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**Project Title**

*Estimating the impact of diabetes prevention on public health: using modelling to aid translation of knowledge into action*

**Project ID**

SPHR-SHF-PH1-MDP

**Lead Researchers**

Alan Brennan, Jim Chilcott – University of Sheffield; ScHARR

**SPHR Collaborators**

Elizabeth Goyder, Nick Payne, Hazel Squires, Louise Preston, Penny Watson, Mike Gillett – University of Sheffield; ScHARR
Simon Griffin – University of Cambridge
Colin Greaves – Peninsula College of Medicine and Dentistry
Peter Diggle – LiLaC; Lancaster University
Simon Capewell – LiLaC; University of Liverpool

**Start Date**

1 April 2012

**End Date**

31 March 2014

**Outline**

Assessing the effectiveness and cost-effectiveness of population / community public health interventions and targeted identification and screening interventions for type 2 diabetes prevention.

This project aims to provide a coherent, model based framework for the evaluation of strategies for the prevention of type 2 diabetes. Specifically the aim is to support decision making on, and enable the design of, preventive strategies that are effective and cost-effective. The focus is on aiding rational allocation of resources across population / community level interventions, which aim to alter the distribution of risk factors for diabetes, and targeted identification / screening interventions (e.g. NHS health checks programme) that aim to identify and provide management for individuals at increased risk.

There are a number of necessary steps in translating knowledge from epidemiological studies in diabetes into preventive action; identification of individuals or groups who are at increased risk, description of the important risk factors that can be altered, identification of key influences on risk factors (e.g. attitudes or environmental aspects), development of interventions to act on risk factors (e.g. promoting walking), development of methods to identify people likely to benefit from an intervention, evaluation of the success of an intervention, estimation of its potential impact on public health. Modelling can play a key role in developing our understanding of this complex system and in estimating the potential impact of different risk identification and management strategies on public health outcomes. Furthermore it can also play a role in facilitating the iterative research cycle by helping us identify and analyse key current uncertainties, focus further research and input into the design of the next generation of interventions.

**Findings**

Version 1.0 of the simulation was run on 30th April 2014 for 5 million individuals randomly sampled from the HSE 2011 dataset. The outcomes of the simulation are reported in Table 1. The results illustrate the incremental costs, QALYs and net benefits (at a willingness to pay threshold of £20,000 per QALY) for the five interventions compared with a do-nothing scenario. All of the interventions are cost-saving, with intervention E demonstrating the highest net benefit. This intervention describes widespread screening for diabetes and individuals at high risk of diabetes, followed by a lifestyle intervention for those individuals at highest risk of diabetes. Intervention A, soft drinks taxation, is also associated with large cost-savings and quality of life gains.

Sensitivity analyses indicate that population-wide efficacy of an intervention is linearly dependent upon uptake. The low uptake of Intervention D, aimed at deprived communities, is the main reason for its relatively modest outcomes. Although intervention B and D have modest Net benefit, they are more likely to reduce health inequalities because they are...
targeted towards individuals with low socioeconomic background. Whereas only 6% and 18% of individuals in intervention C and E are from a low socioeconomic background.

Table 1: Incremental analysis of interventions versus do nothing per patient simulated in the whole population

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Soft drinks tax</td>
<td>Retail policy</td>
<td>Workplace</td>
<td>Community</td>
<td>High risk individuals</td>
</tr>
<tr>
<td>Proportion of individuals benefited (% of total)</td>
<td>100</td>
<td>18.33</td>
<td>10.85</td>
<td>2.28</td>
<td>12.95</td>
</tr>
<tr>
<td>Incremental Total Costs</td>
<td>-51.81</td>
<td>-35.82</td>
<td>-13.49</td>
<td>-17.29</td>
<td>-221.15</td>
</tr>
<tr>
<td>Incremental Intervention Cost</td>
<td>0</td>
<td>0</td>
<td>0.56</td>
<td>3.04</td>
<td>37.93</td>
</tr>
<tr>
<td>Incremental Diabetes Cost</td>
<td>-9.02</td>
<td>0.68</td>
<td>0.34</td>
<td>-2.53</td>
<td>-149.35</td>
</tr>
<tr>
<td>Incremental Cardiovascular Costs</td>
<td>-12.89</td>
<td>-10.96</td>
<td>-4.80</td>
<td>-5.74</td>
<td>-68.85</td>
</tr>
<tr>
<td>Incremental Retinopathy Costs</td>
<td>-0.32</td>
<td>-0.27</td>
<td>-0.11</td>
<td>-0.14</td>
<td>-5.38</td>
</tr>
<tr>
<td>Incremental Nephropathy Cost</td>
<td>-15.29</td>
<td>13.17</td>
<td>-4.69</td>
<td>-5.79</td>
<td>-33.52</td>
</tr>
<tr>
<td>Incremental Neuropathy Cost</td>
<td>-0.22</td>
<td>0.04</td>
<td>0.02</td>
<td>-0.15</td>
<td>-7.55</td>
</tr>
<tr>
<td>Incremental Cancer Costs</td>
<td>0.01</td>
<td>0.05</td>
<td>0.03</td>
<td>0.03</td>
<td>0.46</td>
</tr>
<tr>
<td>Incremental Osteoarthritis Costs</td>
<td>-2.65</td>
<td>0.44</td>
<td>0.14</td>
<td>-0.91</td>
<td>6.79</td>
</tr>
<tr>
<td>Incremental Depression Costs</td>
<td>0.24</td>
<td>0.15</td>
<td>0.06</td>
<td>0.10</td>
<td>2.45</td>
</tr>
<tr>
<td>Incremental Other costs</td>
<td>-11.67</td>
<td>-12.78</td>
<td>-5.05</td>
<td>-5.20</td>
<td>-4.13</td>
</tr>
<tr>
<td>Incremental Life Months</td>
<td>0.08</td>
<td>0.06</td>
<td>0.02</td>
<td>0.04</td>
<td>0.38</td>
</tr>
<tr>
<td>Incremental QALYs</td>
<td>0.00366</td>
<td>0.00266</td>
<td>0.00099</td>
<td>0.00173</td>
<td>0.01880</td>
</tr>
<tr>
<td>Net Benefit (assuming a willingness to pay threshold of £20,000 per QALY)</td>
<td>125.05</td>
<td>89.06</td>
<td>33.23</td>
<td>51.92</td>
<td>587.12</td>
</tr>
</tbody>
</table>

The model suggests that interventions to prevent diabetes are cost-saving and are effective in improving health. In these analyses we have been able to compare the cost-effectiveness of a broad range of intervention types in a common framework. We can estimate the impact of policies targeting different sub-populations.

**Lay summary**

**Background**
Type-2 diabetes is becoming increasingly common in the UK. A diabetes diagnosis reduces the quality of life of affected individuals, whilst costing society a huge amount in treatment of the disease and its complications.

A number of different public health policies have been proposed to help prevent type-2 diabetes. These include screening programmes in which individuals are tested for diabetes, lifestyle interventions (e.g. advice about nutrition and exercise) for people who are at high risk of developing diabetes, and national policies such as taxation of sugary drinks. To ensure that public money is used in the best way, it is necessary to decide which policies are most effective and most value for money.

**Methods**
Health economic models are computer models that are designed to predict the likely effect of different health interventions, in order to help health professionals make decisions about treatments and health policy. We aimed to develop a model that would allow us to look at a wide range of different public health policies for type-2 diabetes. We involved doctors, diabetes researchers and lay members in the model design, in order to ensure that we had accurately represented the causes of diabetes, the care of patients and the outcomes of having the disease.
Our model allowed us to develop individual people and follow their health journeys over time. For each person, their weight, cholesterol levels, systolic blood pressure and HbA1c (a measure of diabetes) fluctuate from year to year, representing natural changes as people age. Individuals can develop diabetes, cardiovascular disease (e.g. heart disease or stroke), diabetes-related complications, cancer, depression or osteoarthritis over the course of their lifetime. Each disease results in a particular cost to society and a reduction in quality of life for the individual.

Results
The model has enabled us to estimate how different health policies can reduce the costs of diabetes and improve health for patients. We find that screening for type-2 diabetes followed by lifestyle education for high risk individuals is particularly cost saving and gives the largest health gains. Sugary drink taxation or community interventions to promote healthy diets lead to smaller improvements in health and smaller cost savings.

Conclusions
We have developed a useful tool to enable different diabetes prevention interventions to be evaluated for their long term costs and health gains. In addition, the model is flexible enough to allow alternative sub-populations to be targeted, or multiple interventions combined.

Publications

Impact
Published Articles

Conference presentations
The development of a statistical model to describe longitudinal and correlated metabolic risk factors to evaluate policies to prevent type 2 diabetes. European Diabetes Epidemiology Group, Sardinia, 29th March-1st April 2014.

Submitted Articles
A statistical model to describe longitudinal and correlated metabolic risk factors to evaluate policies to prevent type 2 diabetes: the Whitehall II Prospective Study.

Planned Articles

Thomas, C. Watson, P. Squires, H. Chilcott, J. Brennan, A. A validation of a policy analysis model to evaluate the economic benefits of diabetes prevention policies.

Thomas, C. Greaves, C. Chilcott, J. Watson, P. Brennan, A. The incremental economic benefits of layering multiple diabetes prevention policies within a population.

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Further information
Jim Chilcott j.b.chilcott@sheffield.ac.uk
Reference List