardening/

3. (physical adj5 (fit$4 or train$3 or activ$3 or endur$4)).tw.

4. (exercis$3 adj5 (fit$4 or train$3 or activ$3 or endur$4)).tw.

5. (leisure adj5 (centre$1 or center$1 or facilit$)).tw.

6. (fitness adj5 (centre$1 or center$1 or facilit$)).tw.

7. or/1-6

8. exp Behavior/ or Motivation/ or Health Knowledge, Attitudes, Practice/

9. ((lifestyle or "life style" or brief) adj2 (change$ or changing or modification$ or modify or modifying or therapy or therapies or program$ or intervention$)).tw.

10. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$) adj5 gym$).tw.

11. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$) adj5 physical activit$).tw.

12. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$) adj5 (circuits or aqua$)).tw.

13. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$) adj5 exercis$).tw.

14. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$) adj5 (keep fit or fitness class$ or yoga)).tw.

15. ((decreas$ or reduc$ or discourag$) adj5 (sedentary or deskbound)).tw.

16. (facilitate$ or uptake or "take up" or increase$ or impact$ or effect$ or improve$ or enhance$ or encourage$ or support$ or promot$ or optimiz$ or optimis$ or adher$ or access$ or motivate$ or satisfaction or compliance or comply or complie$ or availabl$ or provision or incentive$ or start or attend or utilis$ or utiliz$).ti.

17. or/8-16

18. ("rapid evidence" adj3 (assess$ or apprais$)).ti,ab.

19. ((Systematic$ or synthes$) adj3 (Research or evaluation$ or finding$ or thematic$ or report or descriptive or explanatory or narrative or meta$ or review$ or data or literature or studies or evidence or map or quantitative or study or studies or paper or impact or impacts or effect$ or compar$)).ti,ab,sh.

20. ("Meta regression" or "meta synth$" or "meta-synth$" or "meta analy$" or "metaanaly$" or "meta-analy$" or "metanaly$" or "Metaregression" or "Meta-regression" or "Methodologic$ overview" or "pool$ analys$" or "pool$ data" or "Quantitative$ overview" or "research integration").ti,ab,sh.

21. (review adj3 (effectiveness or effects or systemat$ or synth$ or integrat$ or map$ or methodologic$ or quantitative or evidence or literature)).ti,ab,sh.

22. (systematic review or meta-analysis).pt.

23. or/18-22

24. Animals/ not (Humans/ and Animals/)

25. (7 and 17 and 23) not 24

26. limit 25 to yr="2006 -Current"

27. (policy or policies or recommendation$ or strategy or strategies).ti.

28. exp Public policy/ or exp Policy making/

29. 27 or 28

30. 7 and 23 and 29

31. limit 30 to yr="2006 -Current"

32. 26 or 31

Manual searches of the following websites were undertaken to identify grey literature not available through systematic database search:

- Active Living by Design (http://www.activelivingbydesign.org/)
- Association of Public Health Observatories (http://www.apho.org.uk/apho/)
- BHF Physical Activity + Health (http://www.bhfactive.org.uk/home/index.html)
- British Heart Foundation (http://www.bhf.org.uk)
- Centers for Disease Control and Prevention (http://www.cdc.gov/index.htm)
- Commission for Architecture and the Built Environment (http://www.cabe.org.uk/default.aspx?contentitemid=73
- The Countryside Agency (http://www.countryside.gov.uk/LAR/Recreation/index.asp)
- Defra (http://www.defra.gov.uk/)
- Department for Transport (http://www.dft.gov.uk)
- Environment Agency (http://www.environment-agency.gov.uk/)
- ERPHO (http://www.erpho.org.uk/viewResource.aspx?id=21164)
- Forestry Commission (http://www.forestry.gov.uk/)
- GetWalking KeepWalking (http://www.getwalking.org)
- Global Advocacy for Physical Activity (http://www.globalpa.org.uk/)
- Health England (http://www.healthengland.org);
- National Centre for Social Research (http://www.natcen.ac.uk)
- National Obesity Observatory (http://www.noo.org.uk/data_sources/physical_activity)
- NHS Evidence (www.evidence.nhs.uk);
- OPENspace (http://www.openspace.eca.ac.uk/)
- PAHA (http://www.paha.org.uk/Feature/scottish-physical-activity-data-sources)
- Scottish Government (http://www.scotland.gov.uk);
- SEPHO (http://www.sepho.org.uk/topics/physActivity.aspx)
- Space Syntax (http://www.spacesyntax.com/)
- SPARColl (http://www.sparcoll.org.uk/)
- Sport England (http://www.sportengland.org);
- Stockholm Environment Institute at York (http://www.york.ac.uk/inst/sei/welcome.html)
- Sustrans (http://www.sustrans.org.uk/)
- The Cochrane Library (http://www.thecochranelibrary.com);
- Transport 2000 (http://www.transport2000.org.uk/)
- World Health Organization (http://www.euro.who.int);
- Transport Research Laboratory (www.trl.co.uk/)
- Institute for Road Safety Research (http://www.swov.nl/index_uk.htm)

Screening

From databases that were searched and the grey literature, 15,650 abstracts were identified to be screened. Table A4.1 provides the exclusion and inclusion criteria that was used to screen papers identified in the search. To ensure consistency, Matrix reviewed the inclusion/exclusion criteria utilised in the previous NICE guidance reviews'. The criteria listed below are consistent across the reviews and provide a broad set of criteria.

Table A4.1 Exclusion/inclusion checklist for screening papers

	Criteria	Exclusion/ Inclusion code	Notes
C1	**English language paper**	If not **1_EX.LANG**	Only studies published in English will be included.
C2	**Date** To be defined	If not 2_**EX.DATE**	
C3	**Country** OECD countries	f not **3_EX.COUNTRY**	**OECD countries**: Australia; Austria; Belgium; Canada; Chile; Czech Republic; Denmark; Estonia; Finland; France; Germany; Greece; Hungary; Iceland; Ireland; Israel; Italy; Japan; Korea; Luxembourg; Mexico; Netherlands, Norway; New Zealand; Poland; Portugal; Slovak Republic; Slovenia; Spain; Sweden; Switzerland; Turkey; United Kingdom, United States.
C4	**Population** Papers relating to the general adult or child population	If not **4_EX.POP**	For example interventions aimed at people with chronic diseases or specific groups such as athletes or specific ethnic groups should be excluded
C5	**Topic** Papers relating to physical activity	If not **5_EX.TOPIC**	
C6	**Intervention** Papers relating to interventions that increase physical activity	If not **6_EX.INTERVENTION**	For example physical activity programmes or environmental interventions
C7	**Setting** Interventions that were carried out in: • Primary, secondary or tertiary NHS setting • Any local authority, private, community or voluntary social service • Leisure setting	If not **7_EX.SETTING**	

	Criteria	Exclusion/ Inclusion code	Notes
C 8	**Quantitative outcomes** • Percentage of participants who became active (>= 150 min of moderate intensity activity per week). • Mean increase in the number of minutes of exercise per week	If not **8_EX.QUANT OUTCOME**	
C9	**Effectiveness** Whenever possible, only studies showing a statistically significant positive effect will be included. However if these are not available, studies showing non-statistically significant effects and included in meta-analyses in previous NICE guidance, may be considered.	If not **9_EX. EFFECT**	

	Criteria	Exclusion/ Inclusion code	Notes
	Study design • effectiveness studies (RTC, non RTC, and pre-post studies) • economic analyses (cost-benefit analyses; cost-effectiveness studies; and cost-utility analyses) • systematic reviews	Studies that look at effectiveness only: **9_IN.EFFECT** Studies that are economic analyses: **10_IN.ECON** Systematic reviews that include any of the study types: **11_IN.SYSTREV** If relevant to the topic but does not contain data but is an opinion piece include as: **12_IN.BACKGROUND** Studies that report useful cost and resource data include as: **13_IN.COST** If unclear: **Q_Query**	Systematic reviews that include any of the study types listed above will be identified; these will be used as a source of further primary studies rather than included in the review in their own right. Studies that report useful cost and resource data: These costing studies will be excluded from the cost-effectiveness review but will be recorded separately and used to inform the development of the economic models.

Feasibility assessment

After abstract screening using the exclusion and inclusion criteria, 114 studies were identified for full text review and feasibility assessment. The following feasibility criteria were applied to the short listed studies:

- Is the setting relevant to the UK context?
- Is the intervention already covered by NICE guidance or does it update the guidance?
- Does the outcome metric measured in the study allow economic modelling?
- Does the paper provide sufficient data on costs or resources to allow costing?

Results

As a result of the feasibility assessment, two studies were identified as feasible to include in the models in addition to interventions already identified in NICE guidance. Table A4.2 provides a description of the two studies.

Table A4.2 Studies identified through feasibility assessment

Reference	Model	Intervention type	Intervention	Description
Sevick et al (2007)	Adults	Community	Information/ media campaigns	Project STRIDE - email containing tips on how to achieve 30 minutes of moderate physical activity per day, 5 days a week -Regular email surveys regarding level of physical activity, motivational readiness and self-efficacy sent for the first 4 weeks, monthly for 3 months and bi-monthly for 6 months - Participants mailed in physical activity logs and brief surveys each month for 12 months. The return of each survey was reinforced with a $10 incentive. - Feedback forms based on survey results were generated containing theory based counselling messages and mailed to participants.
Araujo-Soares et al (2009)	Children	Group	Health information/ counselling	Children aged 10-16 received twelve 90 minute weekly sessions with a trained psychologist and sports education teacher. The initial session included parents, then an introduction session with the children and two sessions based on a standardised manual. The manual covered topics such as: -physical activity concepts -physical, psychological and social benefits of PA The remaining sessions covered other goals such as healthy eating, prevention on sexually transmitted diseases, smoking, alcohol and illicit drugs. Pupils were asked to keep a diary in which they documented their daily physical activity.

4.6 Appendix 6: Model parameters

Table A5.1 Population data

Data	Source
Population of local area	ONS - Local area specific data
Proportion of population who are inactive	Active people survey, Sport England (2012) – local area specific data
Proportion of population who are low active	Active people survey, Sport England (2012) – local area specific data
Proportion of population who are high active	Active people survey, Sport England (2012) – local area specific data
Proportion of children who meeting recommendations for physical activity	Health Survey for England, Department of Health (2008)
Proportion of children who are inactive	Health Survey for England, Department of Health (2008)
Mortality and life table	Office for National Statistics

Table A5.2 Baseline risk for CHD, stroke and diabetes

Age	CHD	Stroke	Diabetes	Source
33-34	0.000035	0.00008	9E-05	NICE PH44 (2012)
35-44	0.000465	0.00023	0.00028	NICE PH44 (2012)
45-54	0.002095	0.00057	0.000632	NICE PH44 (2012)
55-64	0.00631	0.00291	0.001005	NICE PH44 (2012)
65-74	0.0097	0.0069	0.001116	NICE PH44 (2012)
75-81	0.0097	0.01434	0.001116	NICE PH44 (2012)

Table A5.3 Relative risk data

Data	Value	Assumption (if applicable)	Source
Relative risk CHD	0.9		Based on evidence from Hu et al (2007) quoted in NICE PH44 (2012)
Relative risk Stroke	0.86		Based on evidence from Hu et al (2007) quoted in NICE PH44 (2012)
Relative risk Diabetes	0.67		Based on evidence from Hu et al (2007) quoted in NICE PH44 (2012)
Relative risk Non CVD mortality after non-fatal CHD event	1.71	No data for CHD so assumed to be same as stroke	NICE PH44 (2012)
Relative risk CVD mortality after non-fatal CHD event	3.89	No data for CHD so assumed to be same as stroke	NICE PH44 (2012)
Relative risk Non CVD mortality after non-fatal stroke event	1.71		Based on evidence from Hansen et al (2001) quoted in NICE PH44 (2012)
Relative risk CVD mortality after non-fatal stroke event	3.89		Based on evidence from Hansen et al (2001) quoted

Data	Value	Assumption (if applicable)	Source
			in NICE PH44 (2012)
Relative risk Non CVD mortality after diabetes	1.49		Based on evidence from Preis et al (2009) quoted in NICE PH44 (2012)
Relative risk CVD mortality after diabetes	2.61		Based on evidence from Preis et al (2009) quoted in NICE PH44 (2012)

Table A5.4 Utility data

Data	Value	Source
Utility score for healthy people	1.00	Based on evidence from Ward et al (2005) quoted in NICE PH44 (2012)
Utility score (CHD 1st event)	0.80	Based on evidence from Ward et al (2005) quoted in NICE PH44 (2012)
Utility score (post CHD 1st event)	0.92	Based on evidence from Ward et al (2005) quoted in NICE PH44 (2012)
Utility score (Stroke 1st event)	0.63	Based on evidence from Ward et al (2005) quoted in NICE PH44 (2012)
Utility score (Stroke CHD 1st event)	0.65	Based on evidence from Ward et al (2005) quoted in NICE PH44 (2012)
Utility score (Diabetes CHD 1st event)	0.90	Based on evidence from Ward et al (2005) quoted in NICE PH44 (2012)
Utility score (33-44 year olds)	0.90	NICE PH44 (2012)
Utility score (45-54 year olds)	0.86	NICE PH44 (2012))
Utility score (55-64 year olds)	0.82	NICE PH44 (2012)
Utility score (65-74 year olds)	0.78	NICE PH44 (2012))
Utility score (75+ year olds)	0.72	NICE PH44 (2012)
QALY gain (30 minutes physical activity)	0.00022243	NICE PH17 (2008)

Table A5.4 Other inputs and cost data

Data	Value	Assumption (if applicable)	Source
Annual treatment cost of coronary heart disease (1st event)	£4,204.93		Based on evidence from Ward et al (2005) quoted in NICE PH44 (2012)
Annual treatment cost of coronary heart disease (post 1st event)	£480.47		Based on evidence from Ward et al (2005) quoted in NICE PH44 (2012)
Annual treatment cost of Stroke (1st event)	£10,855.90		Based on evidence from Ward et al (2005) quoted in NICE PH44 (2012)
Annual treatment cost of Stroke (post 1st event)	£2,384.25		Based on evidence from Ward et al (2005) quoted in NICE PH44 (2012)
Annual treatment cost of diabetes	£969.47		Based on evidence from Ward et al (2005) quoted in NICE PH44 (2012)

Data	Value	Assumption (if applicable)	Source
Average days of absenteeism saved per year per person participating in a workplace program encouraging increased physical activity	5.23		Based on evidence from Lechner et al (1997) quoted in NICE PH13 (2008)
Average daily wage rate	£106.18		Based on evidence from NICE PH13 (2008) and Office for National Statistics
Proportion of stroke patients who would need care	0.332		Based on evidence from Commissioning support for London (2011) quoted in Pokhrel et al (2012)
Local authority care as a % of total informal care for stroke	0.125		Based on evidence from Saka et al (2009) quoted in Pokhrel et al (2012))
LA care cost	£1,656.41		Based on evidence from Saka et al (2009) quoted in Pokhrel et al (2012))
Average annual number of car trips per person	614		Calculation based on data from National Travel Survey 2011
Average length of car trip (miles)	7.1		National Travel Survey 2011
Average annual distance travelled by car (miles)	4,301		Calculation based on data from National Travel Survey 2011
Average annual distance travelled by car (km)	6,924		Calculation
% Reduction in annual car distance travelled (km) if low active	0.05%	It is assumed that increasing activity has a very small impact on reduction in the number of km travelled by car	Assumption based on expert opinion
% Reduction in annual car distance travelled (km) if meets recommendations	0.1%	It is assumed that increasing activity has a very small impact on reduction in the number of km travelled by car	Assumption based on expert opinion
Annual car distance travelled if low active (km)	6,921		Calculation: Average annual distance travelled by car (km) * (1-% Reduction in annual car distance travelled (km) if low active) = 6,924*(1-0.05%)

Data	Value	Assumption (if applicable)	Source
Annual car distance travelled if meets recommendations (km)	6,917		Calculation: Average annual distance travelled by car (km) * (1-% Reduction in annual car distance travelled (km) if meets recommendations) = 6,924*(1-0.1%)
Reduction in Km travelled (low active)	3		Calculation: Average annual distance travelled by car (km) - Reduction in Km travelled (low active) = 6,924-6,921
Reduction in Km travelled (meets recommendations)	7		Calculation: Average annual distance travelled by car (km) - Reduction in Km travelled (meets recommendations) = 6,924-6,917
Congestion (Cost per km)	£16.97		Based on evidence from NICE PH41 (2012)
Infrastructure (Cost per km)	£0.13		Based on evidence from NICE PH41 (2012)
Accident (Cost per km)	£1.94		Based on evidence from NICE PH41 (2012)
Local air (Cost per km)	£0.52		Based on evidence from NICE PH41 (2012)
Noise (Cost per km)	£0.13		Based on evidence from NICE PH41 (2012)
Greenhouse gases (Cost per km)	£0.39		Based on evidence from NICE PH41 (2012)
Indirect taxation (Cost per km)	-£4.66		Based on evidence from NICE PH41 (2012)
Total transport (cost per km)	£15.42		Based on evidence from NICE PH41 (2012)

4.7 Appendix 7: Additional information

Accessing the tool

The tool shall be freely available on the NICE website.

Version control

Note that some of the tool inputs are time limited (e.g. population statistics) and may be updated when new data becomes available. As such, it is the user's responsibility to ensure that they are using the latest version of the tool. All versions made available for download will be clearly marked with a version number.

Referencing the tool

Any analysis based on this tool needs to be acknowledge the use of this tool as follows: "This analysis is based on NICE Return on Investment Tool for Physical Activity, version 1" and include the citation as:

Mallender, J., Bertranou, E., Owen, L., Lester-George, A., Jhita, T., Roberts, S. (2013) Physical Activity Return on Investment Tool. London: National Institute of Health and Care Excellence

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Disclaimer information

NICE has provided this tool to aid decision-making. NICE cannot be held liable for any investment or other decisions that are made using information and results obtained from this tool. Implementation of NICE guidance is the responsibility of local commissioners and/or providers. Commissioners and providers are reminded that it is their responsibility to implement NICE guidance, in their local context, in light of their duties to avoid unlawful discrimination and to have regard for promoting equality of opportunity. Nothing in this tool should be interpreted in a way that would be inconsistent with compliance with those duties.

Acknowledgements

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Request to users

This tool may be subject to continuous improvement. If any problem is encountered or inconsistency is found, please report it to NICE by emailing nice@nice.org.uk