Article:
Bower, P. orcid.org/0000-0001-9558-3349, Soiland-Reyes, C., Heller, S. orcid.org/0000-0002-2425-9565 et al. (4 more authors) (2023) Diabetes prevention at scale: narrative review of findings and lessons from the DIPLOMA evaluation of the NHS Diabetes Prevention Programme in England. Diabetic Medicine, 40 (11). e15209. ISSN 0742-3071

https://doi.org/10.1111/dme.15209

Received: 12 June 2023 | Accepted: 23 August 2023

DOI: 10.1111/dme.15209

DIABETIC Medicine

REVIEW ARTICLE

Diabetes prevention at scale: Narrative review of findings and lessons from the DIPLOMA evaluation of the NHS Diabetes Prevention Programme in England

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Funding information
National Institute for Health and Care Research

Abstract

Aims: The NHS Diabetes Prevention Programme (NHS DPP) is a large-scale, England-wide behaviour change programme for people at high risk of progressing to type 2 diabetes. We summarise the findings of our six-year DIPLOMA evaluation of its implementation and impact and highlight insights for future programmes.

Methods: Using qualitative interviews, document analysis, observation, surveys and large dataset analysis, eight interlinked work packages considered: equity of access; implementation; service delivery and fidelity; programme outcomes; comparative effectiveness and cost-effectiveness in reducing diabetes incidence; and patient decision making and experience.

Results: Delivery of the NHS DPP encountered barriers across many aspects of the programme, and we identified inequalities in terms of the areas, organisations and patient populations most likely to engage with the programme. There was some loss of fidelity at all stages from commissioning to participant understanding. Despite these challenges, there was evidence of significant reductions in diabetes incidence at individual and population levels. The programme was cost-effective even within a short time period.

Conclusions: Despite the challenge of translating research evidence into routine NHS delivery at scale, our findings suggest that an individual-level approach to the prevention of type 2 diabetes in a 'high-risk' population was more effective than usual care. By embedding evaluation with programme delivery and working closely with the NHS DPP team, we provided actionable insights for improving communications with potential participants, supporting primary care referral, honing the delivery model with better provider relationships and more patient choice, increasing understanding of behaviour change techniques, and enriching the educational and health coaching content.

KEYWORDS
Access, behavioural management, Cost-effectiveness, Effectiveness, Health Inequalities, Implementation, prevention of diabetes

1 | INTRODUCTION

Type 2 diabetes is a major clinical challenge.[1] The World Health Organisation estimates that approximately 422 million people have diabetes worldwide and 1.5 million deaths are directly attributed to diabetes each year.[2] Diabetes UK recently estimated that over five million people have diabetes in the UK[3] and over two million people have been diagnosed with non-diabetic hyperglycaemia in England.[4]

The NHS Diabetes Prevention Programme (NHS DPP) is a national, publicly funded initiative in England to support people at high risk to reduce progression to type 2 diabetes. The evidence base for diabetes prevention was a critical bedrock for NHS DPP. Building on landmark diabetes prevention trials, Public Health England (PHE) commissioned a review assessing the effectiveness of lifestyle interventions.[5] Thirty-six studies testing prevention in routine settings suggested that, on average, lifestyle interventions reduced incidence rates of type 2 diabetes by 26%. This review acted as both a stimulus for the NHS DPP and a blueprint for its design (see Box 1).

Although this evidence base was strong, it was based on analysis of interventions for individuals with a known high-risk glycaemic category. Whether these gains could be achieved in practice across the whole of England remained uncertain – both in terms of generating the same clinical benefits and doing so at scale, in a way that was cost-effective and contributed to reducing health inequalities. The scale of the NHS DPP provided a critical test bed for whether the NHS could bridge the 'third translational gap'. Following on from the transitions from laboratory-based basic research to clinical medicine (the first translational gap) and then from new intervention development to application to their intended populations in practice (the second gap), the 'third translational gap' concerns the use of results

BOX 1 The NHS Diabetes Prevention Programme (NHS DPP) intervention

The NHS DPP intervention is a behaviour change programme to support individuals to adopt changes in behaviour to lose weight, increase physical activity and eat more healthily. The NHS DPP was first rolled out in 2016 in annual 'waves' and reached national coverage in 2018. Eligible participants were adults 18 years or over, not pregnant, testing positive for non-diabetic hyperglycaemia (NDH) in the previous 12 months, based on HbA1c levels between 42 and 47 mmol/mol (6.0–6.4%) or FPG between 5.5 and 6.9 mmol/L.[6] The intervention is delivered by a small number of external providers, who are commissioned nationally by NHS England (NHSE) and allocated to local areas through competitions.

General practices identify eligible participants and refer them to their NHS DPP provider. On referral, providers explain the programme during an Initial Assessment session after which the participant is enrolled. The first version of the NHS DPP (Framework 1),[7] consisted of 13 sessions across 9 months, delivered face-to-face and in groups of 16–20 people. To support the adoption of lifestyle changes, the NHS DPP specification required providers to deliver 19 specific behaviour change techniques (BCTs).[8] Providers recorded weight at every session attended and HbA1c at baseline and at programme completion.

To date, the programme has been commissioned in three-year cycles and is currently in its third version.[9] During Framework 2,[10] an individual digital delivery mode was implemented but capped at 20% of the participants whilst evaluation of a pilot was concluded.[11,12] In response to social distancing restrictions during COVID-19, this cap was removed, and a temporary self-referral route was implemented. In Framework 3,[9] participants were offered a choice between face-to-face and digital. Other changes implemented in these latest frameworks include removing the requirement of HbA1c tests and promoting testing in primary care as part of annual checks, as recommended by National Institute of Health and Care Excellence's guidance, PH38.[13] Provider payment structures were also amended to incentivise the retention of patients from ethnic minority groups and those from areas of high deprivation.

of health services research in routine health policy and practice.[14-16]

Bridging that gap also needed to be demonstrated to sceptical decision-makers and taxpayers, so the Health and Social Care Delivery Research programme of the National Institute for Health and Care Research commissioned the Diabetes Prevention – Long Term Multimethod Assessment programme (DIPLOMA hereafter), to evaluate the implementation of the NHS DPP.

DIPLOMA involved multiple work packages (see Figure 1) exploring all aspects of the NHS DPP - how the programme was organised, how suitable participants were identified and reached, who accessed and completed it, how the intervention was delivered, and the impacts on participants. The DIPLOMA team actively engaged with the NHS DPP national delivery team at all stages of the research process to help develop the programme and maximise the impact of emerging findings. Other groups (including the NHS DPP team) have done their own evaluations,[6,17,18] but here we focus on the findings from DIPLOMA and the implications for type 2 diabetes prevention nationally and internationally.

2 | IMPLEMENTATION

Our work explored the experience of local staff in delivering the NHS DPP programme and the complex relationships involved, especially since NHSE commissioned external providers to ensure that the NHS DPP did not reduce wider NHS capacity.[19] This work highlighted the tension between the need to generate referrals to the programme, while also being aware of potential inequalities in terms of which practices and which patients were engaging with the NHS DPP. Our further work showed how engagement with the NHS DPP was greater among general practices that were of higher quality in other ways.[20] We also examined the financial incentives offered to practices for making referrals and showed that outcome-based payments were the only effective way to encourage engagement.[21]

3 | ACCESS

We used quantitative and qualitative methods to map the types of patients coming onto the NHS DPP from the population of people with NDH in the community, and to understand that journey in depth.[22]

First, we took advantage of UK data assets. Data from NHS DPP itself allowed us to understand who was engaging with the programme, but these data were restricted to those who started this journey.[23] Population surveys (UK Household Longitudinal Study and Health Survey for England) provided data on patterns of NDH in the community before people engaged with the DPP, enabling us to map cohorts at each stage, and show (for example) that patients with NDH from ethnic minority communities were overrepresented in the initial stages of NHS DPP (showing how effective the programme had been at accessing these groups), but those from deprived areas were consistently under-represented.[22]

Our own survey showed that individual decisions to participate were dependent on perceptions of risk of developing type 2 diabetes, whether people saw the benefits of NHS DPP, and their sense of personal control over health (self-efficacy).[24] Demographic and health differences were less important after accounting for these modifiable issues. Qualitative research explored the process of accessing the NHS DPP.[25] The scale of the programme encouraged use of high-volume, passive methods (e.g. mass mailing from practices) supplemented by discussions with GPs. Although reasonably successful, such methods assume that the label of NDH (and associations with risk)

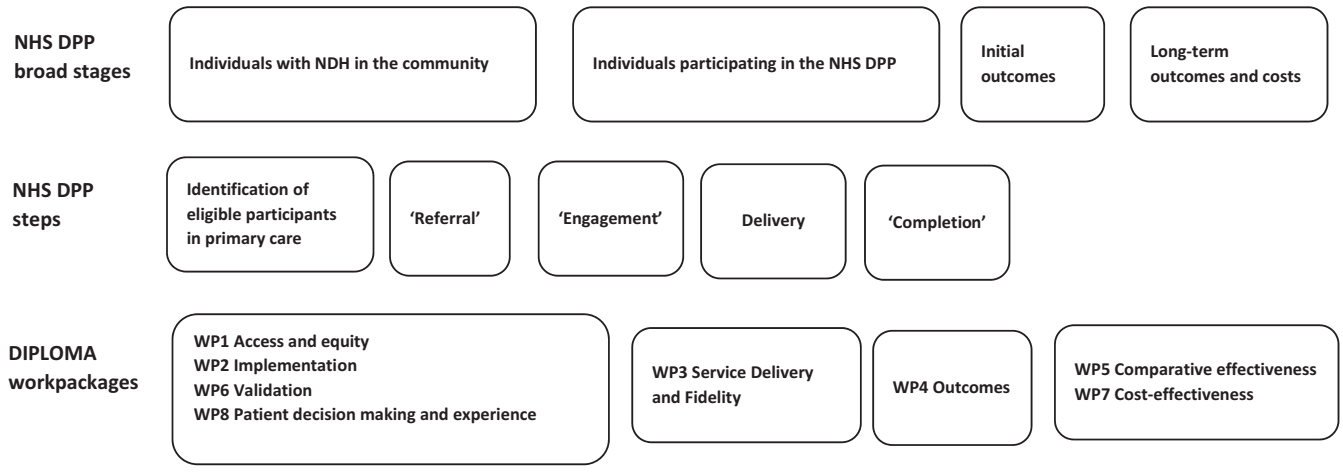

FIGURE 1 DIPLOMA and the NHS DPP.

is unproblematic. Our interviews and observations suggested that both the NDH label and assumptions about risk were 'resisted' by patients.

4 | FIDELITY

The core mechanism of the NHS DPP is supporting behaviour change. Fidelity is the extent to which an intervention is implemented as intended.[26] Examinations of fidelity of national programmes such as NHS DPP are rare, but important – NHS DPP needs to deliver enduring behaviour change through evidence-based BCTs and do this through external providers with their own staff and systems.

We developed a detailed understanding of the proposed content of NHS DPP and mapped that against what providers actually delivered. This included how providers planned to deliver their interventions (i.e. their design 'blueprints'), how they trained their staff and what was provided to participants during delivery (see Figure 2).[27-29]

Given the complexity of the programme, we saw not only evidence of fidelity, but also evidence of 'drift' away from the NHS DPP specification along the delivery pathway, in provider blueprints and in provider manuals, and further drift at the later stages of staff training and on-the-ground delivery.[31] To the degree that BCTs are the core ingredients of sustainable change, there was potentially some loss of potency in delivery. The difficulties of delivering fidelity at a national scale across multiple providers should not be underestimated. The nature of implementing public health interventions requires adapting the intervention based on the learning developed during implementation.[32] As such, DIPLOMA engaged in a feedback loop with NHSE where our findings supported changes to the second round of commissioning.

5 | EFFECTIVENESS AND COST-EFFECTIVENESS

NHS DPP has data collection built into its operations. Using these data[33] we showed that the programme was generating significant benefits in those who engaged and completed, but only 50% of those referred started the course and just 20% completed it, with different providers and practices achieving different levels of participation.[23] However, analyses of change *within* NHS DPP cohorts such as these are not sufficient to demonstrate the benefits provided by the programme compared to alternative interventions (or 'usual care'). Formal trials of the NHS DPP were not possible in the context of routine roll-out, so we used quasi-experimental methods to provide a comparative evaluation, taking advantage of the staged approach to the roll-out of the NHS DPP nationally.

First, we conducted an analysis using individual-level data from electronic health records to estimate how referral to the programme affected individuals' risk of developing type 2 diabetes.[34] We matched individuals referred to the NHS DPP in practices where the programme had been rolled out to similar individuals in practices that had not referred any patients and created a cohort to compare the proportions receiving a type 2 diabetes diagnosis during the subsequent 36 months. The rate of conversion was lower amongst referred individuals (12.7% vs. 15.4%, HR 0.86, 95% CI: 0.76–0.97).

Second, using data from the National Diabetes Audit,[35] we assessed the population-level impact on type 2 diabetes

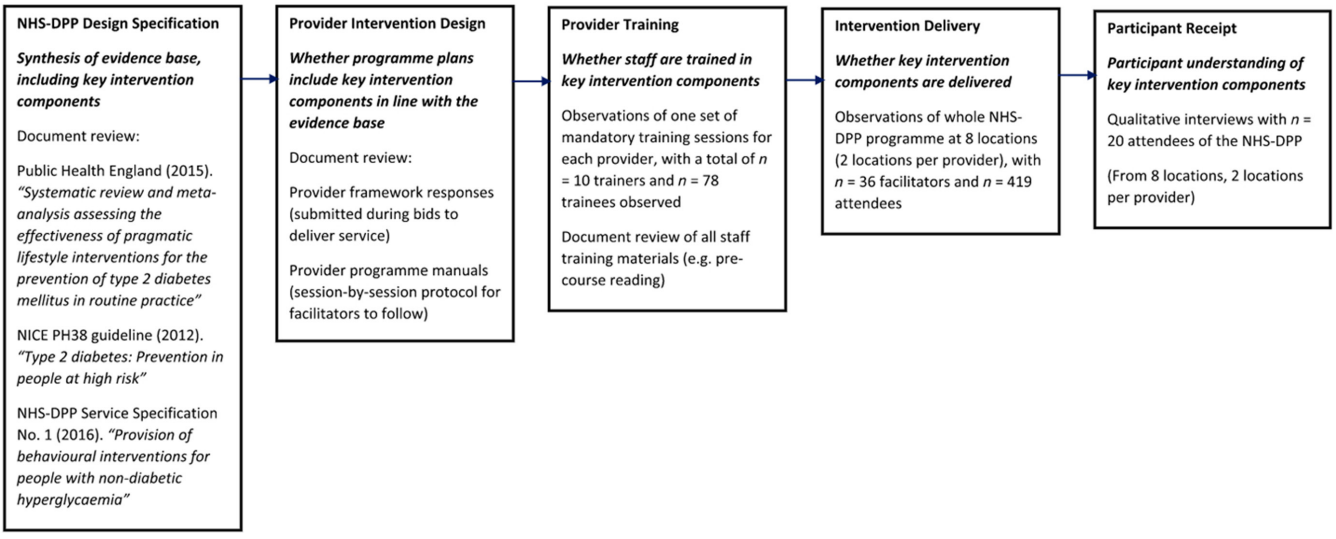

FIGURE 2 How we assessed fidelity of the NHS DPP.[30]

incidence, comparing incidence rates among practices enrolled in the DPP in 2016 with those in 2017 and 2018. Incidence of type 2 diabetes in 2018–19 in practices enrolled in 2016 was lower than those where the NHS DPP was not yet in operation (Incident rate ratio = 0.938, 95% CI 0.905–0.972), with similar results in practices joining in 2017.

We then considered whether the NHS DPP offered good value-for-money by analysing cost-effectiveness in the short and long term. Our short-term analyses examined costs and benefits only during the time participants were taking part in the programme. We estimated costs of implementation and used data on payments to providers and compared these costs to the estimated quality-of-life gains reported by participants during the programme. We found NHS DPP generated cost-per-QALY broadly within the accepted thresholds used by NICE even in this restricted period.[36]

However, this short-term analysis took no account of reductions in the risk of incidence of T2D over the longer term, so we developed a decision-analytic model to investigate long-term impacts, tailoring our economic model to the NHS DPP. With over half a million referrals received by March 2020, we estimate that the first 4 years of the NHS DPP will generate nearly 18,000 additional QALYs and reduce NHS costs by nearly £24 million (at 2020 prices) over the next 35 years. In almost all our simulations, the NHS DPP had an estimated cost-per-QALY below the accepted willingness-to-pay threshold and would therefore be deemed cost-effective (McManus, 2023, under review).

6 | DIGITAL NHS DPP

The role of digital technology in the delivery of the NHS DPP has been a long-standing interest, and careful piloting of different models was used to explore issues such as the impact on access and outcomes before any major implementation.[37]

As the NHS DPP developed in the context of the pandemic, the digital offer evolved to include remote versions of the conventional NHS DPP and digital versions (with support). We adjusted our research plans to explore these. Using existing data and quasi-experimental methods we confirmed that the digital NHS DPP could achieve broadly equivalent results to the conventional model.[12,38] Replicating our earlier work, we demonstrated that digital providers faced many similar challenges in ensuring fidelity.[39-41] We also explored decisions about taking up the digital offer and found that these were based on similar issues to the conventional format (such as self-efficacy) as well as unique features of the digital interventions such as enhanced accessibility.[42] We also found that professional support remained important even with digital delivery.[41]

7 | SUMMARY

The NHS DPP is the first nationwide behaviour change programme.[43] Its implementation has provided a unique opportunity to test whether results observed in previous trials could be delivered in routine settings and whether a 'high-risk' approach can help the NHS reduce type 2 diabetes incidence in the population.

DIPLOMA has provided a broadly positive evaluation, highlighting that provision of NHS DPP reduced the incidence of type 2 diabetes more than usual care, at a cost considered acceptable within current willingness-to-pay thresholds. Although comparisons with existing reviews and trials are fraught with complexity, the effects are smaller than those found in trials, which may reflect a combination of a lower risk threshold among eligible populations compared to those in trials, and some dilution of the dose, quality and potency of behaviour change interventions when delivered at such a scale.

DIPLOMA has also highlighted some areas of concern, in terms of selection into and completion of the programme (impacting particularly on the representation of deprived communities) and fidelity in delivery of behaviour change techniques. Table 1 summarises potentially actionable insights from the study.

Our findings showed that a low-cost individual-level approach to the prevention of type 2 diabetes in the 'high-risk' population was more effective than usual care. Individual-level policies require high levels of individual agency,[44] and 'attrition' of patients at various stages of the programme is of special interest as this can affect effectiveness.[45] Working closely with the NHS DPP team, our findings on implementation, access and fidelity, have led to demonstrable changes in programme delivery to ameliorate particular issues. Other findings (such as the complex processes whereby people engage with risk and prevention programmes) have been highlighted, which are less amenable to a rapid fix or may have significant cost implications of their own.

As well as addressing gaps in evaluation and feedback seen in previous years of policy-making,[46] the traditional challenges of independent evaluation in DIPLOMA have also highlighted key strengths of the NHS and NIHR infrastructure, in terms of national coverage and access to key data assets that have enabled the application of non-experimental methods for evaluation. The learning from DIPLOMA provides a useful model for future evaluations of diabetes care at scale, such as the NHS Low Calorie Diet programme.[47,48]

FUNDING INFORMATION

This project was funded through the NIHR HSDR scheme (16/48/07), Evaluating the NHS Diabetes Prevention

TABLE 1 Actionable insights from the DIPLOMA programme.

	Findings	Actionable insights
IMPROVING UPTAKE		
1. Communication with patients[24,25,42]	Around 50% of those referred take up a place on the NHS DPP. Around 30% of patients do not recall being invited. Patients do not necessarily identify themselves as the target population. Uptake is associated with beliefs about: diabetes risk; own ability to reduce risk; NHS DPP effectiveness	Where possible, healthcare professionals should have adequate discussions about attendance, NDH and type 2 diabetes risk. Professionals may benefit from training. Messages need to be tailored to encourage uptake, with clear information about diabetes risk, what the NHS DPP involves, and its value.
2. Supporting practices to make referrals[21,22,23,33,49]	Early on, there was a lack of awareness of the NHS DPP, and variation in engagement across organisations. Local organisers struggled to engage with some practices, especially those in the most deprived areas. When practices had lower diabetes quality of care, they referred fewer participants to the NHS DPP In the early days of the NHS DPP, pressure to achieve high number of referrals led people to send mass mailings, rather than focus on tailoring messages.	Local champions may be useful. Local leads can play an important facilitation role to enable practice-level engagement (through knowledge and practical support), that in turn influences rates of referral. Offering payments to practices based on the number of referrals they generate increases participation. Equality impact assessments may be useful, employing data analysts to develop integrated data systems to identify the demographics and risk, and undertaking 'outreach' work.
COMPONENTS OF THE NHS DPP		
1. Delivery model[12,19,49]	The contractual relationship between NHS England and providers lacked clarity in some areas. Face-to-face and digital NHS DPP services were both as effective as each other. NHS DPP was more effective when people were given a choice to attend either face-to-face or digital.	Development of closer working relationships between providers and local services was supported by having strong project management processes in place. Based on these (and other) findings, patients are now offered a choice of digital or face-to-face delivery of the NHS DPP.
2. Behaviour change content[30]	NHS DPP providers delivered the majority of behaviour change content specified in their programme designs. However, a drift in fidelity was apparent at multiple points	National commissioners and providers should require providers to explicitly describe the theoretical underpinnings of their programmes. National commissioners and providers should have behavioural science/health psychology expertise in their teams. NHS DPP staff training should include training on *how* to deliver BCTs and the opportunity to practice delivery. Fidelity of BCT content tends to be higher in digital programmes, but effectiveness of digital programmes is dependent on engagement with intervention content.
3. Programme content[27,41]	Positive patient experiences included engagement, satisfaction with the programme, good within-group relationships and reported behavioural changes. There was wide variation in features of delivery of the digital DPP across providers, particularly for delivery of 'support' (e.g. health coaching and/or group support) Evaluation of digital DPP has found health coaches role to be crucial for improved service user experience, increased engaged with digital programme features, and better understanding of some BCTs. There was low engagement with group support forums in digital DPP.	Patients wanted to know their type 2 diabetes risk and how it changed as a result of NHS DPP participation. 'Unlocking' of educational content over a longer period of time may promote engagement. More interactive and visual activities in smaller groups of 10–15 people were associated with more positive patient experiences. Removing structural issues (problems with session scheduling, venue quality, inadequate resources) could avoid negative patient experience. There is a requirement for health coach support in digital programmes. Group support may not be needed for the digital service. There was more engagement with closed peer group chats (10–15 people) but this may require matching in groups

Programme (NHS DPP): the DIPLOMA research programme (Diabetes Prevention Long term Multimethod Assessment). See the NIHR Journals Library website for further project information.

CONFLICT OF INTEREST STATEMENT

MS is a member of the NHS-Digital Advisory Board for the National Diabetes Audit: Non-Diabetic Hyperglycaemia, Diabetes Prevention Programme.

SH chairs a DMSC for Eli Lilly and sits in the Advisory Boards for Zucara, Zealand and Vertex. SH has received institutional and personal funding to be a speaker at NovoNordisk and Medtronic panels. SH has received support for attending meetings and/or travel from Medtronic. SH receives research support from Dexcom. SH chairs the International Hypoglycaemia Study Group, sits in the subpanel for the NIHR PGfAR funding stream, and is the national speciality lead in Diabetes for the NIHR Clinical research network.

DISCLAIMER

This report presents independent research commissioned by the National Institute for Health and Care Research (NIHR). The views and opinions expressed by authors in this publication are those of the authors and do not necessarily reflect those of the NHS, the NIHR, MRC, CCF, NETSCC, the HSDR programme or the Department of Health and Social Care.

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How to cite this article: Bower P, Soiland-Reyes C, Heller S, et al. Diabetes prevention at scale: Narrative review of findings and lessons from the DIPLOMA evaluation of the NHS Diabetes Prevention Programme in England. *Diabet Med*. 2023;00:e15209. doi:10.1111/dme.15209