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Population-level interventions to improve health in people with diabetes in Nottinghamshire

Summary deck

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Summary

This slide deck summarises the approach and findings of ICHP's report on investigating impactful interventions that could be considered for specific diabetes populations in Nottinghamshire.

The main report includes detailed slides on interventions, evidence, ROI, local context, modelling (including relative risk reduction when deploying interventions) and more. We recommend reading the full report should more detail be sought on specific areas of this summary.

Introduction

Nottingham and Nottinghamshire ICS (from now on referred to as 'Nottingham') asked ICHP to use an evidence-based approach to identify high-impact, population-based diabetes interventions relevant to the local geographies. This pack summarises the work, please see the full report for detail.

Methods

1. Nottingham selected key outcomes of interest. These outcomes were used to inform a search for interventions.

2. We conducted pragmatic reviews of the peer-reviewed and general grey literature to identify suitable population-based interventions that may improve the outcomes of interest for diabetic patients.
    - 1,886 papers were screened with a total of 267 as identified as being relevant.

3. We then looked into the population of Nottinghamshire to better understand the demographics, wider determinants of health and burden of disease.

4. We picked out key themes and populations to match with evidence-based interventions in order to ensure they have an impact.

5. To estimate the impact of these interventions and their potential return on investment, we built a stochastic model of diabetes outcomes (based on the UKPDS outcomes models[1]).

Selecting outcomes

In order to prioritise which outcomes Nottingham wanted to influence, three major clinical complications of diabetes were identified by the ICS as being of particular interest – **amputations**, **vision loss** and **chronic kidney disease**.

These outcomes were used in our evidence search as search criteria.

The risk of diabetic complications are driven by the degree of control of diabetes as measured by the **glycosylated haemoglobin (HbA1c)** and other modifiable risk factors including **smoking status**, measures of **cholesterol** (LDL and HDL) **and systolic blood pressure**.[1]

	Diabetic ulcers	**Amputations**	Ischaemic heart disease	Myocardial infarction	Congestive heart failure	Stroke	**Vision loss**	**Renal failure**
HbA1c	X	**X**		X		X	**X**	
Systolic blood pressure		**X**	X	X		X	**X**	**X**
Smoking				X		X		
Low-density lipoprotein (LDL			X	X	X	X		**X**
High-density lipoprotein (HDL)		**X (protective)**	X (protective)	X (protective)				

1. Hayes, A.J., Leal, J., Gray, A.M., Holman, R.R., Clarke, P.M., 2013. UKPDS Outcomes Model 2: a new version of a model to simulate lifetime health outcomes of patients with type 2 diabetes mellitus using data from the 30 year United Kingdom Prospective Diabetes Study: UKPDS 82. Diabetologia 56, 1925–1933. https://doi.org/10.1007/s00125-013-2940-y

Finding interventions

Interventions that were identified within the literature search to influence the selected outcomes included:

Diabetes Prevention Programme	Structured Education	Web-based structured education
NHS Diabetes Prevention Programme (NHS DPP) identifies those at high risk and refers them onto a behaviour change programme. The NHS DPP is a joint commitment from NHS England, Public Health England and Diabetes UK. A commitment to develop digital access is part of the NHS Long-Term Plan.	Structured education programmes teach people newly diagnosed with diabetes about the disease, its treatment, and healthy lifestyles. Examples include DESMOND for people with type 2 diabetes, and DAFNE for people with type 1 diabetes. They are delivered face-to-face, classroom style and typically have low uptake rates.	These are a new generation of structured education programmes that are web-based using the internet and smart-phone apps, along with face-to-face engagement. They have higher uptake rates and report significant remission rates but are less robustly evaluated as they are relatively new.

Finding interventions: continued

Multidisciplinary foot care services	Retinopathy screening	Bariatric surgery
Organisational reconfigurations to streamline case finding and patient pathways. These will make better use of the skills of diabetologists, specialist nurses, surgeons, podiatrists and others to improve the outcomes for people with diabetes with foot problems.	Digital retinopathy screening began in England in 2003 and was nationally implemented by 2008. About 80% of people with diabetes are screened nationally every year. The screening programme appears to have reduced the rate of sight impairment due to diabetes by about 20%.	Bariatric surgery is used to limit a person's food intake and / or its absorption. They are costly procedures but are very effective at reducing weight and have a significant associated remission rate. Types of bariatric surgery include gastric bypass procedures like 'Roux-en-Y', sleeve gastrectomy, adjustable gastric bands or small bowel bypasses.

Lifestyle changes (addressing some wider determinants of health), were also included in the search, although evidence against some of the identified outcomes was limited.

Population by CCG

Alongside understanding what interventions can improve the type of outcomes Nottingham were interested in, we sought to better understand different population segments. This allowed us to match specific interventions to specific populations, allowing services to be commissioned by geography and based on need. The table summarises how challenges differ across the CCGs.

Levels	IMD[1]	Proportion BME[2]	Diabetes prevalence	% age 65 and over	Amputation rate	Type 2 achieving 3 targets
1. Highest	Nott' City	Nott' City	Mansfield & Ashfield	Newark & Sherwood	Nott' City	Nott' West
2	Mansfield & Ashfield	Nott' West	Newark & Sherwood	Nott' West / Rushcliffe	Mansfield & Ashfield	Rushcliffe
3	Newark & Sherwood	Rushcliffe	Nott' West	Nott' West / Rushcliffe	Newark & Sherwood	Nott' North & East
4	Nott' North & East	Mansfield & Ashfield	Nott' North & East	Nott' North & East	Nott' North & East	Newark & Sherwood
5	Nott' West	Nott' North & East	Nott' City	Mansfield & Ashfield	Rushcliffe	Nott' City
6. Lowest	Rushcliffe	Newark & Sherwood	Rushcliffe	Nott' City	Nott' West	Mansfield & Ashfield

Source: Public Health England 'Fingertips'. www.fingertips.phe.org.uk (Accessed December 2019)

At the CCG level, only deprivation and not having an HbA1c between 6.5% and 7.5% were significant predictors of major amputation. For excess risk of renal replacement, prevalence of ethnic minorities, poor control of HbA1c, uncontrolled BP, not being on statins and the proportion failing to meet all three treatment targets were significant predictors.

1. Index of Multiple Deprivation.
2. Black and Minority Ethnicity.
3. Hayes, A.J., Leal, J., Gray, A.M., Holman, R.R., Clarke, P.M., 2013. UKPDS Outcomes Model 2: a new version of a model to simulate lifetime health outcomes of patients with type 2 diabetes mellitus using data from the 30 year United Kingdom Prospective Diabetes Study: UKPDS 82. Diabetologia 56, 1925–1933.

Matching interventions to populations

Having understood who made up the population, we were able to conduct high-level mapping of what interventions might work best in certain subsets of the population based on the literature.

Intervention	Applicable population	Population likely to gain the most.
Structured education: Diabetes Prevention Programme (DPP)	All people with **pre-diabetes**	**Retired** or **not in work**.
Structured education: Traditional	**All** people newly diagnosed with diabetes. Type 2 – **DESMOND** Type 1 – **DAFNE** Either – **X-PERT** Existing people with diabetes who are poorly controlled.	**Retired** or **not in work**.
Structured education: Web-based structured education	**All** people newly diagnosed with diabetes Existing people with diabetes who are poorly controlled or have a history of non-adherence to medication or non-attendance at clinics.	**Working age** people with diabetes, those **living remotely** or with **transport difficulties**.
Multidisciplinary foot care services	**All** people with diabetes	**Poorly controlled**, people with type 1 diabetes with a history of **ulcers** or '**diabetic foot**'.
Retinopathy screening	**All** people with diabetes	**Poorly controlled people with diabetes** from **deprived areas, BME** populations or a **history of non-attendance or non-adherence** to treatment.
Bariatric surgery	People with **type 2 diabetes** with a **BMI over 35** who are engaged with multidisciplinary weight management services. **People who don't have diabetes** with a **BMI over 40** who are engaged with a multidisciplinary weight management service.	**Morbidly obese people with diabetes** with **poor control** or **additional risk factors** and who are **free of significant psychological illness**.

Return on investment / cost-effectiveness

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After investigating what interventions have an impact and which populations might benefit most, we considered RoI to help inform decision-making. A summary can be found below. With the exception of the DPP, these values are calculated in relation to a standard user defined as a 60-year-old, male, obese diabetic:

Intervention	Initial cost	Years to recover initial cost	Ratio[2] 5-years	ICER (cost per QALY gained)
SE: DPP	**£270** per user	12 years	-	£1,162 at 10 years -£2.336 at 20 years
Traditional SE[1]	**DESMOND** – £203 **DAFNE** – £359 **X-PERT** - £180	15 years	0.14	**DESMOND** - £2,920 **DAFNE** - £14,400 **X-PERT** - £6,800
Web-based SE[1]	**HeLP** - **£226** per user **DDM** - **£90 for 3 years** for **Low-carb** app (NHS) **£100 p.a. for the testing app** Annual cost of **£170 per user per year** used for modelling	2 year	2.35	£5,500 at 1 year
Exercise & weight loss	**£1,223** per participant			
Foot care services[1]	**£330** per referral per year	4 years	1.38	No information*
Bariatric surgery[1]	**£6,235** per procedure	18 years	0.14	£7,129
Retinopathy screening	**£40** per year per person	10 year	0.62	£2,469

* No published analysis in the UK identified, but cost saving after 4 years with reduction in amputation rate, so very likely to be cost-effective .

† Negative – this is cost saving at 20 years.

1. Obese 60 year-old male.
2. Ratio represent the number of pounds returned for every pound invested.

Recommendations

Having reviewed the evidence and assessed cost-effectiveness we were able to make a number of recommendations for Nottingham to discuss and consider further.

For example, all of the interventions described in this slide are cost-effective and are therefore worth commissioning. To maximise **return on investment** and **health improvement**, the following should be prioritised:

- **Web-based structured education**. This offers the highest return on investment and is very cost-effective.
- **Multidisciplinary foot-care services**. These have a rapid return on investment, and while a comprehensive UK cost-effectiveness analysis is lacking, it is very likely to be very cost-effective given the observed savings when implemented at pilot sites.
- Take steps to improve uptake rates for **structured education** in all CCGs, and **retinopathy screening** in Nottingham City in particular by:
    - Addressing **competing time pressures** (out-of-hours and weekend services, web-based structured education)
    - Address **transport difficulties** (locating services closer to users, mobile screening units)
    - **Culturally adapt provision** (review translation service provision, web-apps in locally used languages, consult with the local community)
- For **retinopathy screening**, identify and target those people with diabetes who have missed two consecutive years of screening for more intensive reminders and engagement.

1. Johnson, D., Deterding, S., Kuhn, K.-A., Staneva, A., Stoyanov, S., Hides, L., 2016. Gamification for health and wellbeing: A systematic review of the literature. Internet Interv 6, 89–106. https://doi.org/10.1016/j.invent.2016.10.002

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Snapshot of report contents

This section gives a snapshot of the type of detail included in the full report

Local Context

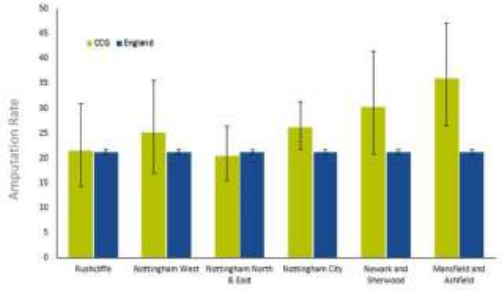
In the main report, multiple evidence sources presenting local context was used to understand how to match interventions to populations accordingly.

Minor amputations

The same systematic review found that minor amputation rates were rising in England.[1]

It may be that earlier aggressive treatment including minor amputations reduces the subsequent risk of major amputation.

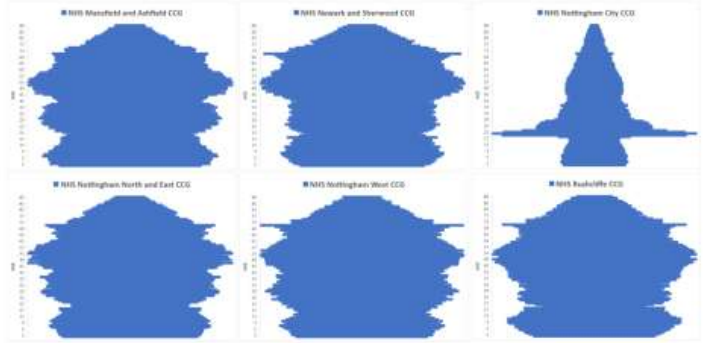
CCG Directly standardised rate of minor amputations per 10,000 patients with diabetes [95% CI] for 2014/15 – 2016/17



1. Ahmad, N., Thomas, G.N., Gill, P., Torella, F., 2016. The prevalence of major lower limb amputation in the diabetic and non-diabetic population of England 2003–2013. Diabetes and Vascular Disease Research 13, 348–353. https://doi.org/10.1177/1479164116651390Public Health England – Diabetes Foot Care Profiles.
2. Public Health England – Diabetes Foot Care Profiles

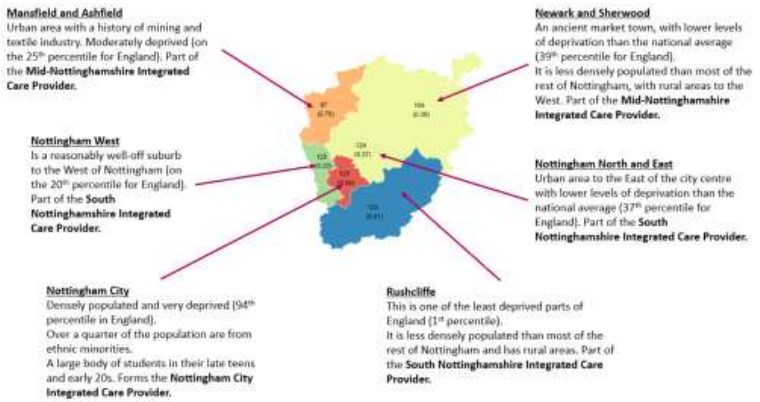
Population: age demographics by CCG

These population pyramid charts show the age distribution in each of the constituent CCG areas of the Nottinghamshire ICS area. Nottingham City stands out as having a large proportion of 18 to 25-year-olds reflecting the presence of a major university.



Source: Office for National Statistics (ONS), Mid 2018 population estimates

Demographics (IMD)



Source: Nottinghamshire PCN Diabetes Profiles, GOV.CO.UK

Evidence for Chronic Kidney Disease (CKD)

Prevalence amongst people with diabetes in Nottinghamshire was **4.56%** versus **4.11%** for England in 2017/18.[1]

Only one Clinical Commissioning Group, **NHS Nottingham City**, fell **below the England average**.

Clinical Commissioning Group	CKD Prevalence 2017/18
NHS Mansfield and Ashfield	4.96%
NHS Newark and Sherwood	5.74%
NHS Nottingham City	**2.93%**
NHS Nottingham North and East	5.77%
NHS Nottingham West	5.32%
NHS Rushcliffe	5.52%

1. Quality and Outcomes Framework, Achievement, prevalence and exceptions data – 2017/18 (qof-1718-prev-all-lev).

Summaries of Intervention Evidence:

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Slides in the main report are included that detail various information from the evidence surrounding the interventions identified. This includes their effect on key outcomes.

Web-based tools: summary of outcomes measures

Diabetes Digital Media (DDM)

Low Carb Programme[1]

- 0.76% (8.3mmol/mol) reduction in HbA1c
- 4.35kg reduction in mass
- 40.4% of participants reducing medication

Hypo programme[5]

- 88% of people know how to spot a hypo
- 89% of people know how to treat a hypo
- 63% fewer severe hypos at 6-month follow up

Changing Health[2]

- 6.4 mmol/mol reduction in HbA1c
- 4.5 kg reduction in mass, 0.4 reduction in BMI
- 1.3 and 1.6 mmHg reduction in systolic and diastolic blood pressure

My Diabetes My Way (MDMW)[3,4]

- 6.4 mmol/mol reduction in HbA1c after one year
- 4.5 kg reduction in mass, 0.4 reduction in BMI
- 1.3 and 1.6 mmHg reduction in systolic and diastolic blood pressure.

Healthy Living for People with Diabetes (HeLP-Diabetes)[6]

- 0.24% (2.6mmol/mol) reduction in HbA1c after one year

1. Saslow, L.R., Summers, C., Aikens, J.E., Unwin, D.J., 2018. Outcomes of a Digitally Delivered Low-Carbohydrate Type 2 Diabetes Self-Management Program: 1-Year Results of a Single-Arm Longitudinal Study. JMIR Diabetes 3, e12. https://doi.org/10.2196/diabetes.9333
2. Smith, W., 2018. Diabetes Digital Behaviour Change Programmes: North West London Pilot. Evaluation Report. Imperial College Health Partners.
3. Cunningham S.G.; Allardice B.; Brillante M.; Wilson L.; Wake D.J., 2018. My Diabetes My Way-an electronic personal health record: Impact on clinical outcomes. Diabetic Medicine 35.
4. Cunningham S.G.; Allardice B.; Wake D.J., 2017. My diabetes my way: User experiences of an electronic personal health record for diabetes. Diabetologia 60, Supplement 1 (S350).
5. Hypo Program. www.hypoprogram.com. "Data on file" at DDM.
6. Murray, E., Sweeting, M., Dack, C., Pal, K., Modrow, K., Hudda, M., Li, L., Ross, J., Alkhaldi, G., Barnard, M., Farmer, A., Michie, S., Yardley, L., May, C., Parrott, S., Stevenson, F., Knox, M., Patterson, D., 2017. Web-based self-management support for people with type 2 diabetes (HeLP-Diabetes): randomised controlled trial in English primary care. BMJ Open 7, e016009. https://doi.org/10.1136/bmjopen-2017-016009

Lifestyle interventions: clinical outcomes

Weight loss and exercise programmes reduce HbA1c, blood pressure, BMI and may increase patient satisfaction.

Social interventions such as including mentors appears to reduce HbA1c levels, BMI and blood pressure in some trials, but not all.

More information is needed about what type of social interventions work and which do not and the context in which they are applied.

	HbA1c	BMI	Blood pressure	Patient Satisfaction, QoL
Exercise	Exercise **reduces HbA1c** between 0.32% and 0.67%.[2,3,4]	Exercise **reduces BMI** between 0.54 and 1.05 Kg/m².[1]	Exercise **reduces systolic blood pressure** by between 2.42 mmHg and 6 mmHg.[5,9] Exercise **reduces diastolic blood pressure** by about 2.23 mmHg.[5]	Dutch people with type 2 diabetes on diet and exercise only treatment (A) have **higher quality of life scores** than those on oral (B) or insulin (C) therapy.[4]
Weight Loss	There is a linear relationship between weight loss and HbA1c. For every **1kg in weight loss, HbA1c reduces by 0.1%.**[7]	Weight loss programmes can be effective. **37.8%** lose over **10% of their initial weight.** **Waist circumference falls** about 6.2cm.[8]	Intensive lifestyle intervention **reduces systolic** by 0.4 mmHg **and diastolic** blood pressure by 0.2 mmHg.[6]	Patients who lose over 10lbs have the **highest satisfaction** compared to those who don't lose weight.[9]
Social Intervention	Including peer support **reduces HbA1c** by about 0.57%.[10]	4 out of 7 studies found no significant difference for peer support.[11]	3 out of 5 randomised control trials (RCTs) found no significant difference for peer support.[11]	-

1-11 see next slide.

NHS DPP: effects

Outcome	Effect	Evidence
Overall Prevention	For every **100,000 interventions** the NHS DPP is expected to prevent/delay **4147 cases** of diabetes	Thomas et al 2017
HbA1c	**0.20%** absolute reduction in the **% HbA1c**	PHE review 2015
BMI/Obesity	**1.47 Kg/m²** reduction in **BMI**	PHE review 2015
Blood Pressure	Systolic blood pressure: **6.57mmHg reduction**	PHE review 2015

Current uptake of interventions

Uptake of current interventions was investigated and presented. This was to help model what the potential impact would be of upscaling existing interventions, or rolling out additional services.

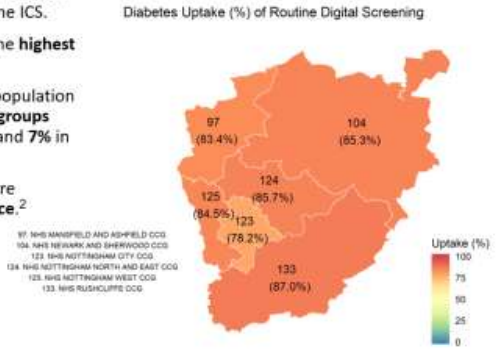
Low uptake of screening in Nottingham City CCG

The population of Nottingham City is much **younger** compared to the rest of the ICS.

Nottingham City is the CCG with the **highest levels of deprivation** in the ICS.[1]

28% of the **Nottingham City** CCG population are from **black or ethnic minority groups (BME)**, compared to between **2%** and **7%** in the rest of the ICS.[1]

Youth, deprivation and **ethnicity** are associated with **reduced attendance**.[2]

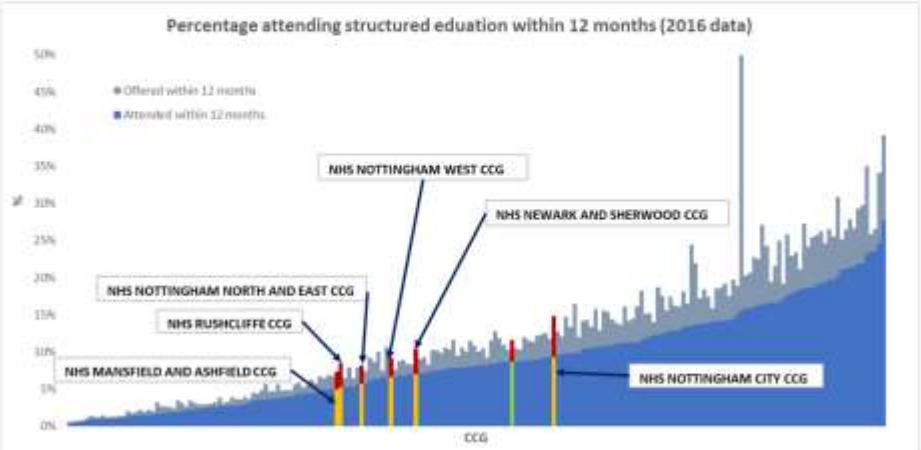


97. NHS MANSFIELD AND ASHFIELD CCG
104. NHS NEWARK AND SHERWOOD CCG
123. NHS NOTTINGHAM CITY CCG
124. NHS NOTTINGHAM NORTH AND EAST CCG
125. NHS NOTTINGHAM WEST CCG
133. NHS RUSHCLIFFE CCG

1. Nottinghamshire PCN Diabetes Profiles, GOV.CO.UK
2. Kashim, R.M., Newton, P., Ojo, O., 2018. Diabetic Retinopathy Screening: A Systematic Review on Patients' Non-Attendance. Int J Environ Res Public Health 15. https://doi.org/10.3390/ijerph15010157

Context for Nottinghamshire

In 2016, five out of six of the Nottinghamshire ICS CCGs had lower than average achievement for the uptake of structured education.[1]



1. National Diabetes Audit (NDA) 2017-2018 Interactive report for England, Clinical Commissioning Groups and GP practices. 13th June 2019. CCGs ranked from lowest percentage achievement on the left to the highest on the right. The positions of the Nottingham CCGs shown in red, with the average for England in green.

Diabetes care process targets 2017-2018

Five out of the six Nottinghamshire ICS CCGs are **above the average** achievement for England. [1]

CCGs ranked from lowest percentage achievement on the left to the most on the right for the eight targets for: HbA1c, blood pressure, cholesterol, serum creatinine, urinary albuminuria, foot surveillance, BMI and smoking.
The positions of the Nottingham CCGs shown in red, with the average for England in green.

1. National Diabetes Audit (NDA) 2017-18 Interactive report for England, Clinical Commissioning Groups and GP practices, 2019. NHS Digital, Health and Social Care Information Centre.

Factors effecting interventions

The project considered how different interventions can be influenced by different factors, including deprivation and wider determinants.

In addition, various further information of interest was provided on interventions to help inform if an intervention should be adopted.

Factors affecting attendance at retinal screening

Age	Deprivation	Distance	Ethnicity
Younger age groups have **lower attendance** rates.[1]	**Deprivation** is associated with **lower attendance** rates.[1]	**Non-attendance** appears to increase with increasing **distance** from places of service delivery.[1]	Coming from a **black or ethnic minority group**, or being **born outside of the UK** increases **non-attendance**.[1]
Younger people may have **less knowledge** about diabetes and the affect of not attending retinal screening on the **risk of blindness**.	People in deprived areas have **less power and control over their daily lives** and may find it difficult to take **time off work** to attend.	The **costs of attendance** to an individual in terms of time or the cost of travel rise with the distance.	There may be **language barriers** that interfere with case finding, engagement and understanding of the need and purpose of screening.
People of working age may have **competing priorities** that make it difficult to attend screening in working hours.[1]	People in deprived area **have fewer resources** and may find the out-of-pocket **costs of attendance** such as travel harder to meet.	Non-attendance rises **0.4%** per minute of travel time[1*], or **3%** if over **2km** away.[3]	There may be concerns about possible **cultural barriers** to participation.

*Failed to reach statistical significance when controlled for other variables.

Distances

Distance may affect the ability of users to access healthcare services [1,2], health outcomes [3] and the experience of care [4].

This map has the major treatment centres in the Nottinghamshire ICS plotted in red. Someone from Southwell (plotted in blue) is over 10km from Newark Hospital and 19km from King's Mill.

Strategies that bring services closer to people with diabetes may improve uptake and therefore outcomes.

1. Maheswaran, R., Pearson, T., Jordan, H., Black, D., 2006. Socioeconomic deprivation, travel distance, location of service, and uptake of breast cancer screening in North Derbyshire, UK. J Epidemiol Community Health 60, 208–212. https://doi.org/10.1136/jech.2005.038398
2. Ellis, D.A., McQueenie, R., McConnachie, A., Wilson, P., Williamson, A.E., 2017. Demographic and practice factors predicting repeated non-attendance in primary care: a national retrospective cohort analysis. The Lancet Public Health 2, e551–e559. https://doi.org/10.1016/S2468-2667(17)30217-7
3. Kelly, C., Hulme, C., Farragher, T., Clarke, G., 2016. Are differences in travel time or distance to healthcare for adults in global north countries associated with an impact on health outcomes? A systematic review. BMJ Open 6, e013059. https://doi.org/10.1136/bmjopen-2016-013059
4. Payne, S., Jarrett, N., Jeffs, D., 2000. The impact of travel on cancer patients' experiences of treatment: a literature review. Eur J Cancer Care (Engl) 9, 197–203. https://doi.org/10.1046/j.1365-2354.2000.00225.x

Increasing uptake of retinopathy screening

Education	Reminders	Service side adaptation	Mobile screening units	Out of hours appointments
Educating people with diabetes to **increase awareness** of and the potential consequences of diabetic retinopathy.[1,2]	Reminders before appointments or at intervals after a failure to attend.[2]	**Cultural adaptations** of the service to increase accessibility to people with diabetes from a BME background. Training of staff on systematic approaches to increasing screening uptake.[2]	Community based screening via **mobile units** can increase uptake, particularly if located at GP surgeries.[2] This will target **working age adults**, the **economically disadvantaged** and those living at **greater distances** from screening centres.	A recent NHS England report by Sir Mike Richards recommends increasing **out of hours provision** of screening to increase uptake.[3] This will target **working age adults**, the **economically disadvantaged**.

1. Hipwell, A.E., Sturt, J., Lindenmeyer, A., Stratton, I., Gadsby, R., O'Hare, P., Scanlon, P.H., 2014. Attitudes, access and anguish: a qualitative interview study of staff and patients' experiences of diabetic retinopathy screening. BMJ Open 4, e005498. https://doi.org/10.1136/bmjopen-2014-005498
2. Zhang, K., Norris, S.L., Saadine, J., Chowdhury, F.M., Horsley, T., Kanjilal, S., Mangione, C.M., Bahremann, R., 2007. Effectiveness of interventions to promote screening for diabetic retinopathy. Am J Prev Med 33, 318–335. https://doi.org/10.1016/j.amepre.2007.05.002
3. Richards, M., 2019. Report of THE INDEPENDENT REVIEW OF ADULT SCREENING PROGRAMMES in England (No. 01089). NHS England, Leeds.

Modelling the effect of interventions

The report details how interventions would impact different outcomes over different time periods and in what populations they have the most impact in.

Lifestyle interventions: clinical outcomes

Weight loss and exercise programmes reduce HbA1c, blood pressure, BMI and may increase patient satisfaction.
Social interventions such as including mentors appears to reduce HbA1c levels, BMI and blood pressure in some trials, but not all.
More information is needed about what type of social interventions work and which do not and the context in which they are applied.

	HbA1c	BMI	Blood pressure	Patient Satisfaction, QoL
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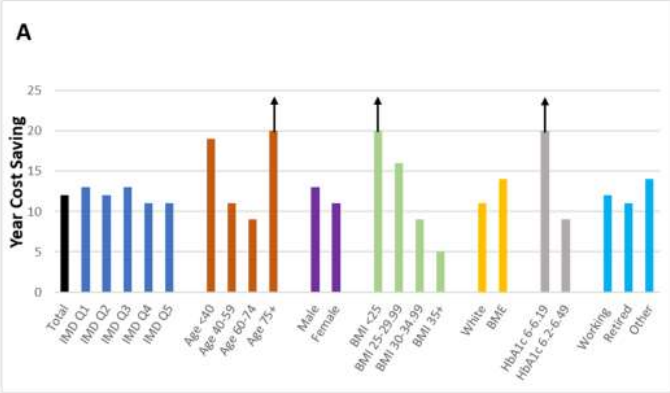
1-11 see next slide.

The following three slides present predicted **cost savings**, **cost effectiveness**, and **20-year return of investment** for different **population segments**.

The sub-groups of patients that achieve cost savings the soonest are:

1. Aged **over 40 and less than 75**
2. With **BMIs over 35 Kg.m²**
3. With the **highest HbA1cs** in the non-diabetic range



Bar charts showing the year that the National Health Service Diabetes Prevention Programme (NHS DPP) becomes cost-saving (recoups intervention costs). Vertical arrows indicate that the DPP is not cost-saving within the 20-year period modelled. BME, black minority ethnic; BMI, body mass index; IMD, index of multiple deprivation.[1]

1. 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, e014953. https://doi.org/10.1136/bmjopen-2016-014953

Web-based tools: modelling outcomes

Only changes statistically significant to p=0.01 are shown.

ROI at 5-years ~ £2.35 **ROI at 10-years** ~ £5.17
Years to break even ~ 3 **Increase in life expectancy** ~ 0.2 years

Outcome	NNT 5-year	RRR 5-year	NNT 10-year	RRR 10-year
Blindness	289	0.50	157	0.50
Foot ulcer	503	0.43	321	0.50
First amputation	-	-	787	0.54
Subsequent amputation	-	-	-	-
Myocardial infarction	332	0.91	160	0.90
Other ischaemic heart disease	-	-	-	-
Congestive heart failure	185	0.77	119	0.83
Stroke	-	-	410	0.91
Renal failure	1923	0.62	1315	0.68
Death	-	-	-	-

For a 60 year-old, male diabetic with a BMI of 30.
All values statistically significant to **p=0.01**. **ROI** – return on investment £ saved for each £ invested. **RRR** – relative risk reduction.

Modelling/presenting cost-effectiveness and RoI

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Finally, ROI and cost effectiveness is modelled/presented for each suggested intervention to help form a case for use, if the intervention is of interest.

Structured education: cost-effectiveness

DESMOND[1]	
Costs	Trial: **£203 per person** for 12 months. Real world cost: £76 per person
Cost-effectiveness	Between £2,920 and £5,387 per QALY gained based on trial and real-World data respectively. (Lifetime)
Savings	Chance of being cost-saving in the long-term is between 28% and 40%.
DAFNE[2]	
Cost	**£359 per person**
Cost-effectiveness	£14,400 per QALY gained
Savings	Per patient: £2,237 at 10 years.
X-PERT[3]	
Costs	**£180 per person.**
Cost-effectiveness	~£6,800 per QALY
Savings	It is not cost-saving over a lifetime as a result of increased survival.[3]

Incremental cost-effectiveness ratio (ICER). The cost of gaining one quality adjusted life-year (QALY)

1. Gillett, M., Dallosso, H.M., Dixon, S., Brennan, A., Carey, M.E., Campbell, M.J., Heller, S., Khunti, K., Skinner, T.C., Davies, M.J., 2010. Delivering the diabetes education and self management for ongoing and newly diagnosed (DESMOND) programme for people with newly diagnosed type 2 diabetes: cost effectiveness analysis. BMJ 341, c4093-c4093. https://doi.org/10.1136/bmj.c4093
2. Kruger J., Brennan A., Thokala P., Basarir H., Jacques R., Elliott J., Heller S., Speight J., 2013. The cost-effectiveness of the Dose Adjustment for Normal Eating (DAFNE) structured education programme: An update using the Sheffield Type 1 Diabetes Policy Model. Diabet. Med. 30, 1236–1244. https://doi.org/10.1111/dme.12270
3. Jacobs-van der Bruggen, M.A.M., van Baal, P.H., Hoogenveen, R.T., Feenstra, T.L., Briggs, A.H., Lawson, K., Feskens, E.J.M., Baan, C.A., 2009. Cost-effectiveness of lifestyle modification in diabetic patients. Diabetes Care 32, 1453–1458. https://doi.org/10.2337/dc09-0363

Foot care services: cost-effectiveness

Examples of foot clinics in different parts of the country and their costs:

Outcome measures	Gain	Ratio
Somerset county-wide diabetes foot pathway[1]	£926,000	6 times the cost of service improvement
Ipswich hospital NHS trust inpatient improvement programme[1]	£214,000	More than 20 times the cost of the programme
Brent specialist foot care team[1]	£474,000	5 times the cost of service
Southampton University Hospitals[2]	£888,979	NA
James Cook Hospital (Middlesbrough)[2]	£249,459	NA

Diabetes UK estimates that multidisciplinary footcare teams are cost-effective and cost-saving within a year of implementation.[2] We were unable to identify a cost-effectiveness analysis in the UK giving a cost per QALY.

Bariatric surgery: cost-effectiveness

Cost-effectiveness of bariatric surgery in morbidly obese patients when half of them have a diagnosis of diabetes is **£7,129 per QALY** gained. Compared to the standard willingness to pay of £20,00 per QALY gained this is **highly cost-effective**.[1]

Potential savings from needing less medication for type 2 diabetes because more people achieve remission.[2]

Time horizon	%	Year 1	Year 2	Year 3	Year 4	Year 5
Estimated number of people who have surgery each year		5,545	5,545	5,545	5,545	5,545
Remission of type 2 diabetes						
No. people 1 year after surgery	60	0	3,327	3,327	3,327	3,327
No. people 2 years after surgery	60	0	0	3,604	3,604	3,604
No. people 3 years after surgery	60	0	0	0	4,436	4,436
Total per year		0	3,327	6,931	11,367	11,367
Potential saving (£000)		0	£1,825	£3,804	£6,238	£6,238

NHS DPP: costs

The cost of the DPP is £270 per user.

Outcome	Effect	Evidence
Return on Investment	**£1.28 saving** for every **£1 invested** (over 20 years)	Thomas et al 2017[2]
QALYs[1]	For every **100,000 interventions** given **3552 QALYs gained** (at £20,000 per QALY)	Thomas et al 2017
Population Cost-Effectiveness	Most cost effective in **obese patients**, a HbA1c between **6.2%** and **6.4%** and those aged **40 to 74**	Thomas et al 2017
Cost-Effectiveness	**97%** probability that it will be cost effective in 20 years. ICER **£21,860 per QALY** gained at 5-years, **£1,162 in 10-years**.* In Nottingham City the ICER is -£2,336 at 20-years (cost saving)	Thomas et al 2017