Assessing the effectiveness and cost-effectiveness of population / community public health interventions and targeted identification and screening interventions for type-2 diabetes prevention, using a common modelling framework to support translation of knowledge into action.

1.	**Project reference:**	**Final report date:**	
	SPHR-SHF-PH1-MDP	12 May 2014	
2.	**Project title:**		
	Assessing the effectiveness and cost-effectiveness of population / community public health interventions and targeted identification and screening interventions for type-2 diabetes prevention, using a common modelling framework to support translation of knowledge into action. http://sphr.nihr.ac.uk/wp-content/uploads/2017/03/Brief-SPHR-SHF-PH1-MDP.pdf#view=Fit		
3.	**Lead investigator(s) on project:**		
	Professor Jim Chilcott, Professor of Healthcare Decision Modelling, ScHARR, University of Sheffield Professor Alan Brennan, Professor of Health Economics and Decision Modelling, ScHARR, University of Sheffield		
	Other NIHR School collaborators (name, School for Primary Care/Social Care Research) on project:		
	N/A		
	Names and roles of others involved in project (e.g. include fixed term contract researchers and external collaborators / partners):		
	Dr Penny Breeze, ScHARR, University of Sheffield Dr Hazel Squires, ScHARR, University of Sheffield Dr Chloe Thomas, ScHARR, University of Sheffield Dr Louise Preston, ScHARR, University of Sheffield Mike Gillett, ScHARR, University of Sheffield Professor Peter Diggle, (LiLaC) Medical School, Lancaster University and Institute of Infection and Global Health, (LiLaC) University of Liverpool Dr Eric Brunner, University College London Dr Adam Tabak, University College London Professor Colin Greaves, University of Exeter Medical School		
4.	**Project start date:**	**Project end date:**	**Duration:**
	1st April 2012	31st March 2014	2 years
5.	**Project objectives originally outlined in proposal:**		
	• Develop a new integrated modelling framework for type 2 diabetes prevention. • Synthesise existing datasets and literature evidence to input to model. • Develop and implement a new software platform for the modelling to enable quicker and more integrated analyses. • Engage with local and national stakeholders to prioritise a set of research questions for		

the new modelling to address, building on recent NICE guidance and health checks work.

- Produce model results to inform local commissioners and national policy makers both on effective / cost-effective intervention strategies where evidence is strong enough, and on research gaps and priorities for applied public health research where evidence is limited and resolving uncertainties in the evidence could affect public health substantially.
- Disseminate findings in academic journals and more importantly to public health and NHS commissioners and practitioners.

6. Briefly describe and explain the reason(s) for any changes to the project originally outlined in proposal:

No substantial changes have been made to the original objectives outlined above.

7. Brief summary of methods, findings against objectives, and conclusions (2-4 pages max):

Developing the Conceptual Model

The model was developed in line with recommendations from a methodological framework for public health cost-effectiveness models developed as part of a PhD fellowship running alongside the project (1). We recruited a stakeholder group comprising public health specialists, research collaborators from other SPHR groups, diabetologists, local commissioners and lay members. This group met for three workshops during the project to inform important decisions regarding the data inputs, model design, and selection of interventions to be evaluated in the model.

A series of literature searches were used to identify data to help structure the conceptual model. A literature review of previous economic evaluations of diabetes prevention interventions found that in order to compare a range of prevention interventions it was necessary to incorporate multiple risk factors for diabetes, diabetes-related complications and obesity related co-morbidity outcomes (2).

The SPHR Model

The School for Public Health Research (SPHR) diabetes model was developed to forecast long-term health and health care costs under alternative scenarios for diabetes prevention intervention. The evolution of individual-level trajectories, rather than aggregate characteristics of a cohort are simulated through a micro-simulation framework. The model was designed to simulate a representative sample of the UK population. The status of all individuals in the model is updated in yearly cycles. The current version of the model includes a detailed description of metabolic risk factors from analysis of the Whitehall II cohort. The metabolic risk factors impact on the incidence of diabetes diagnosis and other major health related events. The model was developed in freely available statistics software, R, which allowed fast and flexible simulation of patient outcomes.

The Health Survey for England

The characteristics of individuals included in the SPHR diabetes model were based on survey data from the 2011 Health Survey for England (12). The total sample size of the HSE 2011 was 10,617. Individuals aged less than 16 and those with a prior diagnosis of diabetes were excluded leaving a final population of 8,038. Individuals were sampled at random with replacement from this dataset to populate the model. Table 1 describes the characteristics of individuals that were randomly sampled for inclusion in the model.

Table 1: Characteristics of final sample from HSE 2011 (N=8038)

	Number	Percentage	
Male	3506	43.6	
White	7212	89.7	
IMD 1 (least deprived)	1700	21.1	
IMD 2	1699	21.1	
IMD 3	1696	21.1	
IMD 4	1479	18.4	
IMD 5 (most deprived)	1464	18.2	

Non-smoker	6415	79.8	
Anti-hypertensive treatment	2092	26.0	
Statins	665	8.3	
	Mean	Standard deviation	Median
Age	48.59	18.49	47.00
BMI	27.13	5.18	26.40
Total Cholesterol	5.42	1.07	5.40
HDL Cholesterol	1.53	0.44	1.50
HbA1c	5.61	0.47	5.60
Systolic Blood Pressure	125.90	16.92	123.50
EQ-5D (TTO)	0.836	0.232	0.883
BMI Body Mass Index; IMD Index of Multiple Deprivation; EQ-5D 5 dimensions Euroqol (health related quality of life index)			

The Whitehall II model

Collaboration with SPHR partners from University College London enabled us to access and analyse the Whitehall II cohort data for this study (3). The Whitehall II analysis specified two hour glucose, fasting plasma glucose, and HbA1c test results as observations of an underlying latent construct we called glycaemia. This allowed the simulation to predict these test results to be correlated but also dependent on other individual characteristics.

Latent glycaemia and body mass index are estimated from a quadratic growth model in which the intercept and slope factors are conditional on individual characteristics and unobservable random error terms. The growth models for systolic blood pressure, total cholesterol and HDL cholesterol are estimated from linear growth models. The growth factors for BMI are included as covariates influencing the growth factors for latent glycaemia, systolic blood pressure, total cholesterol and HDL cholesterol. Therefore, changes in the slope factor for BMI cause a change from their natural history in an individual’s slope factor for other metabolic risks. When an individual is diagnosed with type 2 diabetes, the model simulates subsequent HbA1c test results using the UKPDS outcomes model. Furthermore, if an individual is prescribed anti-hypertensive treatment or statins, their systolic blood pressure or total cholesterol are reduced and held constant for all subsequent cycles.

Long term health outcomes

The model simulates a number of health outcomes that are related to BMI and diabetes. The model simulates opportunistic screening for diabetes, hypertension and dyslipidemia when individuals attend their general practitioner. The QRISK2 algorithm is used to estimate the probability of a cardiovascular disease event, and is conditional on many individual characteristics including BMI, cholesterol, systolic blood pressure and diabetes (4). The specific type of event and progression of the event over time are estimated from transition probabilities taken from a previous model (5). Modifications were made to the QRISK to incorporate the risk of HbA1c into the risk equation (6;7). Microvascular events including renal failure, blindness, foot ulcer and amputation were simulated using the UKPDS outcomes model, and events were conditional on HbA1c and other metabolic risk factors (6). Cancer incidence and association with BMI was estimated from the EPIC-Norfolk study (8;9). Osteoarthritis was associated with BMI and HbA1c>=6.5. The incidence of depression was increased in individuals following a diagnosis of type-2 diabetes or depression (10;11). Finally, other cause mortality (excluding cardiovascular mortality and cancer mortality) was estimated from UK life tables and was associated with HbA1c>=6.5 (12).

Outcomes

Discussions from the stakeholder workshop highlighted that a broad range of model outcomes would be useful to help guide policy on diabetes prevention interventions. As a consequence, the model has been designed to collect multiple outcomes for costs and health benefits. Furthermore, the evaluation can be split into sub-populations to gauge the equity impact of the intervention.

Costs

Costs were estimated from a NHS and Personal Social Services perspective in 2012-13 UK pounds. Costs were assigned to the health outcomes simulated in the model to estimate an overall cost for each individual in the model. Costs were discounted at 1.5% in line with recommendations for public health economic evaluations (13).

Quality Adjusted Life Years
At baseline, EQ-5D scores were extracted from the HSE dataset to describe an individual's baseline health related quality of life. A utility decrement for age was applied to the baseline EQ-5D each year. Change in BMI was also associated with a quality of life decrement (14). Cardiovascular disease, cancer, microvascular disease, osteoarthritis and depression were associated with a utility factor decrement which was multiplied by the individual's baseline utility, and adjusted for age and change in BMI.

The Intervention
We selected five diabetes prevention interventions; soft drinks taxation, a retail policy improving supply of fruit and vegetables, a workplace intervention promoting healthy eating, a community intervention promoting healthy eating in deprived areas, and a lifestyle intervention for individuals at high risk of diabetes. Evidence for these interventions was sought from the published literature. We consulted with Colin Greaves on how to implement these interventions in the model and what supplementary evidence was needed on uptake, wider benefits and maintenance of effects. We assumed that the effectiveness of all interventions deteriorated over five years.

Validation
We have run five simulations designed to evaluate how the simulation outcomes compare with published data from general population and newly diagnosed diabetes cohorts.

1. We compared the three year incidence of diabetes between the model and the EPIC-Norfolk cohort (15). The model reports a higher three year incidence of diabetes than that reported in the EPIC-Norfolk cohort. However, the risk is underestimated in individuals at moderate risk of diabetes (HbA1c 5-5.9).
2. We simulated the HSE 2003 data for eight years and compared population distributions for metabolic risk factors and cardiovascular prevalence between the model and the HSE 2011 cohort. Overall the predictions were good. The simulation slightly over-predicted higher systolic blood pressure and lower total cholesterol than observed. HbA1c was slightly under-predicted. The prevalence of diabetes and cardiovascular disease were similar to those observed in the data.
3. We simulated the ADDITION trial, which has evaluated a programme for screening for diabetes and evaluated the effectiveness of an intensive treatment programme post-diagnosis. As observed within the trial, the model simulation did not find a statistically significant difference in mortality between the screening and non-screening population (16). We identified some small differences in the five year changes in metabolic risk factors between the simulation and the ADDITION trial (17). The simulation predicted smaller decreases in systolic blood pressure and total cholesterol, but slightly higher rates of cardiovascular events and mortality.
4. The LookAHEAD trial evaluated a lifestyle intervention following diagnosis of diabetes (18). The trial reported cardiovascular events and mortality rates for the two arms of the trial. The model predicted higher rates of cardiovascular disease and mortality than observed in the trial. However, the incidence of heart failure was under-estimated.
5. We compared model simulation outcomes with the UKPDS events for individuals newly diagnosed with diabetes (6). The model predicted similar rates of microvascular disease, stroke and heart disease, but lower rates of MI and mortality.

The validation confirmed that the model predicted reasonable outcomes for metabolic risk factors and long term outcomes when compared with other datasets. The differences observed between the model simulation and observed data are likely to be due to differences in the populations studied. For example, the UK population is likely to have higher cardiovascular and mortality event rates compared with the ADDITION trial due to a higher proportion of individuals from ethnic minorities and lower socioeconomic areas.

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 2. The results illustrate the incremental costs and QALYs for the five interventions compared with a do-nothing scenario. All of the interventions are cost-saving, with intervention E demonstrating the highest cost-savings and quality of life gains. 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 associated with large cost-savings and quality of life gains. Intervention D reports modest outcomes, mainly due to the low uptake of the intervention in deprived communities.

Table 2: Incremental analysis of interventions versus do nothing per patient simulated in the whole population

	A	B	C	D	E
	Soft drinks tax	Retail policy	Workplace	Community	High risk individuals
Proportion of individuals benefited (% of total)	100	17.97	11.36	2.47	12.56
Incremental Total Costs	-51.63	-36.09	-13.85	-22.15	-240.32
Incremental Intervention Cost	0	0	0.28	1.52	18.96
Incremental Diabetes Cost	-8.96	0.65	0.35	-2.81	-149.20
Incremental Cardiovascular Costs	-12.98	-11.13	-4.76	-6.44	-68.79
Incremental Retinopathy Costs	-0.31	-0.27	-0.11	-0.18	-5.39
Incremental Nephropathy Cost	-15.14	13.22	-4.83	-7.53	-33.81
Incremental Neuropathy Cost	-0.19	-0.03	0.02	-0.17	-7.55
Incremental Cancer Costs	-0.00	0.05	0.03	0.03	0.44
Incremental Osteoarthritis Costs	-2.66	0.43	0.15	-0.86	6.75
Incremental Depression Costs	0.25	0.15	0.06	0.12	2.45
Incremental Other costs	-11.65	-12.78	-5.05	-5.84	-4.19
Incremental Life Months	0.08	0.05	0.02	0.04	0.38
Incremental QALYs	0.00366	0.00264	0.00098	0.00192	0.01872
ICER	Cost-saving	Cost-saving	Cost-saving	Cost-saving	Cost-saving

Conclusions

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.

8. Plain English Summary (400 words max)
Please provide a summary of the project, including background, findings and conclusions:

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.
9.	**Keywords** **Please provide up to 8 keywords that relate to the research undertaken in this study:**
	Type-2 diabetes Cardiovascular disease Cost-effectiveness Model Individual patient simulation Prevention Economics
10.	**Dissemination – please detail planned or published articles in peer-reviewed journals (including web links):**
	Articles and reports Chloe Thomas, Susi Sadler, Penny Breeze, Hazel Squires, Michael Gillett, Alan Brennan. Assessing the Potential Return on Investment of the Proposed UK NHS Diabetes Prevention Programme in Different Population Subgroups: An Economic Evaluation. BMJ Open (in press) Breeze PR, Thomas C, Squires H, Brennan A, Greaves C, Diggle PJ, Brunner E, Tabak A, Preston L & Chilcott J (2017) The impact of Type 2 diabetes prevention programmes based on risk-identification and lifestyle intervention intensity strategies: a cost-effectiveness analysis. Diabetic Medicine. Breeze PR, Thomas C, Squires H, Brennan A, Greaves C, Diggle P, Brunner E, Tabak A, Preston L & Chilcott J (2017) Cost-effectiveness of population-based, community, workplace and individual policies for diabetes prevention in the UK.. Diabetic Medicine. Dunkley A, Tyrer F, Spong R, Gray L, Gillett MJ, Doherty Y, Martin-Stacey L, Patel N, Yates T, Bhaumik S, Chalk T, Chudasama Y, Thomas C, Sadler S, Cooper S, Gangadharan S, Davies M & Khunti K (2016) Screening for glucose intolerance and development of a lifestyle education programme for prevention of Type 2 diabetes in a population with intellectual disabilities. NIHR Journals Library.

Breeze P, Squires H, Chilcott J, Stride C, Diggle PJ, Brunner E, Tabak A, Brennan A. A statistical model to describe longitudinal and correlated metabolic risk factors: the Whitehall II prospective study. Journal of Public Health (Oxford) 2015 Nov 6. DOI: 10.1093/pubmed/fdv160 https://goo.gl/Mcf8P0

Watson P, Preston L, Squires H, Chilcott J, Brennan A. (2014) *Modelling the Economics of Type 2 Diabetes Mellitus Prevention: A Literature Review of Methods.* Applied Health Economics & Health Policy. 2014, DOI 10.1007/s40258-014-0091-z https://goo.gl/ObbLJY

Conference presentations

Penny Breeze, Chloe Thomas, Susi Sadler, Penny Breeze, Hazel Squires, Michael Gillett & Alan Brennan An Economic Evaluation of the Proposed NHS Diabetes Prevention Programme in the general population and sub-groups. PHE Applied Epidemiology Scientific Conference, 21st March, University of Warwick.

Chloe Thomas, Susi Sadler, Penny Breeze, Hazel Squires, Michael Gillett & Alan Brennan. Assessing the Return on Investment of the NHS Diabetes Prevention Programme in Different Population Subgroups. Public Health England Conference, 13-14 Sept 2016, University of Warwick.

Penn, L. Thomas, C Breeze, P. Stocken, D. Sniehotta, F. White, M. Pragmatic identification of high-risk individuals for implementation and evaluation of type 2 diabetes prevention programmes Public Health Research Centres of Excellence Conference, July 14-15 2016, University of East Anglia, Norwich. (Poster)

Breeze, P., Thomas, C., Squires, H., Brennan, A., Greaves, C., Diggle, P., Brunner, E., Tabak, A., Preston, L., & Chilcott, J. *Cost-effective allocation of resources for type-2 Diabetes prevention between high-risk subgroups.* Personalised Medicine and Resource Allocation Conference, Oxford, 2 Mar 2015.

Thomas, C, Watson, P, Greaves, C, Squires, H, Chilcott, J, Brennan, A. *Layering Interventions for Type-2 Diabetes Prevention using the SPHR Diabetes Model.* ISPOR 17th Annual European Congress. 8-12 Nov 2014. Amsterdam, The Netherlands (poster)

Thomas, C, Watson, P, Greaves, C, Squires, H, Chilcott, J, Brennan, A. *Validation of the SPHR Diabetes Prevention Model.* ISPOR 17th Annual European Congress. Amsterdam, 8-12 Nov 2014 (poster)

Breeze P, Brennan A, Chilcott J, Squires H, Diggle P, Brunner E, Tabak A, Greaves C. *A policy analysis model to evaluate policies and interventions to prevent Type 2 diabetes*. NIHR SPHR Annual Scientific Meeting, Sheffield, 22 Oct 2014. (poster)

Watson, P. *A policy analysis model to evaluate policies and interventions to prevent Type 2 diabetes.* Public Health England Conference. Warwick, 16 – 17 Sept, 2014. (poster)

Watson P, Squires H, Chilcott J, Stride C, Diggle P, Brunner E, Tabak A, Brennan A. *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, 29 Mar -1 Apr 2014.

Watson P. *Estimating the impact of diabetes prevention on public health: cost-effectiveness of diabetes screening and prevention.* NIHR SPHR Annual Scientific Meeting. London, 8 Oct 2013.

Watson P, Brennan A, Chilcott J, Stride C, Diggle P, Brunner E, Tabak A. *Cost-effectiveness of prevention and screening of Type 2 diabetes.* NIHR SPHR Annual Scientific Meeting, London, 8 Oct 2013. (poster)

Brennan A, Chilcott J, Goyder E, Payne N, Squires H, Preston L, Watson P, Gillett M, Griffin S, Greaves C, Diggle P, Capewell S. *Cost-effectiveness of prevention and screening of Type 2 diabetes.* NIHR SPHR Annual Scientific Meeting, Sheffield, 10 Oct 2012.

<u>Non-academic conferences, workshops and seminars</u>

Brennan A, Gillespie DOS. Overview of the Sheffield models for t2diabetes and tobacco/alcohol focusing on methodological and practical challenges in modelling multiple behaviours. Public Health England Economics of Prevention Workshop. 20 Apr 2016.

Sanders T. What counts as evidence in public health commissioning: engagement between local authorities and research to increase understanding of commissioning and knowledge exchange through a new healthcare innovation. Excellence and Innovation in Public Health. Sheffield, 5 Nov 2015.

Assessing the effectiveness and cost-effectiveness of population / community public health interventions and targeted identification and screening interventions for type-2 diabetes prevention, using a common modelling framework to support translation of knowledge into action. Stakeholder event with public health practitioners and public involvement representatives. Sheffield, May 2014, Mar 2013 & Oct 2012. (workshops)

11. Public and participant involvement
Please provide comment on your experiences, any changes made and lessons drawn:

The stakeholder group for this project included two lay members who were diabetic, who we invited to join through their links with Diabetes UK. They attended all three stakeholder workshops and contributed usefully to the discussion.

At some stages of the workshop the clinical details of our questions may have isolated them from our discussion. However, in some cases we were able to split the workshop into subgroups to help include all members and focus discussion on the most relevant topics. On reflection this approach could have been used more.

12. What impact has the research already achieved or what might it achieve? (i.e. policy, practice, academic):

<u>1. Sharing the SPHR Diabetes Prevention Model with public health commissioners & practitioners</u>

Research team members have undertaken a range of activities to further link public health practitioners to the research and its findings. For example Dr Penny Watson (Breeze) held a meeting with Dr Andrew Lee of PHE and Dr Jason Horsley of Sheffield CCG to discuss the outcomes of the cost-effectiveness models and what adaptations would be needed to meet the requirements of local decision-makers. The discussion highlighted the need for non-healthcare cost implications of policies, particularly social care costs due to the wider perspectives of decision-makers in local government. The model currently estimates employer costs and describes the impact on health inequalities. Subsequently, Dr Breeze gave a presentation at the Public Health Intelligence North East network meeting in York and following on from this the public health team at Doncaster Council expressed interest in exploring the utility of the model for their own local decision making. The model was also presented at the Public Health England Annual Conference in 2016.

<u>2. Implementation of the SPHR Diabetes Prevention Model in a local authority context</u>

A further research project explored the practical implementation of the SPHR Diabetes Prevention Model in a local authority context to inform decision making, and was undertaken in collaboration with the NIHR CLAHRC-YH and with public health practitioners working within Doncaster Council.

SPHR funding and expertise was combined with expertise, research funding and matched resources from local authorities-based partners largely contributed through the “Knowledge into Action” and “Public Health & Inequalities” Themes of the NIHR CLAHRC-YH. The team undertook a qualitative research study exploring potential implementation processes associated with translating a public health economic modelling tool into a real-world public health decision-making setting in local government. Findings were generated which were of direct value in terms of understanding key issues for local authorities who need to be able to use economic models. The project produced direct insights for Doncaster stakeholders into their decision-making processes and the obstacles to integration of economic modelling tools. In particular, the findings revealed the need for academics to consider the different evidence-based resources that public health managers utilise, and the interdependent nature of commissioning practices, services and policies. Of key importance are the negotiations with elected council members and how the evidence generated from the Diabetes Prevention Tool could be integrated within these broader political priorities. The research team has shared the key findings from the study to engage local authority staff in further discussion of the value of the Diabetes Prevention Tool in future discussion of prioritisation and decision making. These discussions are identifying potential routes towards exploring the wider dissemination and implementation strategy of the tool beyond Doncaster.

Additional evidence of further impact in 2016/17

Contribution to budget impact assessment for the NHS Diabetes Prevention Programme by NHS England: NHS England commissioned a return on investment Excel tool based on model results analysing the potential cost-effectiveness of the NHS DPP, which enabled them to estimate the resource implications for the NHS and the expected return of the programme in the short and long run: https://www.england.nhs.uk/wp-content/uploads/2016/08/impact-assessment-ndpp.pdf

Development of a web based local modelling tool for use by English Local Authorities for Public Health England: this was commissioned and funded by PHE in 2016 and is now available on the PHE website for economic modelling tools and is being used by local authorities to evaluate commissioning options for the NHS DPP: https://dpp-roi-tool.shef.ac.uk/

Updating of national public health guidance for diabetes prevention by NICE: the model is being used by the NICE Public Health Guidelines Update Committee in 2017 to inform ongoing guidance development on the delivery of cost-effective diabetes prevention in different population subgroups: https://www.nice.org.uk/Guidance/PH38

Further collaborative work with Doncaster Council: The ongoing close working with Doncaster Council also had the positive effect of increasing understanding across the academia-practice boundary and the development of strong collaborative research partnerships between academic and local authority colleagues in Doncaster. This resulted in the identification of a number of other joint initiatives and grant applications (including applications to the NIHR Obesity Prize, the NIHR RfPB Obesity Call, the NIHR RfPB programme and the Sheffield CCG small grant scheme). A current proposal to the NIHR HS&DR Programme on 'Actionable tools' (with the Diabetes Prevention Model as a case study) is in preparation.

Collaborative work with Sheffield City Trust to explore the health impact of a local sugar tax:
Other direct developments include two funded projects to work with a provider of leisure facilities, Sheffield City Trust (SCT), to explore the health impact of a local "sugar tax" through an MRC Proximity to Discovery knowledge transfer partnership from May – September 2017. This will establish an ongoing partnership which will, from October 2017, be supported by a three year fully funded PhD scholarship funded by the ESCR White Rose Doctoral Training Programme to develop and evaluate further interventions in collaboration with SCT.

SPHR Ageing Well Programme: The model has been further developed as part of the Work Package 6 of Ageing Well to include a dementia module to describe mid-life risk factors for the incidence of dementia and burden of ageing and social care costs in older age. This integrated approach to modelling diabetes, cardiovascular disease and dementia enables comprehensive evaluation of the long term health and health care costs public health policies in England.

This project was funded by the National Institute for Health Research School for Public Health Research (SPHR-SHF-PH1-MDP)