REF2021

Institution: University of Sheffield
Unit of Assessment: A-02 Public Health, Health Services and Primary Care
Title of case study: Shaping policy and practice for type 2 diabetes prevention in the UK
Period when the underpinning research was undertaken: 2012–2020
Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Alan Brennan	Prof of Health Economics & Decision Modelling	1994–present
Penny Breeze	Research Fellow	2012–present
Chloe Thomas	Research Fellow	2014–present
James Chilcott	Professor of Healthcare Operational Research	1996–present
Michael Gillett	Research Fellow	2004–present
Elizabeth Goyder	Professor of Public Health	2001–present
Maxine Johnson	Honorary Research Fellow	2003–2019
Kelly Mackenzie	Academic Public Health Fellow	2015–2019
Susi Sadler	Research Associate	2014–2016
Hazel Squires	Modelling Researcher	2005–present
Laura Heathcote	Research Assistant	2018–present
Lindsay Blank	Research Fellow	2002–present
Daniel Pollard	Research Fellow	2013–present

Period when the claimed impact occurred: 2015-2020
Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact (indicative maximum 100 words)

Over 4 million people in the UK are estimated to be affected by type 2 diabetes (T2D), with treatment costs accounting for just under 9% (£8.8 billion) of annual NHS expenditure. Our integrated approach to modelling diabetes, cardiovascular disease and dementia enables comprehensive evaluation of the long-term health and health care costs of public health policies in the UK.

Our modelling was key to the implementation of the NHS Diabetes Prevention Programme, designed to prevent or delay the onset of T2D, and provide tools to forecast return on investment. National guidelines have been updated to include recommendations based on our economic modelling and targeting of interventions, enabled by the tools we developed.

2. Underpinning research (indicative maximum 500 words)

Over 4 million adults in the UK are estimated to be affected by type 2 diabetes (T2D). T2D and its complications have considerable health impacts and lead to a reduction in life expectancy and health related quality of life as well as being a significant burden on the NHS. T2D is a complex condition with a range of risk factors, but most cases could be prevented or delayed.

Between 2012-2014, funded by the National Institute for Health Research School for Public Health Research (NIHR SPHR), in collaboration with Lancaster University and University College London, Sheffield led the development of a new mathematical model which could be used to evaluate a wide range of preventive strategies for T2D (Versions 1.0 to 2.1). This model was used to assess the impact of a lifestyle intervention for diabetes prevention in different high risk subgroups within the UK population. This work was published in June 2015 as an online report with study publication in 2017 [R1]. The research showed that intervention is potentially cost-saving over a lifetime horizon, and that it will have a differential impact on disease outcomes and time horizon of cost-savings in different high-risk groups. Two further papers gave methodological detail and undertook further evaluation of different interventions [R2, R3].

In 2015, with research funded by NHS England, our model was used to assess the new NHS Diabetes Prevention Programme (DPP). This programme aims to identify those at high risk and refer them onto an evidence-based behaviour change programme to help reduce their risk (version 2.2). The model assessed the health impacts, costs, and NHS savings of introducing the DPP under a range of scenarios for NHS England.

In 2016, we conducted a health economic assessment of the DPP (funded by PHE). We undertook qualitative assessment of important system incentives and disincentives around delivering prevention programmes like the DPP, and quantitative modelling work to understand whether different subgroups of the population would stand to benefit more or less from the DPP. This concluded that the programme was cost-effective for all subgroups examined but provided particularly high health benefits and value for money for people living with obesity (especially BMI 35+). The work also resulted in the development of a local return on investment forecasting tool to help commissioners understand and predict the impact of delivering the DPP locally [R4].

Diabetes has some of the same risk factors as cardiovascular disease (for example, heart attack, stroke), and the model evolved to become a diabetes and cardiovascular disease prevention model.

In 2017, funded by PHE, we developed a new return on investment tool for cardiovascular disease (CVD) prevention in people at high risk (diabetes, pre-diabetes, hypertension, high cholesterol, atrial fibrillation, and chronic kidney disease). The tool consists of a web interface with underlying model, and runs in response to user inputs, allowing a range of outcomes to be explored [R5].

Between 2016- 2017, our diabetes prevention model has been further developed as part of the NIHR SPHR Ageing Well programme 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 (version 3.1) [R6]. The model utilises data from the English Longitudinal study of Ageing to update BMI, blood pressure, cholesterol and blood glucose trajectories into old age. The incidence of dementia is derived using risk equations developed from a large GP database.

3. References to the research (indicative maximum of six references)

R1. **Breeze, P. R., 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, 34*(8), 1136–1144. https://doi.org/10.1111/dme.13349

R2. **Breeze, P., Squires, H., Chilcott, J.,** Stride, C., Diggle, P. J., Brunner, E., Tabak, A., & **Brennan, A.** (2015). A statistical model to describe longitudinal and correlated metabolic

risk factors: the Whitehall II prospective study. *Journal of Public Health, 38*(4), 679–687. https://doi.org/10.1093/pubmed/fdv160

R3. **Breeze, P. R., Thomas, C., Squires, H., Brennan, A.,** Greaves, C., Diggle, P. J., 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, 34*(5), 632–640. https://doi.org/10.1111/dme.13314

R4. **Thomas, C., Sadler, S., Breeze, P., Squires, H., Gillett, M.,** & **Brennan, A.** (2017). Assessing the potential return on investment of the proposed UK NHS diabetes prevention programme in different population subgroups: an economic evaluation. *BMJ Open, 7*(8), e014953. https://doi.org/10.1136/bmjopen-2016-014953

R5. **Thomas, C., Brennan, A., Goka, E., Squires, H. Y., Brenner, G., Bagguley, D., Buckley Woods, H., Gillett, M., Leaviss, J., Clowes, M., Heathcote, L., Cooper, K.,** & **Breeze, P.** (2020). What are the cost-savings and health benefits of improving detection and management for six high cardiovascular risk conditions in England? An economic evaluation. *BMJ Open, 10*(9), e037486. https://doi.org/10.1136/bmjopen-2020-037486

R6. **Breeze, P., Thomas, C., Thokala, P.,** Lafortune, L., Brayne, C., & **Brennan, A.** (2020). The Impact of Including Costs and Outcomes of Dementia in a Health Economic Model to Evaluate Lifestyle Interventions to Prevent Diabetes and Cardiovascular Disease. *Medical Decision Making, 40*(7), 912–923. https://doi.org/10.1177/0272989x20946758

4. Details of the impact (indicative maximum 750 words)

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. School of Health and Related Research (ScHARR) research provided key evidence to shape national policy and implementation for the prevention of T2D in the UK.

Informing national decisions and implementation

'Healthier You', the NHS Diabetes Prevention Programme (NHS DPP) offers adults in England at high risk of T2D an evidence-based behavioural intervention to prevent or delay T2D onset. Our modelling initially funded by NHS England (NHSE) in 2015 has been used to support their business case:

"*Outputs from ScHARR's independent and peer reviewed model indicated that the programme was cost-effective and potentially cost-saving under a range of scenarios which was highly beneficial in supporting and steering planning for the continued roll out and expansion of the NHS DPP*" [S1]

NHSE's Impact Analysis of the NHS DPP supports the investment in the provision of services for 2016/17 until 2020 and makes explicit reference to our modelling i.e. if 390,000 people participate in the NHS DPP intervention over 5 years, this would result in approximately £1.1bn of health benefits; 12,000-18,000 cases of T2D prevented or delayed by year 8 and by year 12 the programme will be cost saving [S2]. Our model was used in 2016 to support the ongoing planning and development of the programme for PHE and developed a local return on

investment forecasting tool [S3]. The report provides support for the commissioning framework and is directly referenced on the PHE website [S3].

In 2018, we updated NHSE's Impact Analysis of the NHS DPP based on data from the initial roll-out. We developed a new tool for NHSE including cost, uptake and effectiveness of the programme enabling NHSE to keep updating their business plan as the DPP progresses [S4].

Roll-out of the NHS DPP: the DPP began in 2015 in seven 'demonstrator sites', followed in June 2016 with a roll out to a first wave of 27 areas covering 26 million people, making up to 20,000 places available. In April 2017, a further 13 sustainability and transformation partnerships (STP) were included, achieving full coverage in England from April 2018. NHSE and Diabetes UK have provided a suite of resources to support implementation of the DPP [S4, S5]. NHSE and NHS Improvement indicate that *"the NHS DPP has now been rolled out nationally in England to all STPs and is already the largest such programme in the world"* [S1].

The 'NICE impact diabetes' report 2018, notes that by 2017 the DPP had reached 75% of the population of England. Between June 2016 - March 2017, 43,603 referrals were made. The 43,603 referrals were 16% higher than expected [S6]. Of those referred, 49% attended the initial assessment, higher than the 40% modelled uptake. Data suggests that the programme is reaching both those who are at greater risk of developing T2D and those who typically access healthcare less effectively [S7]. As at 30 September 2020, data from the National Diabetes Audit (NDA) indicates that 687,730 people have been offered the NHS DPP. Of those, 245,665 declined (35.7%), slightly lower than the modelled figures. 442,065 people have now been offered the NHS DPP and not declined. Data as available indicates that 89,604 have completed the NHS DPP as at January 2020 [S8]. Analysis of outcomes by NHSE and NHS Improvement indicates that "*the programme is highly effective with a mean weight change of -3.7kg for participants who are overweight or obese which means the NHS DPP is having a tangible real life impact for thousands of users on the programme and will contribute to the ambitions as outlined in the NHS Long Term Plan to ensure the NHS is sustainable for generations to come*" [S1].

Informing national guidelines on diabetes prevention

Our research has been incorporated into the National Institute for Health and Care Excellence (NICE) Guideline 'Type 2 diabetes: prevention in people at high risk', PH38. The September 2017 update includes reference to our cost-effectiveness modelling and targeting who should be prioritised for the DPP. It includes new recommendations for intensive lifestyle-change programmes and metformin for people at risk of T2D based on results of the economic modelling [S9].

Enabling national and local cardiovascular disease (CVD) prevention decision-making

Our return on investment tool for CVD in people at high risk (diabetes, pre-diabetes, hypertension, high cholesterol, atrial fibrillation, and chronic kidney disease) provides for the first time a single platform in which a large number of different strategies for detection and management of people at high CVD risk can be analysed. The CVD tool incorporates our work on the dementia module.

The tool is available from the PHE website and allows a range of outcomes to be explored, including cost-savings, quality adjusted life year gains and CVD events prevented. Results are tailored to each clinical commissioning group, STP, local authority and at national level [S10].

The tool was used 2,000 times within the first year of launch [S10]. PHE indicate that CVD costs the NHS £7.4billion each year. Examples of exemplar analyses indicate that optimising the use of statins and hypertensives could bring the most considerable cost-savings [S10].

5. Sources to corroborate the impact (indicative maximum of 10 references)

S1. NHS England and NHS Improvement. Senior Analytical Manager, NHS England, NHS Diabetes Prevention Programme. Letter of support. 25 Nov 2020.

S2. NHS England, '*Impact Analysis of implementing the Healthier You: NHS Diabetes Prevention Programme*', Feb 2016. Available at https://bit.ly/3lFoX36. The report cites our modelling for the analysis (page 1).

S3. Public Health England '*Health economics commissioning framework: diabetes prevention*'. Published 3 Nov 2016 includes a link to the ScHARR forecasting analysis report and a link to the diabetes prevention programme return on investment tool. Public Health England '*Assessing the potential Return on Investment of the proposed Healthier You: NHS Diabetes Prevention Programme in different population subgroups*' v 1.0/November 2016 –the report prepared by ScHARR for PHE. Available at http://bit.ly/3tM4ZGN.

S4. Diabetes prevention resources on the NHS England website (http://bit.ly/318TWv7) confirms ScHARR's continuing involvement in updating the evidence for NHS England for the DPP. Includes NHS England resources to support implementation.

S5. Diabetes UK, NHS diabetes prevention programme. Resources to support implementation of the DPP, includes a link to ScHARR's modelling (http://bit.ly/2Pk8eGq).

S6. National Institute for Health and Care Excellence, 'NICE impact diabetes'. September 2018. Reports on the roll-out of the DPP 2016-2017, pp.4-5. https://bit.ly/3lFofmF

S7. Barron, E., et. al. (2017). Progress of the Healthier You: NHS Diabetes Prevention Programme: referrals, uptake and participant characteristics. *Diabetic Medicine, 35*(4), 513–518. https://doi.org/10.1111/dme.13562

S8. NHS Digital. National Diabetes Audit, Diabetes Prevention Programme (DPP), Quarterly Data Release, 1 January-30 September 2020 (http://bit.ly/3161Oxq); NHS England. NHS support sees people lose the weight of 43 ambulances. 2 January 2020: (http://bit.ly/316FgMT).

S9. NICE Public Health Guideline PH38 'Type 2 diabetes: prevention in people at high risk'. 2012. Last updated Sep 2017. Available at: https://www.nice.org.uk/guidance/ph38. Intensive lifestyle-change programmes and metformin, Recommendations 1.5.5, 1.5.6, 1.19.1. The rationale for the recommendations is noted on p.29. Our health economic analysis forms Appendix I: https://www.nice.org.uk/guidance/ph38/documents/addendum-2.

S10. Combined source demonstrating use of Cardiovascular Disease Prevention Return on Investment Tool and benefits from the tool. Tool and all reports are also available at: https://www.gov.uk/government/publications/cardiovascular-disease-prevention-cost-effective-commissioning.