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Evaluation of the uptake and delivery of the NHS Health Check programme in England, using primary care data from 9.5 million people: a cross-sectional study

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ABSTRACT

Objectives To describe the uptake and outputs of the National Health Service Health Check (NHSHC) programme in England.

Design Observational study.

Setting National primary care data extracted directly by NHS Digital from 90% of general practices (GP) in England.

Participants Individuals aged 40–74 years, invited to or completing a NHSHC between 2012 and 2017, defined using primary care Read codes.

Intervention The NHSHC, a structured assessment of non-communicable disease risk factors and 10-year cardiovascular disease (CVD) risk, with recommendations for behavioural change support and therapeutic interventions.

Results During the 5-year cycle, 9 694 979 individuals were offered an NHSHC and 5 102 758 (52.6%) took up the offer. There was geographical variation in uptake between local authorities across England ranging from 25.1% to 84.7%. Invitation methods changed over time to incorporate greater digitalisation, opportunistic delivery and delivery by third-party providers.

The population offered an NHSHC resembled the English population in ethnicity and deprivation characteristics. Attendees were more likely to be older and women, but were similar in terms of ethnicity and deprivation, compared with non-attendees. Among attendees, risk factor prevalence reflected population survey estimates for England. Where a CVD risk score was documented, 25.9% had a 10-year CVD risk ≥10%, of which 20.3% were prescribed a statin. Advice, information and referrals were coded as delivered to over 2.5 million individuals identified to have risk factors.

Conclusion This national analysis of the NHSHC programme, using primary care data from over 9.5 million individuals offered a check, reveals an uptake rate of over 50% and no significant evidence of inequity by ethnicity or deprivation. To maximise the anticipated value of the NHSHC, we suggest continued action is needed to invite more eligible people for a check, reduce geographical variation in uptake, prioritise engagement with non-

Strengths and limitations of this study

- ► A comprehensive national-level snapshot of National Health Service Health Check (NHSHC) programme, derived from primary care records, and which underpins the recently released NHSHC data dashboard.
- ► Academic and public health collaboration with full access to half a billion records for over 9.5 million people offered an NHSHC between 2012 and 2017.
- ► This first data analysis reports on elements relating to uptake, implementation, process and delivery of NHSHCs, the sociodemographic and risk factor profile of both those who did and did not attend a check and rates of advice, referrals and statin prescriptions delivered as part of the check.
- ► The data were restricted to people with an NHSHC activity code, and thus we were unable to quantify the full eligible population to determine coverage and the gap in programme reach.
- ► Missing data and varying volume of completeness of risk factor measures limit comparisons between attendees and non-attendees.

attendees and promote greater use of evidence-based interventions especially where risk is identified.

INTRODUCTION

Cardiovascular disease (CVD) remains a major public health priority in England.[1] To address this, the government introduced an ambitious programme of vascular checks in 2009, for people aged 40–74, delivered by England's National Health Service (NHS).[2] NHS Health Checks (NHSHCs) sought to address the key risk factors driving the health and economic burden from vascular disease,[3] with early

modelling suggesting that each year NHSHCs would prevent 9500 heart attacks and strokes, 4000 new cases of diabetes and identify at least 25 000 people with existing undiagnosed diabetes or kidney disease before they developed complications.[2 4] Furthermore, with the same vascular risk factors increasingly recognised as contributing to other conditions like dementia, preventable cancers and liver disease,[3] the programme has assumed an even greater importance in the prevention of non-communicable diseases (NCD).[5–7]

Over a decade on, the NHSHC is now an embedded systematic and nationwide detailed risk assessment, awareness and management programme in England. Since 2013, following legislation, local authorities have a statutory obligation to make provision for all eligible people to have an NHSHC every 5 years.[8] However, concerns have been raised that delivery and practical implementation of such a programme presents a paradoxical risk of increasing health inequality if implemented in a way which does not systematically prioritise equity of access, outputs and outcomes. Furthermore, the absence of convincing randomised clinical trial evidence about the effectiveness of such programmes has further prompted ongoing scrutiny and questions around its delivery, uptake, impact and cost-effectiveness.[9]

In response, the number of studies evaluating the delivery and impact of the NHSHC continue to grow but have shown variable results.[10] This may be a result of heterogeneity in programme delivery, small sample sizes, use of national data before NHSHCs were passed into law or variation in local coding practices. In addition, some studies have drawn conclusions from analyses of the Clinical Practice Research Datalink or QResearch databases,[11] which although a representative and important primary care research resource, are limited by being restricted to volunteer practices using specific electronic health record systems with some under-representation in Northern England.[11 12]

To overcome some of these difficulties and provide a contemporaneous overview of the NHSHC programme in England, we sought to analyse the largest NHSHC national primary care dataset to be extracted to date, drawing on data for almost 10 million individuals and half a billion records, specifically extracted for this purpose and one which underpins the recently released NHSHC data dashboard.[13] A series of reports will examine the delivery of the programme, prevention opportunities identified and the impact of the NHSHC. The objectives of this first paper are to describe the data extract and to provide an overview of the programme, reporting on: (1) its uptake, process and delivery, (2) the sociodemographic and risk factor profiles of attendees and non-attendees and (3) advice, referrals and statin prescriptions following the check.

METHODS

Study setting

Public Health England (PHE) is responsible for national oversight and implementation support of the NHSHC programme. PHE worked with NHS Digital (NHSD) to develop business rules for a data extract of all NHSHC coding activity to allow England wide monitoring of the NHSHC.[14] A Data Extract Advisory Committee (DEAC) was set up to guide use of the data extract. Full details of the scope and composition of the committee are available online.[15]

Study design

We conducted a retrospective descriptive cross-sectional study of all individuals who were offered an NHSHC, using individual-level participant data. We describe the data extraction before defining the study population. The study design and report conform to the REporting of studies Conducted using Observational Routinely-collected Data (RECORD) recommendations for reporting of observational studies using routinely collected data.[16]

Data were extracted from 6524 (90%) of the 7216 general practices (GPs) participating in the General Practice Data Extraction Service (GPES),[17] after excluding individuals who had opted out of their data being used for purposes other than direct patient care.[18]

The inclusion criteria for the data extract were primary care Read code for any one of the following NHSHC activities: invitation, completion, non-attendance, inappropriate, commenced or declined (prior to 1 April 2018). Full details of the Read codes used for defining NHSHC activity are available in online supplemental table 1.

The data extracted for each individual included sociodemographic characteristics, risk factors for CVD, diagnostic tests requested following the check and interventions including advice and referrals. CVD diagnoses and medication data were also extracted from three out of the four GP clinical information technology system providers, corresponding to 60% of practices. Data extraction for all variables was restricted to time windows around the individual's contact with the NHSHC programme as specified in the business rules for extraction, listed in online supplemental table 2. Data for CVD diagnoses and a broader range of medications will be presented in subsequent papers.

At the time of extraction in 2018, the business rules limited the upper age limit to 75 years for each year. Due to the rolling nature of the programme, this resulted in missing data for the 70–74 age group, most of whom turned 75 during the 5-year cycle. Thus, the maximum age of patients in the extract is 69 for the financial year 2012/2013, compared with 73 in 2016/2017. The final extraction consisted of 12 151 896 patient records with NHSHC activity coding recorded up until 31 March 2018. Data management and data cleaning details are provided in Supplementary Methods and online supplemental table 3.
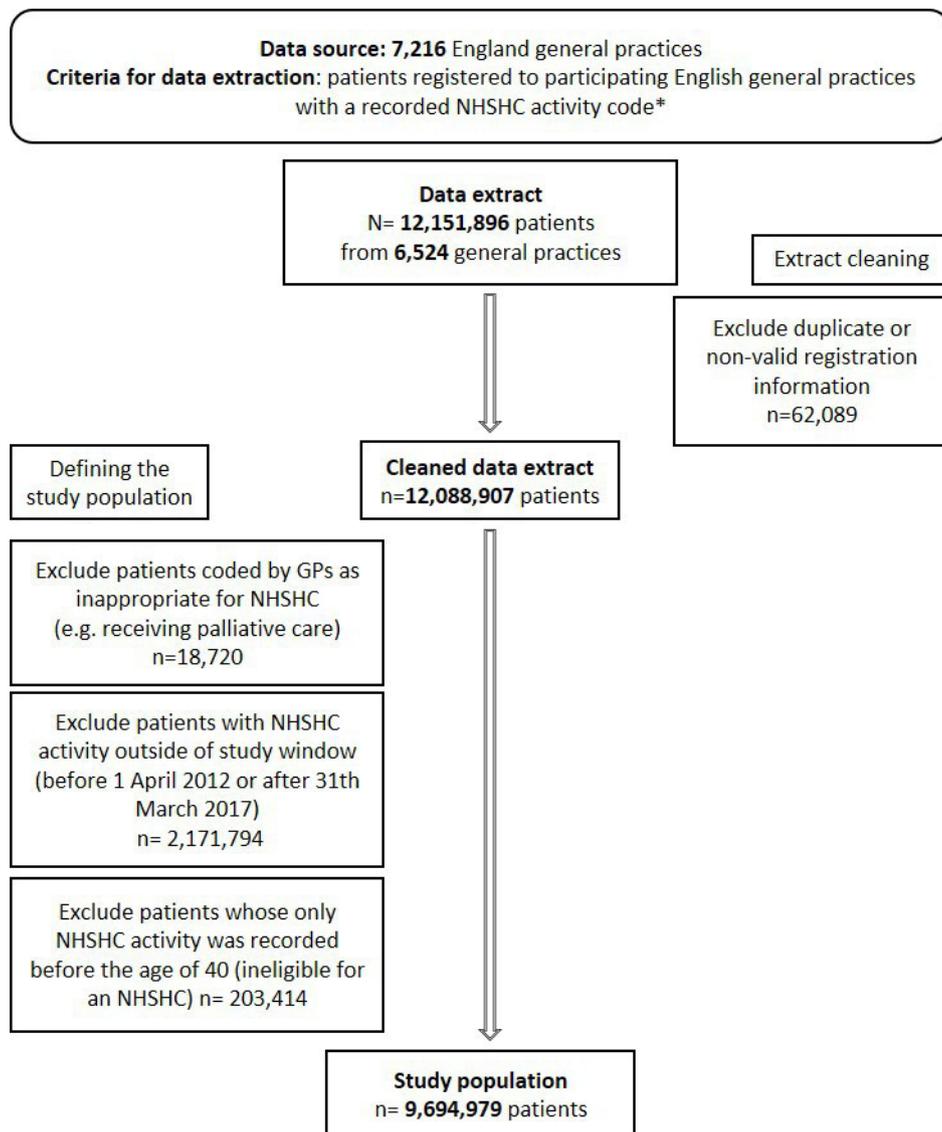
Data source: 7,216 England general practices
Criteria for data extraction: patients registered to participating English general practices with a recorded NHSHC activity code*

Data extract
N= 12,151,896 patients
from 6,524 general practices

Extract cleaning

Exclude duplicate or non-valid registration information
n=62,089

Cleaned data extract
n=12,088,907 patients

Defining the study population

Exclude patients coded by GPs as inappropriate for NHSHC (e.g. receiving palliative care)
n=18,720

Exclude patients with NHSHC activity outside of study window (before 1 April 2012 or after 31th March 2017)
n= 2,171,794

Exclude patients whose only NHSHC activity was recorded before the age of 40 (ineligible for an NHSHC) n= 203,414

Study population
n= 9,694,979 patients

Figure 1 Study extract and study population flowchart. The study population inclusion dates (1 April 2012 to 31 March 2017) reflect a snapshot of the 5-year rolling programme from April 2012, when all trusts commissioning primary care in England had implemented the programme. *NHSHC activity refers to any interaction that a patient may have had with the NHSHC programme. This includes if a patient was invited to, commenced, completed, declined, did not attend, or was inappropriate for, the NHSHC. More details are provided in online supplemental table 1. GP, general practices; NHSHC, National Health Service Health Check.

Study population

NHSHCs are offered to individuals aged 40–74 years and without any of the following conditions: hypertension, diabetes mellitus, familial hypercholesterolaemia, coronary heart disease, heart failure, atrial fibrillation, stroke or transient ischaemic attack, peripheral arterial disease, chronic kidney disease and those already on statins or known to have a 10-year CVD risk of ≥20%.[5]

The study population for this analysis was derived from the data extract described above for any NHSHC coded activity. From this group, individuals (1) with NHSHC activity coded outside the study window, (2) aged <40 years at the time of activity and (3) coded by the GP as inappropriate for an NHSHC were then additionally excluded. The final study population thus included only

those people offered an NHSHC (invited or completed). Figure 1 presents the study extract and population flowchart.

Definitions and study variables

Individuals were categorised as either NHSHC attendees if they had a Read code for a completed check within the 5-year period or a non-attendee if they did not. Uptake of the programme was defined as the proportion of the total study population who attended.

An index date was generated from the date of an individual's primary NHSHC activity to identify age and the most relevant risk factor measurements for each patient. Risk factor and clinical measurements were selected for analysis if they occurred on the index date. Otherwise

we took the closest recording within predefined time windows set by the DEAC. Statin prescriptions that occurred on or after the index date among attendees with no data for previous statin prescription were selected. A full list of variables, Read codes used to define variables, time windows and coding algorithms are available in online supplemental table 4.

Further details on study variable definitions and thresholds are provided in Supplemental Methods and online supplemental tables 4–8.

Data presentation

Statistical tests were not used for comparisons because the amount of missing data between groups varies, preventing meaningful comparisons and the large size of the study population permits the identification of very small differences between groups. Instead, we highlighted the size of differences between groups and interpreted it in relation to the missing data. Where appropriate, we presented data for attendees and non-attendees. Data for uptake, invitation type and third-party provider are presented by financial year to describe changes over time. Data on uptake are also presented by local authority for geographical comparisons. To minimise bias, we include missing data details in all tables and figures.

Patient and public involvement

PHE developed an information notice for patients, including an easy read version, explaining how their personal data would be used and the purpose of the research project. Membership of the DEAC overseeing the use of the NHS Health Check dataset, including the development of this study, its design and outcomes, includes a patient representative. Study results will not be disseminated to individuals whose data are used but the collective analysis presented here will be shared publicly once published.

Ethical approval

A Direction from the Secretary of State for Health and Social Care instructed NHS Digital with the legal requirement to carry out the NHSHC data extract.[19] This study was subject to an internal review by the Research Support and Governance Office in PHE to ensure that it was fully compliant with the UK Policy Framework for Health and Social Care Research (2017) and with all other current regulatory requirements.

RESULTS
NHSHC uptake
Overall uptake by year

Between 1 April 2012 and 31 March 2017, 9 694 979 individuals aged 40–74 years were offered an NHSHC in England. Of these 5 102 758 (52.6%) completed a check. Uptake by financial year is presented in table 1. Uptake remained >50% throughout the 5 years of programme delivery. The number of individuals offered an NHSHC

Table 1 Attendance to an NHS Health Check by financial year among individuals aged 40–74 years in England between April 2012 and March 2017 (N=9 694 979)

Financial year	Individuals offered an NHS Health Check	Individuals attending an NHS Health Check	Uptake of offers rate %
2012/2013	1 469 031	742 935	50.6
2013/2014	1 796 483	962 831	53.6
2014/2015	2 162 454	1 135 746	52.5
2015/2016	2 154 129	1 142 151	53.0
2016/2017	2 112 882	1 119 095	53.0
Total	9 694 979	5 102 758	52.6

NHS, National Health Service.

increased from just under 1.5 million in 2012/2013 to 1.8 million the year after, plateauing at approximately 2.1 million each year after that (table 1).

Geographical variation in uptake of offers

Across England, uptake rates varied by region, as presented in figure 2A. The highest uptake of offers over the 5-year cycle was 84.7% and the lowest 25.1% by region. Data for uptake by upper tier local authority are available in online supplemental table 9. Variation in uptake in London is shown in figure 2B. Central and north London local authorities had higher rates of uptake, with lower rates in the south east.

Process and delivery
Invitation frequency

Of the 9 694 979 individuals in the study population with codes for NHSHC activity, 7 970 396 (82.2%) had a record of at least one NHSHC invitation (see online supplemental table 10). Table 1 presents the number of recorded invitations for attendees and non-attendees (recording by each financial year is available in online supplemental table 11).

Among the 5 102 758 attendees, almost a third (32.8%) had no invitation code recorded but still had a completed NHSHC recorded. The remaining two-thirds (3 429 914) had an invitation recorded, with 50.5% having one invitation and 16.7% having two or more. Among these attendees coded as invited, 590 869 (17.2%) received an invitation on the same date as the NHSHC and were thus assumed to be opportunistic rather than planned. Among those with an invitation in advance of the NHSHC (82.8%; n=2 839 045), the median number of days between recording of their first invitation and a completed NHSHC was 42 (IQR 21, 90) days.

Among non-attendees, 98.9% had a formal invitation record, with a quarter (25.5%) having two or more invitations. The remaining 1.1% of non-attendees had Read codes for declining or not attending a check (see online supplemental table 1).
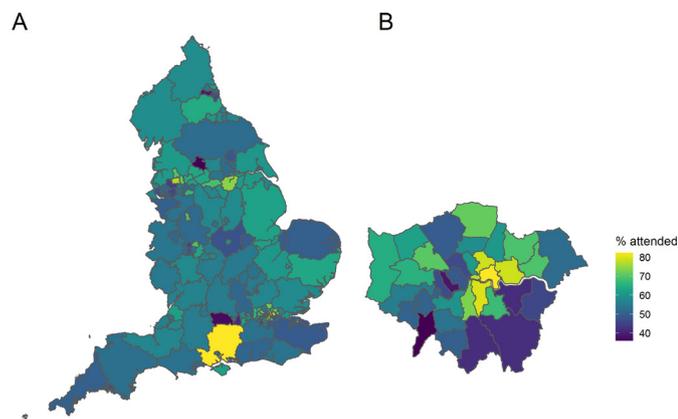
Figure 2 Variation in NHSHC uptake across (A) England and (B) London. Uptake rates shown as % of people taking up an offer of a check, between 2012/3 and 2016/17, by upper tier local authority of the individuals' usual residence. NHSHC, National Health Service Health Check.

Invitation type

Among both attendees and non-attendees, the most common invitation type was a letter, however, other forms of invitations, including text messaging, increased with each year of the programme. The online supplemental figure 1 presents the type of invitation by financial year among attendees and non-attendees.

Delivery

Among all attendees within the 5-year time frame, 3.0% had a clinical code to indicate that their NHSHC was completed by a third party. This increased gradually from 1.2% in the first year to 4.1% in the final year.

Characteristics of invitees
Sociodemographic characteristics

Table 2 presents the sociodemographic characteristics of the study population and the characteristics of the general population according to Office for National Statistics modelled estimates. The population offered an NHSHC was representative of the general population of people aged 40–74 years in terms of sex and deprivation index although they were younger relative to the age distribution of the general population (age <55: 62.2% vs 49.7%). Those who were offered an NHSHC also closely resembled the ethnic makeup of the general population for most ethnicities, except for people self-reporting as white or black Caribbean who appeared underrepresented, although 16.7% of data for ethnicity were missing.

Attendees differed from non-attendees. More attendees were women (54.7%) compared with non-attendees (47.5%; general population 50.9%). There were also notable differences by age. Most attendees were <55 years as they constituted the largest group of eligible people, but individuals ≥55 years had higher rates of attendance after invitation. For ethnic group comparisons, a large proportion of missing data for non-attendees (27.8%) compared with attendees (6.8%) limits interpretation, but where data were available and compared with the

general population, ethnic minority groups appeared to be better represented among attendees than non-attendees (table 2).

Deprivation indices indicate few differences between attendees and non-attendees, except at the extreme ends of the index of multiple deprivation spectrum, where there were slightly more attendees from the most affluent areas (Decile 10: 11.0% vs 10.0%) and slightly fewer attendees from the most deprived areas (Decile 1: 8.2% vs 9.4%). Finally, although the numbers were small, there was no evidence to indicate that people with severe mental illness, physical or cognitive disability were under-represented among attendees (table 2).

Risk factors

Overall, completeness of data for common risk factors measurements including systolic blood pressure (95.8%), smoking (95.7%), Body Mass Index (BMI) (96.3%) and total cholesterol (93.6%) was high in attendees, in contrast to recording of physical activity (64.5%), blood glucose (18.2%), Haemoglobin A1C (HbA1C) (36.6%) and alcohol (38.3%). A CVD risk score was formally documented for 79.7% of attendees (figure 3, online supplemental table 12). Family history data were only recorded where a positive finding was present, making it difficult to estimate how much data were missing or were assessed and were negative. Completeness of most, but not all risk factors, was lower among non-attendees, with the exception of diabetes risk measurements that were similarly low in both groups.

Figure 4 shows the proportion of all individuals identified as having each CVD risk factor among attendees and non-attendees and with respect to missingness of data. Among attendees, where missingness was low, we identified 24.5% with hypertension, while 23.8% were obese and 16% were current smokers. Where a 10-year CVD risk score was documented in the primary care record (79.7% of attendees), just over a quarter (25.9%) were identified as high risk, with a score of ≥10%.

Interventions
Advice, information and referrals

Advice, information and referral for an intervention following an NHSHC were recorded almost 6 million times for all attendees and more than 2.5 million times for individuals with elevated CVD risk factors (table 3). Among all attendees, 16.0% were coded to have received general lifestyle and behavioural advice, just over a fifth were given formal advice on diet and almost a third on physical activity. Among those whose alcohol use puts them above low risk, more than a third were directed to alcohol treatment services. Almost half of all current smokers were directed to smoking cessation services and 19.6% of those who had BMI ≥30 were directed to weight loss and obesity services.

Statin prescriptions

Information on a new statin prescription, occurring on or after NHSHC completion, was available for 60.4% of all attendees

Table 2 Sociodemographic characteristics of NHSHC invitees April 2012–March 2017 compared with ONS estimated English population aged 40–74 at mid-2015

Sociodemographic characteristic	ONS mid-2015 England resident population (aged 40–74 years) n (%)	NHSHC invitees n (%)	Attendees n (%)	Non-attendees n (%)
Sex				
Male	11 200 690 (49.1)	4 724 015 (48.7)	2 311 604 (45.3)	2 412 411 (52.5)
Female	11 604 922 (50.9)	4 970 906 (51.3)	2 791 130 (54.7)	2 179 776 (47.5)
Unknown	–	58 (0.0)	24 (0.0)	34 (0.0)
Age group (years)				
40–44	3 636 454 (15.9)	2 208 213 (22.8)	984 908 (19.3)	1 223 305 (26.6)
45–49	3 889 360 (17.1)	1 986 966 (20.5)	966 356 (18.9)	1 020 610 (22.2)
50–54	3 811 000 (16.7)	1 833 267 (18.9)	958 263 (18.8)	875 004 (19.1)
55–59	3 278 322 (14.4)	1 414 091 (14.6)	783 740 (15.4)	630 351 (13.7)
60–64	2 904 721 (12.7)	1 105 914 (11.4)	669 503 (13.1)	436 411 (9.5)
65–69	3 017 135 (13.2)	910 089 (9.4)	585 653 (11.5)	324 436 (7.1)
70–74	2 268 620 (9.9)	236 439 (2.4)	154 335 (3.0)	82 104 (1.8)
Ethnic group				
White	20 383 677 (89.4)	6 946 824 (71.7)	4 067 864 (79.7)	2 878 960 (62.7)
Indian	524 313 (2.3)	202 004 (2.1)	136 598 (2.7)	65 406 (1.4)
Pakistani	291 546 (1.3)	137 222 (1.4)	89 970 (1.8)	47 252 (1)
Bangladeshi	101 926 (0.4)	46 802 (0.5)	34 863 (0.7)	11 939 (0.3)
Black African	314 107 (1.4)	147 462 (1.5)	94 539 (1.9)	52 923 (1.2)
Black Caribbean	271 649 (1.2)	79 987 (0.8)	53 621 (1.1)	26 366 (0.6)
Chinese	121 129 (0.5)	44 730 (0.5)	27 360 (0.5)	17 370 (0.4)
Other Asian	302 667 (1.3)	125 853 (1.3)	79 354 (1.6)	46 499 (1)
Other group	494 599 (2.2)	239 024 (2.5)	142 621 (2.8)	96 403 (2.1)
Not stated		104 136 (1.1)	31 319 (0.6)	72 817 (1.6)
Missing		1 620 935 (16.7)	344 649 (6.8)	1 276 286 (27.8)
Deprivation index (IMD decile)				
Most deprived	1 914 356 (8.4)	853 547 (8.8)	420 547 (8.2)	433 000 (9.4)
2	1 999 183 (8.8)	896 809 (9.3)	472 647 (9.3)	424 162 (9.2)
3	2 083 743 (9.1)	904 131 (9.3)	477 140 (9.4)	426 991 (9.3)
4	2 202 902 (9.7)	921 244 (9.5)	477 516 (9.4)	443 728 (9.7)
5	2 304 663 (10.1)	974 023 (10)	509 715 (10.0)	464 308 (10.1)
6	2 402 719 (10.5)	991 135 (10.2)	517 381 (10.1)	473 754 (10.3)
7	2 443 073 (10.7)	1 044 505 (10.8)	547 909 (10.7)	496 596 (10.8)
8	2 458 761 (10.8)	1 034 751 (10.7)	547 016 (10.7)	487 735 (10.6)
9	2 491 679 (10.9)	1 045 098 (10.8)	565 872 (11.1)	479 226 (10.4)
Least deprived	2 504 533 (11.0)	1 022 539 (10.5)	563 798 (11.0)	458 741 (10.0)
Missing		7197 (0.1)	3217 (0.1)	3980 (0.1)
Patient characteristics				
Deaf	n/a	321 (0.0)	171 (0.0)	150 (0.0)
Blind	n/a	13 405 (0.1)	7224 (0.1)	6181 (0.1)
Severe mental illness	n/a	111 878 (1.2)	59 351 (1.2)	52 527 (1.1)
Learning disability	n/a	39 612 (0.4)	21 535 (0.4)	18 077 (0.4)
Dementia	n/a	7521 (0.1)	3060 (0.1)	4461 (0.1)

Continued

Table 2 Continued

Sociodemographic characteristic	ONS mid-2015 England resident population (aged 40–74 years) n (%)	NHSHC invitees n (%)	Attendees n (%)	Non-attendees n (%)
Rheumatoid arthritis	n/a	74 281 (0.8)	38 104 (0.7)	36 177 (0.8)
Total	22 805 612	9 694 979	5 102 758	4 592 221

IMD, index of multiple deprivation; NHSHC, National Health Service Health Check; ONS, Office for National Statistics.

(n=3 079 705, see the Methods section). Overall, a statin was prescribed for 8.2% of these attendees. Stratifying this group by CVD risk revealed that a statin was prescribed in 20.3% of those with a 10-year CVD risk score ≥10% and in 39.1% of those with a CVD risk score of ≥20%. Among the 1 910 919 individuals with a CVD risk score <10%, 3.3% received a new statin prescription, while in the remaining 504 374 with no CVD risk score recorded, 11.0% were prescribed a statin (see online supplemental table 13).

Assuming similar rates of statin prescription nationally, we estimate that of the 5 102 758 attendees in this study, up to 418 000 may have received a new statin prescription, with over half of these (n~2 13 000) prescribed to those identified at the NHSHC visit as being at >10% risk of CVD events.

DISCUSSION

In the largest nationwide study of the NHS Health Check programme, using primary care data, we find that the checks have been offered to over 9.5 million people during a 5-year cycle up to 2017, with 52% of people taking up the offer. While we noted geographical variation in uptake rates and an age and sex bias for attendance, we found little evidence of inequality in who was offered or who received an NHSHC by ethnicity or deprivation indices. Where an NHSHC was delivered, risk factors were identified at a similar rate to population estimates, with advice and referrals offered over 2.5 million times to those with risk factors, along with 20% of those at highest risk receiving a new statin prescription as per guidelines. These insights into the evolving process and delivery of the NHSHC programme will support efforts to further enhance the value of the programme, especially for improving uptake rates, targeting those at greatest risk
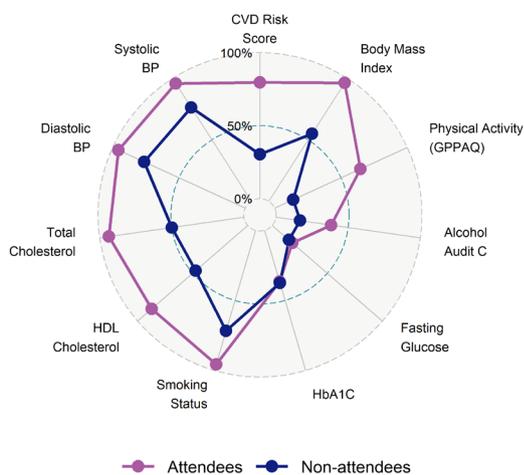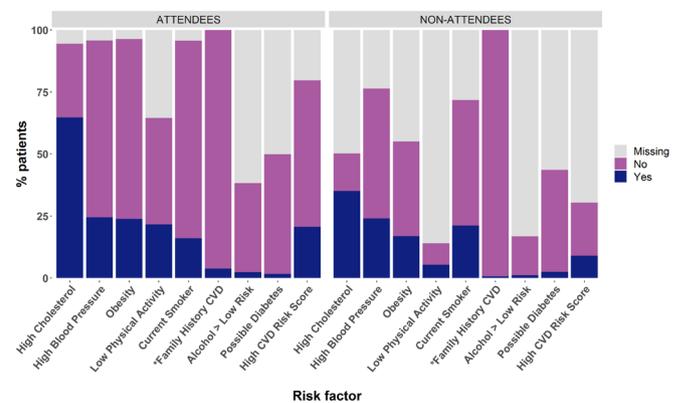

Figure 3 Completion of risk factor measurements for attendees and non-attendees (2012/13–2016/17). Proportion of available and missing data for each risk factor related measurements are shown here. Note these are available measurements within the time frame of the data extract (see Supplemental Methods). Family history not shown as coded only as yes with unknown negative/missing data. See also online supplemental table 12 for the completeness values. AUDIT-C, Alcohol Use Disorders Identification Test-Consumption; BP, blood pressure; CVD, cardiovascular disease; HbA1C, haemoglobin A1c; HDL, high-density lipoproteins; GPPAQ, General Practice Physical Activity Questionnaire.

Figure 4 Proportion of attendees and non-attendees with common CVD risk factors. Definitions as per online supplemental table 6) and include: high cholesterol=total cholesterol >5 mmol/L or cholesterol ratio >4; high blood pressure=systolic ≥140 or diastolic pressure ≥90 mm Hg; obesity=body mass index≥30 kg/m^2; alcohol>low risk=Alcohol Use Disorders Identification Test-Consumption (AUDIT C) score ≥8; low physical activity=General Practice Physical Activity Questionnaire (GPPAQ) moderate inactive or inactive; possible diabetes= haemoglobin A1C (HbA1C) ≥48 mmol/mol or Fasting Blood Glucose (FBG) >7 mmol/L; current smoker=current smoking; high CVD risk score=10-year CVD risk score ≥10%. *Family history is predominantly only recorded if present so accurate information on its absence is unavailable. See also online supplemental table 6 for more detailed information. CVD, cardiovascular disease.

Table 3 Number and proportion of attendees that were coded as received advice, information or a referral following their NHSHC among all attendees and attendees with CVD risk factors

Intervention type	All attendees n (%)	Attendees with the CVD risk factor above threshold for intervention n (%)
Alcohol consumption	792 761 (15.5)	46 611 (38.4)
Diet	1 189 986 (23.3)	766 521 (25.1)
Physical activity	1 501 103 (29.4)	434 326 (39.3)
General lifestyle/ behaviours	814 611 (16.0)	211 571 (20.1)
Smoking cessation	865 913 (17)	467 119 (57.3)
Weight loss and obesity	821 414 (16.1)	599 380 (19.6)
Diabetes prevention programme	4551 (0.1)	3348 (0.9)
Total	2 501 565 (49.0)	565 047 (53.7)

Thresholds defined in online supplemental table 8.
CVD, cardiovascular disease; NHSHC, National Health Service Health Check.

and maximising the use of available NCD and CVD risk reduction interventions.

Our key finding of a 52% uptake rate is slightly higher than previous studies, reporting around 48%.[10] This may be due to the larger, more nationally representative and contemporary data to which we had access, supported by the finding that uptake rates have steadily increased since 2012. Furthermore, we also found wide geographical variation, across the country and in London, possibly due to differing coding practices or invitation methods, which could skew findings from smaller studies or explain discordance with other reports of NHSHC activity.[20] However, an important difference that precludes direct comparison with other studies reporting on NHSHC reach is that our study was restricted to people who had an NHSHC code in their GP records, indicating either an invitation or completion of a check. As such we were unable to quantify coverage of the programme, that is, how many eligible people were offered a check. Estimates from PHE, based on Office for National Statistics data minus the estimated number of people on existing disease registers suggests an eligible population of ~15.5 million.[20] Using this number and based on 5.1 million having had a check, we estimate that a further 6.5 million in the same 5 year cycle would need to complete an NHSHC to achieve the original programme aspiration of 75% coverage.[4 8]

Some NHSHC providers have raised concerns that the programme may paradoxically increase health inequality by only attracting the worried well with more affluent and white people.[21] Reassuringly the data do not show gross differences in the offering or uptake of the programme. First, those who were offered an NHSHC closely resemble the population of England, as measured through census data, with no differences by sex, ethnicity or deprivation indices. They were slightly younger overall, but this is likely because eligibility for an NHSHC falls with comorbidities which are frequently age related.[5] Second, although missing data on ethnicity limit definitive conclusions, ethnic minorities such as those from South Asian backgrounds were equally if not more represented as reported by others.[22 23] Furthermore, although there were small differences at the extremes of deprivation deciles, overall, there was no gross bias towards greater attendance by increasing affluence and previous mixed findings are likely due to regional variation,[22–24] while the similar uptake rates in those with physical disability or serious mental illness also indicate that the programme is equitably delivered. There was however a notable bias towards more women and older people attending for an NHSHC compared with non-attendees, a finding also observed by others.[10 11 22 23]

Of note, despite older people being more likely to attend than not attend after having an offer of an NHSHC, proportionally 57% of all attendees were <55 years, which is higher than reports from other national evaluations of the programme.[11] This could be because our data were limited for the age 70–74 group or that more older people are excluded having been identified with comorbidities earlier in the programme cycle when these other studies reported. However, it may also indicate that younger people are motivated to understand their CVD risk and engage with care providers to address their longer term and lifetime risk, a finding we previously observed with the use of digital risk assessment tool.[25] The potential benefits of this earlier engagement with CVD risk will need to be evaluated over the longer term.

An important benefit of the NHSHC programme has been improvements in risk factor and behaviour data recording, which can guide patient interventions and inform regional resource priorities. For core data items such as smoking status, data completeness was as high as 96%, while for alcohol and physical activity (measures that are legally required as part of the NHSHC but not needed to calculate a person's 10-year CVD risk) was close to 65%. This contrasts with the high degree of missing data among non-attendees for most risk factors. The exception being blood glucose and HbA1C measurements which were similarly complete at low levels for both non-attendees and attendees. This may be because these tests are only performed in attendees at high diabetes risk, combined with parallel current or historical efforts to establish and maintain a diabetes disease register outside of the NHSHC. Where risk factors were recorded, they reveal that prevalence in attendees is close to those in the wider UK population.[3 26] A 10-year risk score was documented in 79.7% of all attendees. We anticipate that in the remaining ~20%, practitioners may have estimated

the score using an online or other tool not integrated into the clinical system, which may have meant that the score was discussed but not recorded, although it is possible some may not have calculated it at all. Overall, where a score was recorded over a quarter of all attendees were calculated to have a 10 year CVD risk score of ≥10%, the current threshold set by the National Institute of Clinical Excellence (NICE) to consider preventative interventions such as statin prescription.[27] Indeed, we found that 20% of this population was newly prescribed a statin following the NHSHC. This figure was even higher at nearly 40% for those with a 10-year CVD risk score of ≥20%, an older NICE threshold for statin prescription. This is an encouraging finding, being higher than in earlier studies and approaching the national ambition of 45% for statin use in this very high risk group.[11 28] Our data also suggest that the NHSHC encounter prompted relevant non-statin interventions with over 2.5 million people with risk factors being coded as having received advice, information or referrals. We note however that these figures may be an underestimate being entirely dependent on coding practices and availability of services by region. For example, the low referral rates for the diabetes prevention programme) are partly explained by the programme launching relatively recently in 2016 and also due to variation in its availability across England and the poor recording of referrals to the programme in the primary care record as reported by others.[29]

Limitations

Despite being the largest national evaluation of the NHSHC programme, our study has some important limitations. First, our data were restricted to people with an NHSHC activity code, and thus we were unable to quantify the full eligible population to determine coverage and the gap in programme reach. Although this is an aspiration for future analyses, it will require access to GP records for much of the population, raising important data governance and handling challenges. Second, we had substantial missing data, especially for the non-attendees, limiting our ability to make robust conclusions about differences in characteristics and risk between these groups. Also, our data extract did not include information on 10% of practices in GPES, which could have introduced a degree of bias in our estimates if the reasons for missing data were not random and related to participation in the NHSHC programme. Third, important information on those >70 years was limited due to a business rule that led to loss of older people once they turned 75 for each year of the data extract. However, the proportionally smaller number of older people eligible for an NHSHC means our results are unlikely to have been impacted significantly. Fourth, prescription data were only available from 60% of practices. The estimate for statin prescriptions derived from the available data however is likely to be representative. Finally, we used a Read code to identify whether an NHSHC took place. This, of course, does not provide any indication as to the extent or quality of the conversations around risk or the suitability of information given, on which the full impact and value of an NHSHC are likely to depend.

Clinical implications

This analysis provides a national-level overview of the NHSHC programme, against which local authorities and healthcare providers can benchmark local achievements. Used with the NHSD dashboard, this will enable local CVD risk strategies to be developed, to increase the invitation of eligible individuals not yet invited for an NHSHC as well as targeting those who still do not attend even after invitation.[13] Importantly, we show that a national prevention programme to tackle NCDs is possible and population health can be targeted through routine healthcare. It represents a systematic approach to switching the conversation from illness to preventing disease and appears to have good engagement from the public so far. From the data, we observe that in England, there remains a major challenge for reducing risk factors that impact multiple long-term chronic conditions. The programme appears to have been successful at promoting advice and guideline-based interventions. Although assessing the efficacy of these interventions on individual-level behaviour change is challenging, further analysis of this large dataset will explore the impact on available metrics such as diagnosis rates and clinical outcomes.

CONCLUSION

In this large-scale analysis of the NHSHC programme using national primary care data, we found that in recent years, over half of all people offered a check have completed one. Although there was substantial variation between local authorities in uptake rates, we found little or no evidence of inequity in invitation processes or uptake. Furthermore, the programme has identified a high burden of risk among attendees, with correspondingly encouraging levels of guideline-driven advice, referrals and statin prescriptions for the primary prevention of CVD. However, to achieve fully the anticipated benefits of the NHSHC programme, we highlight a need for continued efforts to invite more of the eligible population for an NHSHC, reduce geographical variation in uptake of offers, prioritise those who are not attending and to maximise the use of evidence-based interventions to support risk reduction. Subsequent research should provide more insight into how different delivery models influence outcomes.

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Data availability statement Data are available upon reasonable request. All data relevant to the study are included in the article or uploaded as supplemental information. The legal basis for the data extract was a Secretary of State for Health and Social Care Direction. With DEAC approval PHE and NHS Digital have set up a process for dealing with information requests relating to the pseudonymised primary care data used in this paper. The purpose for using this data must be for the scope of work relating to the evaluation of the NHS Health Check in line with the requirements of the Direction.

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Supplementary Materials

An evaluation of the uptake and delivery of the NHS Health Check Programme in England, using primary care data from 9.5 million people: A cross-sectional study

Contents

1

Supplementary Methods

Data Management and Cleaning

The data extract was stored within a Structured Query Language (SQL) database and processed using queries within SQL Server Management Studio. Duplicate patient records were removed. Implausible values were re-coded as missing values. Plausible ranges for risk factors, Supplementary Table 3, were defined by DEAC.

Definitions and Study Variables

Individuals were categorised as either NHSHC attendees if they had a Read code for a completed check within the 5-year period, or a non-attendee if they did not. Further details are provided in Supplementary Table 1. Uptake of the programme was defined as the proportion of the total study population who attended.

An index date was generated from the date of an individual's primary NHSHC activity to identify age and the most relevant risk factor measurements for each patient. Risk factor and clinical measurements were selected for analysis if they occurred on the index date, otherwise we took the closest recording within pre-defined time windows set by the DEAC. A full list of variables, Read codes used to define variables, time windows and coding algorithms is available in Supplementary Table 4.

An individual's age in years was estimated based on year of birth and index date and presented in five-year intervals. We derived an ethnic group variable with the aim of generating fewer categories while still representing important ethnic groups for CVD (Supplementary Table 5). We also included Index of Multiple Deprivation (IMD) (2015) national deciles matched at Lower Super Output Area (LSOA) level based on the patient's postcode of residence at the time of data extraction.[1] ONS April 2019 upper tier local authority (UTLA) boundaries were used.[2] Gender was reported as coded in the extract (Male; Female). Learning difficulty, serious mental illness (SMI), blindness, deafness, rheumatoid arthritis and dementia (present/absent) are reported as binary variables.

We present the following risk factors as binary variables, using cut-points defined in consultation with DEAC, Supplementary Table 6; obesity (BMI>30kg/m^2), blood pressure (derived from systolic (>=140mmHg) or diastolic blood pressure (>=90mmHg), cholesterol (total cholesterol >5mmol/L or cholesterol ratio >4), blood glucose (fasting plasma glucose >=7mmol/L or HbA1C>=48mmol/mol), smoking (current), physical activity (general practice physical activity questionnaire = moderately

inactive or inactive), alcohol intake and behaviour (Audit C score >=8), CVD risk score (10 year risk >=10%) and family history of CVD before 60 years. Rules for conflicting measures for the same patient on the same day are available in Supplementary Table 7.

Among attendees, we considered invitations in the 365 days prior to the index date. Time to attendance was derived from the number of days between first recorded invitation and the index date. Invitation type for attendees was grouped into three categories: advanced invitation (invitation recorded prior to date of NHSHC), opportunistic invitation (invitation recorded same date as NHSHC) and missing invitation (invitation not recorded but NHSHC completed). Among non-attendees for whom the primary contact was an invitation, we considered invitations in the 365 days after the index date. The provider delivering the NHSHC (GP staff; third party) was reported as a binary variable.

Among attendees, we present data for delivery of advice, information or referral for diet, alcohol, physical activity, smoking, weight loss and general lifestyle, referrals for diabetes prevention and prescriptions for statins (present/absent) as binary variables. Statin prescribing data was made available by three out of four GP clinical IT system providers, and subsequently a Read code was attached to 60.4% of attendees in the dataset. We present data for any statin prescription on or after the date of NHSHC activity, as individuals with current statin prescriptions would not be eligible for an invitation to the NHSHC. We also present these data among attendees with a risk profile indicating that intervention was appropriate. We defined appropriate thresholds for action of intervention through consultation with the DEAC advisory board. These are available in Supplementary Table 8.

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Supplementary Figures

Supplementary Figure 1 - Invitation type for first invitation record by year of invitation among attendees and non-attendees
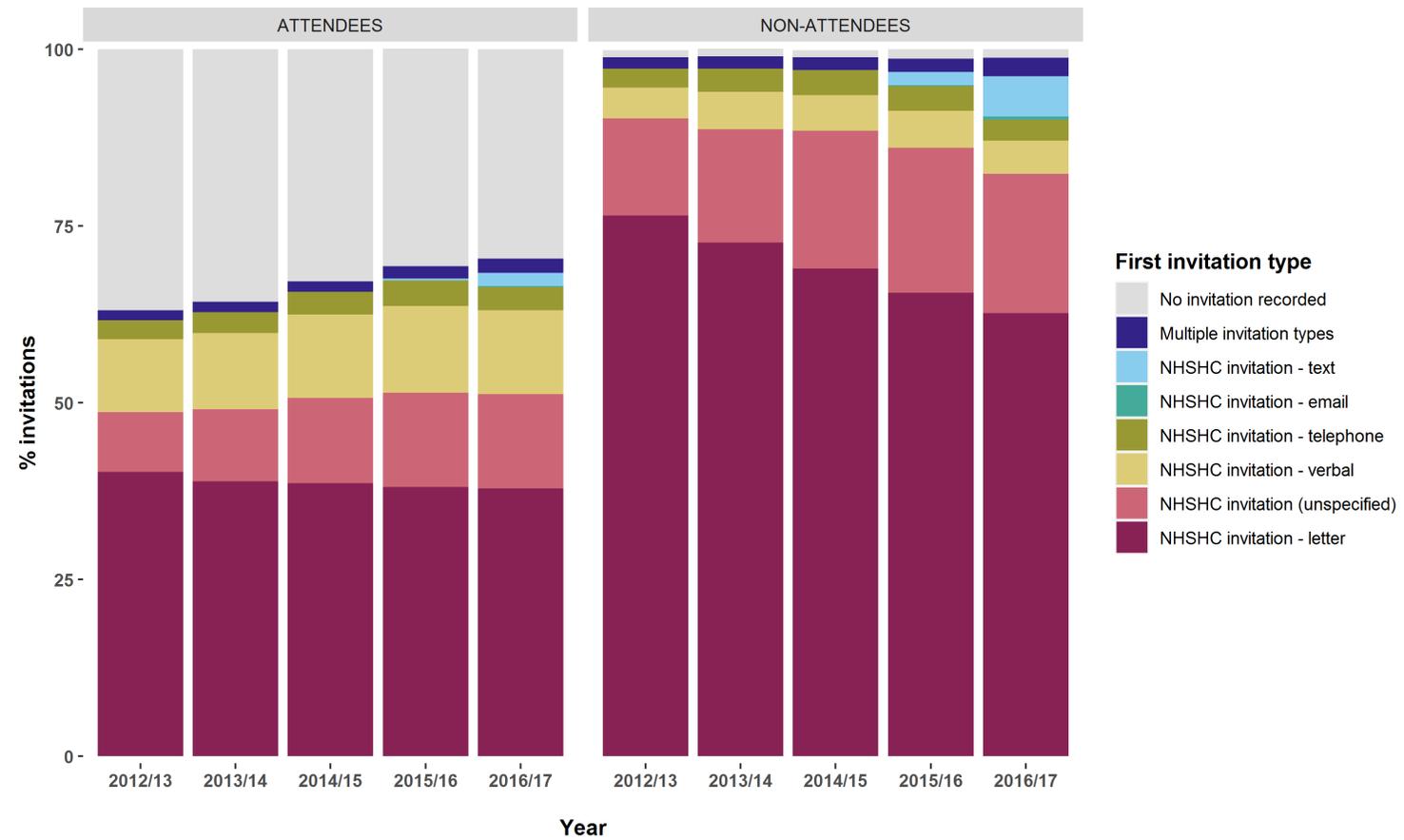
Supplementary Tables

Supplementary Table 1: Read codes for NHS Health Check activity codes and prioritisation rules for definition of primary contact with programme

Order	Clinical NHSHC activity code	Read V2 clinical codes (date introduced)	CTV3 clinical codes (date introduced)	Reported grouping	Criteria
1	Inappropriate	9NSH. (01/10/2013)	Xaaac (01/10/2013)	Excluded from study	Patient has a code recorded as being inappropriate for an NHS Health Check in the data extract
2	Completed	8BAg. (01/04/2010) 8BAg0 (01/10/2012)	XaRBQ (01/04/2010) XaZPq (01/10/2012)	Attendee	Patient has a completed NHS Health Check code recorded in the 5-year period **Index date**: date of patient's first completed check code
3	Declined	8IAx. (01/04/2011)	XaX8h (01/04/2011)	Non-attendee	Patient has a declined NHS Health Check code recorded in the 5-year period **Index date:** date of patient's first declined code
4	Did not attend	9NiS. (01/04/2010)	XaRAA (01/04/2010)	Non-attendee	Patient has an NHS Health Check not attended code recorded in the 5-year period **Index date:** date of patient's first non-attendance code
5	Commenced	8CV9. (01/04/2016)	Xaeab (01/04/2016)	Non-attendee	Patient has a commenced NHS Health Check code recorded in the 5-year period (and no completed/did not attend/declined code recorded in the following 8 weeks) **Index date:** date of patient's first commenced code
6	Invitation	9mC.., 9mC0., 9mC1., 9mC2., 9mC3., 9mC4., (01/04/2010) 9mC5., 9mC6. (01/10/2015)	XaRBR, XaR9z, XaRBS, XaRBT, XaRBU, XaRBV (01/04/2010) Xad0C, Xad0D, (01/10/2015)	Non-attendee	Patient has an invitation to attend an NHS Health Check code recorded in the 5-year period (and no follow up (non-invitation) code recorded within the following 6 months) **Index date:** date of patient's first invitation code

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Supplementary Table 2: Data extraction rules

Category data item	Details data item	before event	Event of interest (NHS Health check offer, completed, DNA, declined …)	after event	GPES EXTRACT
Patients demographics & equity measures	Carer status	latest code before event	1 month		
	Learning disabilities, serious mental illness, blindness, deafness, dementia	include only first recorded code (if not 'resolved')			
	Deprivation (calculated), age (calculated), gender, ehtnicity, first language	latest available code			
CVD risk factor	Smoking status, height, weight, BMI, waist circum., alcohol use, physical activity, CVD risk score	all codes 2 years before event		all codes after event	
Tests results	Blood pressure, pulse, cholesterol & HDL, glucose/ HbA1c, eGFR, ACR	all codes 2 years before event		all codes after event	
CVD diagnosis (**)	Family history CVD, CHD, CKD, diabetes type 2, TIA, stroke, AF, Heart failure, hypertension, familial hypercholesterolemia, hypercholesterolemia, hyperlipidaemia, PAD. (+ non-diabetic hyperglycaemia, impaired glucose regulation, impaired fasting glycaemia, impaired glucose tolerance) (+ rheumatoid arthritis)	all codes (if not resolved)			
Referrals	Referral to NHS DPP (start 2016)	all codes			
	Advice, signposting, referral to lifestyle services, referral for other CVD assessment (diabetes, hypertension, …)	latest code before event	all codes within 1 year of event		
Prescribed CVD medication	Lipid regulation, anti-hypertensive, anti-coagulant, diabetes treatment, AF treatment	all codes 2 years before event	all codes within 1 year of event		

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Supplementary Table 3: Plausible ranges for risk factor measurements

Risk factor	Plausible measurement range (inclusive unless stated)
Alcohol risk score (AUDIT; AUDITC; FAST)	0 – 40
Blood pressure - systolic	70 – 300 mmHg
Blood pressure - diastolic	20 – 150 mmHg
BMI	12 – 90 kg/m^2
Cholesterol – total	1 – 40 (exclusive)
Cholesterol – HDL	0.5 – 5
Cholesterol – ratio	0.2 – 80
Fasting Plasma Glucose (FPG)	0 (exclusive) – 100
HbA1c	20 – 195 mmol/mol
Height	100 – 230 cm
CVD risk score	0 – 100
Weight	20 – 250 kg

Supplemental material

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Supplementary Table 4: Order of priority for selecting metrics in time window around patient's index date

Metric	First priority	Second priority	Third priority	Derivation / other prioritisation rules	Clinical codes (Read V2)	Clinical codes (CTV3)
Patient characteristics						
Ethnic group	Ethnic group recorded in patient's GPES profile at time of data extraction (31/3/2018)	Most recent ethnic group recorded via a clinical code (looking over whole data extract)	n/a	n/a	9S...% , 9T...% , 9t...% , 9i...%	XaBEN%
Blindness	On index date	Anytime before index date (most proximal to index date used)	n/a	n/a	6689. , 6688. , 668D. , 668C.	6689.% , XaW0l , XaCGX% , XaLMz
Deafness	On index date	Anytime before index date (most proximal to index date used)	n/a	n/a	F599. , F591B , F591E , F59A. , F5919	XaRE4 , XaZuB , XaZuE , XaaLf , XaRE5 , Xa0PN
Dementia	On index date	Anytime before index date (most proximal to index date used)	n/a	n/a	Eu02.% , E00..% , Eu01.% , E02y1 , E012.% , Eu00.% , E041. , Eu041 , F110.- F112. , F116. , F118. , F21y2 , A410. , A411.%	X002w% (excluding X003E , X003F , X001T) , Eu02.% , XE1Xt , E00z. , E02y1
Learning Disability	On index date	Anytime before index date (most proximal to index date used)	n/a	n/a	E3...% , Eu7..% , Eu814 , Eu815 , Eu816 , Eu817 , Eu81z , 918e. , Eu818	E3...% , XaQZ4 , XaQZ3 , XaKYb , XaREt , XaREu , Eu81z , XaaiS , Xabk1
Severe Mental Illness	On index date	Anytime before index date (most proximal to index date used)	n/a	n/a	E10..% , E110.% , E111.% , E1124 , E1134 , E114.- E117z , E11y.% (excluding E11y2) , E11z. , E11z0 , E11zz , E12..% , E13..% (excluding E135.) , E2122 , Eu2..% , Eu30.%	X00S6% (excluding Xa9B0% , E14..%) , X00SL , X00SM% , X00SJ% , XSGon , E11z. , E11z0 , E11zz , XE1ZZ , XE1Ze , XaX54 , XaX53 , E130. , E1124 , E1134

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					, Eu31.% , Eu323 , Eu328 , Eu333 , Eu32A , Eu329	
CVD risk factors						
Family history of CVD	On index date	Anytime before index date (most proximal to index date used)	Anytime after index date (most proximal to index date used)	n/a	12C.. , 12C2. , 12C3. , 12C4. , 12C5. , 12CA. , 12CB. , 12CC. , 12CD. , 12CE. , 12CF. , 12CG. , 12CH. , 12CI. , 12CL. , 12CM. , 12CN. , 12CP. , 12CV. , 12CW. , 12CZ.	XaP9K , XaP9M , ZV174 , XE24Z , XaLQq , Xa6aj% , XM1Jg , XM1Jw% , XaP9K , XaP9M
Rheumatoid arthritis	On index date	Anytime before index date (most proximal to index date used)	**Attendees:** n/a **Non-attendees:** Anytime after index date (most proximal to index date used)	n/a	N040.% , N041. , N042.% (excluding N0420) , N047. , N04X. , N04y0 , N04y2 , Nyu11 , Nyu12 , Nyu1G , Nyu10 , G5yA. , G5y8.	N040.% , XE1DU , X705I , G5y8.
Alcohol AUDIT/AUDIT-C/FAST	On index date	Most proximal score to index date for each of AUDIT, AUDIT-C and FAST used. **Attendees:** Up to 365 days before index date **Non-attendees:** Anytime before index date	Most proximal score to index date for each of AUDIT, AUDIT-C and FAST used. **Attendees:** Up to 90 days after index date **Non-attendees:** Anytime after index date	No AUDIT-C/FAST/AUDIT score available: risk factor is **missing** AUDIT-C or FAST assessment is positive, but no AUDIT score available: risk factor is **missing** AUDIT-C (and/or) FAST assessment is negative: risk factor is **low risk** AUDIT score available and greater than or equal to 8: risk factor is **high risk**	38D4. (AUDIT-C), 388u. (FAST), 38D3. (AUDIT)	XaORP (AUDIT-C), XaNO9 (FAST), XM0aD (AUDIT)

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Blood pressure	On index date	Systolic and diastolic BP recordings recorded most proximal to index date used. **Attendees:** Up to 365 days before index date **Non-attendees:** Anytime before index date	Systolic and diastolic BP recordings recorded most proximal to index date used. **Attendees:** Up to 90 days after index date **Non-attendees:** Anytime after index date	On examination (O/E) readings considered only. Systolic BP or Diastolic BP is unavailable: risk factor is **missing**	246..% (excluding 2460. , 2468. , 246H. , 246I. , 246K. , 246L. , 246M. , 246h. , 246i. , 246j. , 246k. , 246n.% , 246o.%)	X773t% (excluding XaI9f , XaI9g , XaZvo , XaZxj , X779b , X779R , X779T , X779W , XaYai , XaYg8 , XaYg9 , Xabhx , Xac5K , Xac5L , Xaedn%) , 246..% (excluding 2460. , 2468. , XaCFN , XaCFO)
Blood glucose	On index date	HbA1c and Fasting Plasma Glucose recorded most proximal to index date considered. **Attendees:** Up to 365 days before index date **Non-attendees:** Anytime before index date	HbA1c and Fasting Plasma Glucose recorded most proximal to index date considered. **Attendees:** Up to 90 days after index date **Non-attendees:** Anytime after index date		HbA1c: 42W5. , 42W50 , 42W51 Fasting Plasma Glucose: 44g1.	HbA1c: XaPbt , Xaezd , Xaeze Fasting Plasma Glucose: 44g1.
Body mass index	On index date	Most proximal to index date used. **Attendees:** Up to 365 days before index date **Non-attendees:** Anytime before index date	Most proximal to index date used. **Attendees:** Up to 90 days after index date **Non-attendees:** Anytime after index date	If BMI is unavailable but height and weight are, BMI is calculated (BMI = kg/m^2) Height and weight are not used if BMI is available	BMI: 22K..% (excluding 22K9.% , 22KA.) Weight: 22A..% (excluding 22A7.- 22A9.) , 9NSa. , 8IAH. Height: 229..% (excluding 2296.) , 9NSZ. , 8IHM.	BMI: 22K..% (excluding XaVwA% , X76CN , XaZMj) , Xa7wG% Weight: 22A..% , 22AA. , X76C3 , XaesG , XaQ7T Height:

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						229..% (excluding 2296.) , XaesF , Xaef4
Cholesterol (ratio)	On index date	Most proximal to index date used. **Attendees:** Up to 365 days before index date **Non-attendees:** Anytime before index date	Most proximal to index date used. **Attendees:** Up to 90 days after index date **Non-attendees:** Anytime after index date	If cholesterol ratio is unavailable but total and HDL cholesterol are, the cholesterol ratio is calculated (ratio = total/HDL) Total and HDL cholesterol are not used if cholesterol ratio is available	Cholesterol: 44O5. , 44PH. , 44P5. , 44PF. , 44PJ. , 44P.. , 44OE. , 44P1. , 44P2. , 44P3. , 44P4. , 44PK. , 44PZ. , 44I2. , 44IF. , 44IG. , 662a. HDL cholesterol: 44P5. , 44PB. , 44PC. , 44d3. , 44d2.	Cholesterol: XaFs9 , XSK14 , 44P5. , 44PF , 44PJ. , XalRd , XE2eD% , 44P1. , 44P2. , 44P3. , 44P4. , 44PH. , XaERR , XaEUq , XaEUr , X772L HDL cholesterol: X772M , 44P5. , 44PB. , 44PC. , XaEVr , 44d3. , 44d2.
Physical activity (GPPAQ)	On index date	Most proximal to index date used. **Attendees:** Up to 365 days before index date **Non-attendees:** Anytime before index date	Most proximal to index date used. **Attendees:** Up to 90 days after index date **Non-attendees:** Anytime after index date	n/a	138b. , 138a. , 138Y. , 138X. , 38Dh.	XaPPE , XaPPD , XaPPB , XaPP8 , XaXX5
CVD risk score	On index date	QRISK/QRISK2 and Framingham risk score recorded most proximal to index date used. **Attendees:** Up to 365 days before index date	QRISK/QRISK2 and Framingham risk score recorded most proximal to index date used. **Attendees:** Up to 90 days after index date	QRISK or QRISK2 score recorded most proximal to index date is used if available. If QRISK and QRISK2 unavailable, Framingham score is used.	QRISK/QRISK2: 8IEL., 8IEV., 38DF., 38DP. Framingham: 38DR.	QRISK/QRISK2: XaYzy, XaZdA, XaPBq, XaQVY Framingham: XaQaG

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		Non-attendees: Anytime before index date	**Non-attendees:** Anytime after index date			
Smoking status	On index date	Most proximal to index date used. **Attendees:** Up to 365 days before index date **Non-attendees:** Anytime before index date	Most proximal to index date used. **Attendees:** Up to 90 days after index date **Non-attendees:** Anytime after index date	Lookup used to map smoking status to binary categories: Non-smoker; Current smoker	Non-smoker: 1371, 137A., 137I., 137N., 137O., 137S., Current smoker: 137.., 137C., 137e., 137h., 137m., 137P., 137Q., 137R., 137V., 137X., 137Y.,	Non-smoker: 1371, 1377, 1378, 1379, 137B., 137F., 137K., 137T., Ub0p1, Ub1na, Xa1bv, XaQ8V, XE0oj, XE0ok, XE0ol, XE0om, XE0on, XE0op, XE0oh Current smoker: 1372, 1373, 1374, 1375, 1376, 137D., 137G., 137J., 137Z., Ub1tI, Ub1tJ, Ub1tK, Ub1tR, Ub1tS, Ub1tU, Ub1tW, XaIlu, XaIkW, XaIkX, XaIkY, XaItg, XaJX2, XaLQh, XaWNE, XaZIE, XE0oq, XE0or
Interventions – attendees only						
Advice, information, referral – ALCOHOL	On index date	Up to 365 days after index date	n/a	n/a	Advice, information and any brief intervention given on alcohol usage: 67H0. , 67A5. , 8CAM. , 8CAM0 , 8CAv. , 8CE1. , 9k1A. , 8IAF. , 8IAt. , 9k11. , 9k14. , ZV6D6 , 6792. , 8CdK. Referral regarding alcohol usage:	Advice, information and any brief intervention given on alcohol usage: XaJlr , Xa1dA , 67A5. , XaFvp , XaXan , XaPmB , 8CE1. , XaPPv , XaPty , XaX4S , XaKAC , XaKAo , ZV6D6 , 6792. , Xac6H Referral regarding alcohol usage:

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					8HkG. , 8H7p. , 8HHe.	XaYWV , XaIPn , XaKUg , XaPna , XaORR
Advice, information, referral – DIET	On index date	Up to 365 days after index date	n/a	n/a	Advice, signposting or information on diet: 67H7. , 8CA4. , 8CA40 , 6799. Referral regarding diet: 8H76. , 8H760 , 8HHE.	Advice, signposting or information on diet: XaQaU , 8CA4. , XaXTD , Xa2jQ , XE0i1 , Xa2hD , 6799. Referral regarding diet: XaBSz , XaAhZ , XaAha , XaJSp , XaAdX , XaAdY , XaAdZ
Advice, information, referral – LIFESTYLE	On index date	Up to 365 days after index date	n/a	n/a	67H..% , 8Hlu.	XaEFY% , Xaam2
Advice, information, referral – PHYSICAL ACTIVITY	On index date	Up to 365 days after index date	n/a	n/a	Advice, signposting or information on physical activity: 67H2. , 8CA5. , 9Oq3. , 6798. , 8CA52 , 8Cd4. , 8IAv. , 8HBN. Referral regarding physical activity: 8H7q. , 8H7q0 , 8HHc. , 8HkX. , 8BAH.	Advice, signposting or information on physical activity: XaJlt , Xa1dN , 8CA5. , XM18T , XaPjx , 6798. , XabFV , XaREx , XaX5H , XaREy Referral regarding physical activity: XaIPu , XaR5C , XaKRq , XaREh , XaCmH
Advice, information, referral	On index date	Up to 365 days after index date	n/a	n/a	Support and refer Stop Smoking Service/Advisor:	Support and refer Stop Smoking Service/Advisor:

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– SMOKING					8CAL. , 8HTK. , 8HkQ. , 8H7i. , 8IAj. , 8IEK. , 9N2k. , 13p50 , 9Ndf. , 9Ndg. , 8T08. , 8IEo. Advice, signposting or information on smoking: 67H1. , 8CAL. , 67A3. , 8CAg. , 6791. , 8IAj. , 8CdB.	Ua1Nz , XaFw9 , XaQT5 , XaItC , XaIye , XaW0h , XaX5W , XaX5X , XaRFh , XaREz , XaaDy , XaaDx Advice, signposting or information on smoking: XaJIs , Ua1Nz , 67A3. , Ua1O0 , XaLD4 , 6791. , XaRFh , XaXnG
Advice, information, referral – WEIGHT	On index date	Up to 365 days after index date	n/a	n/a	Advice, signposting or information on weight management: 67I9. , 8CA40 , 8Cd7. , 66CQ. , 679P. , 8CdC. , 8IAu. Referral regarding weight management: 8HHH. , 8HHH1 , 8HHH0 , 8H4n.	Advice, signposting or information on weight management: XaADJ , Xa1dF , XaX5F , XaX5k , XaKHd , XaXnI , XaX5G Referral regarding weight management: XaJSu , XaZKe , XaXZ9 , XaZKi
Diabetes Prevention Programme referral	On index date	Up to 365 days after index date	n/a	n/a	679m4, 679m0, 679m1, 679m2	XaeDH, XaeCw, XaeCz, XaeD0
Statin prescriptions	On index date	Up to 365 days after index date	n/a	n/a	bxi..% , bxg..% , bxe..% , bxk..% , bxd..% DM+D codes (EMIS): 134489001, 319996000, 319997009, 320000009,	bxi..% , x01R2% , x01R3% , bxk..% , bxd..%

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				320006003, 320012008, 320013003, 320014009, 320029006, 320030001, 320031002, 408036003, 408037007, 409108001, 4896711000001108	

Supplementary Table 5: Derived Ethnic Group Categories

Ethnic group	Subgroups (with ONS codes)
White	A = White British
	B = Irish
	C = Any other White background
	T = White: Gypsy or Irish Traveller
Indian	H = Indian
Pakistani	J = Pakistani
Bangladeshi	K = Bangladeshi
Black African	N = African
Black Caribbean	M = Caribbean
Chinese	R = Chinese
Other Asian	L = Any other Asian background
Other Ethnic Group	D = White and Black Caribbean
	E = White and Black African
	F = White and Asian
	G = Any other mixed background
	P = Any other Black background
	S = Any other ethnic group
	W = Other ethnic group: Arab
Unknown	X = Unknown/No information
	Z = Not stated

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Supplementary Table 6: Categories for risk factors - Risk factors by binary cut points

Risk factors by binary risk cut-offs

Risk factor	High risk threshold/ cutpoint	Risk category	Attendees n (%)	Non-attendees n(%)	Total
Alcohol > Low Risk	Full AUDIT score 8 or more	Missing	3,150,667 (61.7)	3,823,634 (83.3)	6,974,301
		Low risk	1,830,799 (35.9)	714,947 (15.6)	2,545,746
		High risk	121,292 (2.4)	53,640 (1.2)	174,932
Possible Diabetes	HbA1C ≥ 48 or FPG ≥ 7	Missing	2,558,719 (50.1)	2,590,405 (56.4)	5,149,124
		Low risk	2,460,489 (48.2)	1,885,332 (41.1)	4,345,821
		High risk	83,550 (1.6)	116,484 (2.5)	200,034
High Blood Pressure	Systolic BP ≥ 140 or Diastolic BP ≥ 90	Missing	217,714 (4.3)	1,086,797 (23.7)	1,304,511
		Low risk	3,636,511 (71.3)	2,404,097 (52.4)	6,040,608
		High risk	1,248,533 (24.5)	1,101,327 (24)	2,349,860
Obesity	BMI ≥ 30	Missing	187,402 (3.7)	2,064,936 (45)	2,252,338
		Low risk	3,700,522 (72.5)	1,755,019 (38.2)	5,455,541
		High risk	1,214,834 (23.8)	772,266 (16.8)	1,987,100
High Cholesterol	Total cholesterol >5mmol/L or Ratio > 4	Missing	282,100 (5.5)	2,286,595 (49.8)	2,568,695
		Low risk	1,519,485 (29.8)	696,458 (15.2)	2,215,943
		High risk	3,301,173 (64.7)	1,609,168 (35.0)	4,910,341
CVD risk score	10 or more	Missing	1,036,820 (20.3)	3,197,683 (69.6)	4,234,503
		Low risk	3,014,556 (59.1)	979,685 (21.3)	3,994,241
		High risk	1,051,382 (20.6)	414,853 (9)	1,466,235
Family history of CVD	Clinical code present for a CVD event before 60 years old in a first degree relative	No	4,910,543 (96.2)	4,561,766 (99.3)	9,472,309
		Yes	192,215 (3.8)	30,455 (0.7)	222,670
Physical Activity	GPPAQ "moderately inactive" or "inactive"	Missing	1,812,161 (35.5)	3,952,015 (86.1)	5,764,176
		Low risk	2,184,515 (42.8)	392,263 (8.5)	2,576,778
		High risk	1,106,082 (21.7)	247,943 (5.4)	1,354,025
Smoking	Current smoker	Missing	221,351 (4.3)	1,296,474 (28.2)	1,517,825
		Low risk	4,066,412 (79.7)	2,325,196 (50.6)	6,391,608
		High risk	814,995 (16)	970,551 (21.1)	1,785,546

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Supplementary Table 7: Rules for conflicting risk factors measurements

Rules for processing conflicting risk factor measurements for the same patient on the same day

Risk factor	Rule applied
Smoking status; Physical activity status (from GPPAQ)	Records deleted if descriptive statuses are conflicting (e.g. "smoker" and "non-smoker" recorded on the same day)
Blood pressure	Record with lowest systolic measurement taken
BMI; height; weight; QRISK/QRISK2 score; Framingham score; total cholesterol; HDL cholesterol; Cholesterol ratio; HbA1c; FPG	Measurements recoded as missing (unclear which is correct)

Supplementary Table 8: Intervention risk thresholds for action

Intervention type	Advice or Information given	High risk threshold for action
Advice, information or referral	Alcohol usage	Alcohol: FULL AUDIT 8 or more
	Diet	Overweight (BMI ≥ 25)
	Physical activity	GPPAQ "moderately inactive" or "inactive"
	Lifestyle/Counselling	CVD risk score 10 or more
	Smoking cessation	Current smoker
	Weight management	Overweight (BMI ≥ 25)
Diabetes referral	Diabetes Prevention Programme (DPP) referral	Blood glucose: RAISED risk HbA1C ≥ 42 and < 48 or FPG ≥ 5.5 and < 7
Statin prescription	Statins prescribed	CVD risk score 10 or more

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Supplementary Table 9: Data for attendance by UTLA

Number of NHS Health Check invitees and attendees with attendance rate by Upper Tier Local Authority of patient's residence

UTLA Code	UTLA	Invitees	Attendees	Attendance rate	Lower 95% CI	Upper 95% CI
E10000014	Hampshire	179,937	152,318	84.7	84.5	84.8
E09000030	Tower Hamlets	42,098	34,660	82.3	82.0	82.7
E09000028	Southwark	41,938	33,536	80.0	79.6	80.3
E09000025	Newham	51,556	40,706	79.0	78.6	79.3
E09000012	Hackney	37,636	29,713	78.9	78.5	79.4
E08000001	Bolton	64,013	49,792	77.8	77.5	78.1
E09000001	City of London	1,176	910	77.4	74.9	79.7
E08000017	Doncaster	19,869	14,736	74.2	73.6	74.8
E06000053	Isles of Scilly	482	353	73.2	69.1	77.0
E09000022	Lambeth	35,757	26,172	73.2	72.7	73.7
E09000010	Enfield	38,337	27,370	71.4	70.9	71.8
E09000005	Brent	68,977	48,573	70.4	70.1	70.8
E08000002	Bury	31,309	21,979	70.2	69.7	70.7
E09000002	Barking and Dagenham	36,578	25,402	69.4	69.0	69.9
E09000026	Redbridge	51,865	35,942	69.3	68.9	69.7
E06000021	Stoke-on-Trent	55,178	37,866	68.6	68.2	69.0
E06000008	Blackburn with Darwen	17,852	12,192	68.3	67.6	69.0
E08000030	Walsall	49,943	33,947	68.0	67.6	68.4
E09000023	Lewisham	26,396	17,838	67.6	67.0	68.1
E08000016	Barnsley	51,420	34,550	67.2	66.8	67.6
E09000009	Ealing	61,109	40,012	65.5	65.1	65.9
E06000039	Slough	16,191	10,600	65.5	64.7	66.2
E09000017	Hillingdon	45,539	29,447	64.7	64.2	65.1
E08000007	Stockport	44,540	28,763	64.6	64.1	65.0
E08000005	Rochdale	36,853	22,967	62.3	61.8	62.8
E09000015	Harrow	29,691	18,476	62.2	61.7	62.8
E06000047	County Durham	120,544	73,877	61.3	61.0	61.6
E09000019	Islington	38,209	23,415	61.3	60.8	61.8
E08000033	Calderdale	41,631	25,247	60.6	60.2	61.1
E09000031	Waltham Forest	50,680	30,720	60.6	60.2	61.0
E08000034	Kirklees	97,779	59,189	60.5	60.2	60.8
E10000029	Suffolk	147,142	89,051	60.5	60.3	60.8
E09000032	Wandsworth	57,469	34,442	59.9	59.5	60.3
E08000025	Birmingham	178,771	106,909	59.8	59.6	60.0
E06000036	Bracknell Forest	19,697	11,778	59.8	59.1	60.5
E10000019	Lincolnshire	200,192	119,037	59.5	59.2	59.7
E06000046	Isle of Wight	24,068	14,251	59.2	58.6	59.8
E08000004	Oldham	34,227	20,184	59.0	58.4	59.5
E06000031	Peterborough	44,281	26,027	58.8	58.3	59.2
E06000025	South Gloucestershire	59,350	34,683	58.4	58.0	58.8

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E09000014	Haringey	29,867	17,448	58.4	57.9	59.0
E08000022	North Tyneside	40,154	23,434	58.4	57.9	58.8
E06000013	North Lincolnshire	24,121	13,870	57.5	56.9	58.1
E10000017	Lancashire	218,451	125,262	57.3	57.1	57.5
E06000005	Darlington	27,163	15,546	57.2	56.6	57.8
E06000011	East Riding of Yorkshire	12,161	6,894	56.7	55.8	57.6
E10000003	Cambridgeshire	116,035	65,679	56.6	56.3	56.9
E08000018	Rotherham	7,953	4,476	56.3	55.2	57.4
E06000016	Leicester	40,169	22,547	56.1	55.6	56.6
E06000034	Thurrock	32,083	17,982	56.0	55.5	56.6
E09000018	Hounslow	44,165	24,579	55.7	55.2	56.1
E10000006	Cumbria	120,237	65,183	54.2	53.9	54.5
E06000040	Windsor and Maidenhead	21,114	11,418	54.1	53.4	54.7
E06000057	Northumberland	75,940	40,859	53.8	53.4	54.2
E10000034	Worcestershire	141,667	76,000	53.6	53.4	53.9
E10000012	Essex	331,942	178,015	53.6	53.5	53.8
E10000024	Nottinghamshire	198,187	106,221	53.6	53.4	53.8
E09000024	Merton	43,144	23,114	53.6	53.1	54.0
E06000022	Bath and North East Somerset	44,466	23,810	53.5	53.1	54.0
E06000004	Stockton-on-Tees	35,341	18,857	53.4	52.8	53.9
E08000014	Sefton	48,044	25,630	53.3	52.9	53.8
E08000026	Coventry	64,356	34,306	53.3	52.9	53.7
E06000002	Middlesbrough	23,037	12,243	53.1	52.5	53.8
E08000019	Sheffield	80,302	42,628	53.1	52.7	53.4
E10000007	Derbyshire	197,165	104,520	53.0	52.8	53.2
E08000035	Leeds	174,645	92,288	52.8	52.6	53.1
E06000003	Redcar and Cleveland	25,185	13,304	52.8	52.2	53.4
E08000015	Wirral	80,558	42,456	52.7	52.4	53.0
E10000027	Somerset	75,851	39,814	52.5	52.1	52.8
E10000015	Hertfordshire	200,153	104,948	52.4	52.2	52.7
E09000016	Havering	42,627	22,305	52.3	51.9	52.8
E06000012	North East Lincolnshire	38,004	19,816	52.1	51.6	52.6
E08000029	Solihull	32,476	16,930	52.1	51.6	52.7
E10000013	Gloucestershire	137,245	71,077	51.8	51.5	52.1
E06000045	Southampton	33,058	17,102	51.7	51.2	52.3
E06000038	Reading	8,400	4,338	51.6	50.6	52.7
E06000027	Torbay	31,524	16,268	51.6	51.1	52.2
E06000024	North Somerset	40,162	20,498	51.0	50.5	51.5
E06000001	Hartlepool	12,989	6,616	50.9	50.1	51.8
E09000027	Richmond upon Thames	33,597	17,021	50.7	50.1	51.2
E06000033	Southend-on-Sea	48,006	24,182	50.4	49.9	50.8
E06000054	Wiltshire	114,656	57,526	50.2	49.9	50.5
E10000031	Warwickshire	102,623	51,428	50.1	49.8	50.4
E09000029	Sutton	24,049	11,959	49.7	49.1	50.4

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E10000025	Oxfordshire	175,246	87,139	49.7	49.5	50.0
E06000056	Central Bedfordshire	73,732	36,607	49.6	49.3	50.0
E08000021	Newcastle upon Tyne	32,888	16,287	49.5	49.0	50.1
E10000021	Northamptonshire	155,686	76,979	49.4	49.2	49.7
E09000003	Barnet	52,312	25,849	49.4	49.0	49.8
E08000006	Salford	34,274	16,934	49.4	48.9	49.9
E06000019	Herefordshire, County of	37,499	18,421	49.1	48.6	49.6
E06000018	Nottingham	52,693	25,880	49.1	48.7	49.5
E06000043	Brighton and Hove	33,275	16,336	49.1	48.6	49.6
E06000030	Swindon	18,496	9,078	49.1	48.4	49.8
E06000023	Bristol, City of	58,017	28,467	49.1	48.7	49.5
E09000033	Westminster	48,724	23,723	48.7	48.2	49.1
E06000051	Shropshire	67,337	32,700	48.6	48.2	48.9
E08000028	Sandwell	39,552	19,164	48.5	48.0	48.9
E06000042	Milton Keynes	63,247	30,510	48.2	47.9	48.6
E08000036	Wakefield	61,543	29,680	48.2	47.8	48.6
E06000010	Kingston upon Hull, City of	17,074	8,219	48.1	47.4	48.9
E06000055	Bedford	31,728	15,205	47.9	47.4	48.5
E06000049	Cheshire East	52,794	25,264	47.9	47.4	48.3
E10000011	East Sussex	118,596	56,747	47.8	47.6	48.1
E08000009	Trafford	38,971	18,629	47.8	47.3	48.3
E06000044	Portsmouth	25,966	12,359	47.6	47.0	48.2
E06000059	Dorset	51,066	24,250	47.5	47.1	47.9
E08000023	South Tyneside	33,636	15,962	47.5	46.9	48.0
E10000030	Surrey	74,960	35,532	47.4	47.0	47.8
E06000015	Derby	62,407	29,315	47.0	46.6	47.4
E06000032	Luton	48,454	22,742	46.9	46.5	47.4
E08000008	Tameside	42,845	20,077	46.9	46.4	47.3
E10000008	Devon	105,836	49,495	46.8	46.5	47.1
E09000013	Hammersmith and Fulham	43,237	20,205	46.7	46.3	47.2
E09000007	Camden	44,662	20,798	46.6	46.1	47.0
E10000023	North Yorkshire	160,704	74,128	46.1	45.9	46.4
E09000004	Bexley	41,045	18,789	45.8	45.3	46.3
E08000003	Manchester	36,987	16,930	45.8	45.3	46.3
E10000028	Staffordshire	99,238	45,042	45.4	45.1	45.7
E08000013	St. Helens	35,045	15,868	45.3	44.8	45.8
E08000011	Knowsley	31,100	14,066	45.2	44.7	45.8
E06000058	Bournemouth, Christchurch and Poole	43,888	19,839	45.2	44.7	45.7
E06000020	Telford and Wrekin	34,384	15,444	44.9	44.4	45.4
E06000009	Blackpool	28,193	12,621	44.8	44.2	45.3
Unknown	Unknown	7,197	3,217	44.7	43.6	45.9
E10000002	Buckinghamshire	136,674	61,016	44.6	44.4	44.9

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Supplemental material

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E10000032	West Sussex	90,033	40,022	44.5	44.1	44.8
E06000006	Halton	26,863	11,753	43.8	43.2	44.3
E06000052	Cornwall	48,099	20,877	43.4	43.0	43.8
E06000050	Cheshire West and Chester	40,408	17,537	43.4	42.9	43.9
E06000035	Medway	60,300	26,064	43.2	42.8	43.6
E10000020	Norfolk	161,582	69,173	42.8	42.6	43.1
E06000017	Rutland	6,741	2,862	42.5	41.3	43.6
E09000006	Bromley	75,672	31,841	42.1	41.7	42.4
E10000016	Kent	347,229	145,984	42.0	41.9	42.2
E09000008	Croydon	29,612	12,399	41.9	41.3	42.4
E09000011	Greenwich	32,488	13,547	41.7	41.2	42.2
E06000014	York	20,330	8,385	41.2	40.6	41.9
E08000027	Dudley	78,489	32,316	41.2	40.8	41.5
E06000026	Plymouth	28,855	11,707	40.6	40.0	41.1
E08000012	Liverpool	99,029	40,074	40.5	40.2	40.8
E10000018	Leicestershire	172,437	69,666	40.4	40.2	40.6
E08000024	Sunderland	47,131	18,370	39.0	38.5	39.4
E09000020	Kensington and Chelsea	35,607	13,811	38.8	38.3	39.3
E06000007	Warrington	48,004	18,287	38.1	37.7	38.5
E08000031	Wolverhampton	32,226	12,091	37.5	37.0	38.0
E08000010	Wigan	53,620	19,638	36.6	36.2	37.0
E09000021	Kingston upon Thames	32,087	11,529	35.9	35.4	36.5
E06000041	Wokingham	5,010	1,621	32.4	31.1	33.7
E08000037	Gateshead	49,663	14,497	29.2	28.8	29.6
E06000037	West Berkshire	16,235	4,376	27.0	26.3	27.6
E08000032	Bradford	82,669	20,791	25.1	24.9	25.4

Supplementary Table 10: Number of invitations recorded for attendees and non-attendees

Number of invitations	Attendees n(%)	Non-attendees n(%)
0	1,672,844 (32.8)	51,739 (1.1)
1	2,577,581 (50.5)	3,369,517 (73.4)
2	677,783 (13.3)	783,472 (17.1)
> 2	174,550 (3.4)	387,493 (8.4)
TOTAL	**5,102,758 (100.0)**	**4,592,221 (100.0)**

Supplementary Table 11: Invitations by financial year

Proportion of attendees and non-attendees with an invitation recorded

Year	Attendees with invitation	% attendees	Non-attendees with invitation	% non-attendees
2012/13	468,766	63.1	718,527	99.0
2013/14	619,559	64.3	824,429	98.9
2014/15	763,444	67.2	1,016,155	99.0
2015/16	790,731	69.2	999,178	98.7
2016/17	787,414	70.4	982,193	98.8
TOTAL	**3,429,914**	**67.2**	**4,540,482**	**98.9**

Supplementary Table 12: Completeness of risk factor measurement

Percentage of NHSHC attendees and non-attendees with recorded risk factor measurements (restricted to 15-month window around index date for attendees and unrestricted for non-attendees)

Group	CVD risk score	Body Mass Index	Physical Activity (GPPAQ)	Alcohol (Audit C)	Fasting glucose	HbA1C	Smoking Status	Cholesterol (HDL)	Cholesterol (total)	Diastolic BP	Systolic BP
Attendees	79.7%	96.3%	64.5%	38.3%	18.2%	36.6%	95.7%	87.2%	93.6%	95.7%	95.8%
Non-attendees	30.4%	55.0%	13.9%	16.7%	15.1%	37.5%	71.8%	47.3%	50.0%	76.3%	76.3%

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Supplementary Table 13: Statin prescription rates

New statin (any dose) prescriptions among the subset (60.4%) of NHSHC attendees in whom medication data was available

Group	Attendees (n)	Prescribed a statin (n)	Proportion (%)
CVD score <10%	1,910,919	63,227	3.3
10-19.9%	532,046	83,279	15.7
≥20%	132,366	51,691	39.1
No CVD score	504,374	55,630	11.0
Overall total	**3,079,705**	**253,827**	**8.2**