

**Cardiovascular risk management and new co-morbidities in the NHS Health Check: a matched analysis in three east London Clinical Commissioning Groups**

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**Abstract.**

**Background:** In 2014, the NHS Health Check programme completed its first five years, identifying those at highest cardiovascular disease risk, new co-morbidities and offering behavioural change support and treatment.

**Aim:** To describe the coverage and impact of this programme on cardiovascular risk management and identification of new co-morbidities.

**Design and Setting:** Observational five-year study, April 2009 to March 2014, in 139 of 143 general practices in three Clinical Commissioning Groups (CCGs) in east London.

**Method:** Matched analysis comparing co-morbidity and treatment in attendees and non-attendees.

**Results:** 252,259 adults aged 40-74 years were eligible for an NHS Health Check of whom 85,122 people attended an NHS Health Check in 5 years. Attendance increased from 7.3% (10,900/149,867) in 2009 to 17.0% (18,459/108,525) in 2013/14 representing increasing coverage from 36.4% to 85.0%. Attendance was higher amongst more deprived quintiles and among South Asians. Statins were prescribed to 11.5% of attendees and 8.2% of non-attendees. In a matched analysis comparing attendees with non-attendees, newly diagnosed co-morbidity was more likely in attendees, with odds ratios for new diabetes 1.30 (95% Confidence Interval (CI): 1.21 to 1.39), hypertension 1.50 (CI 1.43 to 1.57) and chronic kidney disease 1.83 (CI 1.52 to 2.21).

**Conclusions:** In these CCGs, the NHS Health Check programme provision was equitable with recent coverage of 85%. Statins were more 40% more likely to be prescribed to attendees than non-attendees with estimated absolute benefits of public health importance. More new cases of diabetes, hypertension and chronic kidney disease, were identified among attendees than a matched group of non-attendees.

**Key words**

Primary care

Prevention

Cardiovascular disease

Statins

Health Check

**What this adds**

- The NHS Health Check programme was successfully implemented in three east London CCGs with support including performance dashboards, managed practice networks and financial incentives.
- In 2014 coverage was 85%. Attendance was higher among the most deprived quintile and South Asian people.
- Statins were 40% more likely to be prescribed to attendees than non-attendees: – an intervention of public health importance with considerable room for further improvement.
- New co-morbidities were 30-80% more likely to be identified in attendees than matched non-attendees.

## Background

England's NHS Health Check programme completed its first full five-year cycle 2009-2014. Uptake is now around 50% with 1.5 million Checks annually.<sup>1-3</sup> Birth of this new programme was controversial. Statins received adverse publicity and programme effectiveness was contested,<sup>4 5-8</sup> largely based on a review of 16 trials of health checks, of which 12 trials were before 1994 when neither statins nor modern antihypertensive drugs were in use.<sup>9-20</sup> During the study, statin treatment was recommended at a 10 year CVD risk of 20% or more.<sup>21 22</sup> Major NHS change and austerity compounded the difficulties of implementation. Clinical Commissioning Groups (CCGs) replaced Primary Care Trusts (PCTs) in April 2013 and programme responsibility passed to Local Authorities.<sup>23 24-27</sup> Implementation has been highly variable.<sup>28 29</sup> NHS Check effectiveness remains controversial and Public Health England are addressing improvement.<sup>30 31 32 33</sup>

This study took place in three neighbouring inner London CCGs with among the most ethnically diverse and socially deprived populations in the UK. 50% of the population of 950,000 were from ethnic minority groups of whom 30% are South Asian and 10% are black African/Caribbean. Levels of premature cardiovascular death are high, particularly in South Asians.<sup>34</sup> High turnover of patients, extended overseas visits, changes of address and language, all make programme delivery difficult. Implementation of the NHS Check programme was well supported by these CCGs but their implementation differed.<sup>35</sup>

Because those who attend for NHS Health Checks differ systematically from those who do not attend, comparison between groups requires matching of individuals to reduce the likelihood of bias. This current study therefore aimed to add a comparative element to newly identified co-morbidity in attendees in comparison to matched non-attendees and to add a description of a full five-year cycle to earlier reports.<sup>36</sup>

## Methods

The study used routinely collected and anonymised data. Ethics committee approval was not required and reporting conformed to the STROBE and RECORD recommendations.<sup>37 38</sup>

### Identification of study cohort

This was a retrospective observational five year study 2009-14, on an open cohort of patients eligible for an NHS Health Check, based on routine data in general practitioner electronic health records in City and Hackney, Newham and Tower Hamlets CCGs. All but four of the 143 local general practices used the same web-enabled health record (EMIS Web) covering 98% of the 950,000 locally registered patients. The other four practices undertook NHS Health Checks but their computer system differed and was unable to provide study data.

People eligible for an NHS Health Check were age 40-74 years without pre-existing vascular disease, hypertension, familial hyperlipidaemia, chronic kidney disease, diabetes or current statin prescription. In 2015, the Clinical Effectiveness Group at Queen Mary University of London extracted patient level data for eligible patients during the period 1 April 2009 to 31 March 2014. Attendance was recorded once, as this is a five year rolling programme.

For those registered with the practice on 1<sup>st</sup> April 2009, eligibility and entry into the cohort was assessed on that date. For patients who registered after 1<sup>st</sup> April 2009, eligibility and entry were set as the date of registration. Eligibility was reassessed each year on 1<sup>st</sup> April. The index date for attendees was date of the NHS Health Check and for non-attendees the 1<sup>st</sup> April each year (or later date of registration).

Attendees to NHS Health Checks were eligible patients with a Read code 38B1 or 8BAg denoting attendance, recorded 1<sup>st</sup> April 2009 to 31<sup>st</sup> March 2014. Non-attendees were those eligible on the 1<sup>st</sup> of April of each year and did not have these codes recorded in the year. Townsend deprivation scores were grouped into quintiles based on national distributions. Self-reported ethnicity was grouped into Census categories. Coverage was reported as number of attendees divided by one-fifth of the eligible population in that year expressed as a percentage.

In City and Hackney and Tower Hamlets CCGs the practice payment for each NHS Check attendance was partly incentivised based on achieving targets for uptake and for statin prescription in people at high CVD risk. In Newham a flat fee was paid. In Tower Hamlets, and to a lesser extent City and Hackney, people at highest CVD risk were invited first, but invitations in Newham were not targeted in this way. Finally, Tower Hamlets used managed practice networks to support implementation and target achievement.<sup>35</sup> Because of these differences in implementation we report the three CCGs separately and in combination.

### **Matching of cases and controls**

From previous analyses<sup>36</sup>, attendees and non-attendees differed in demographic and clinical characteristics. Therefore, for the purpose of comparison of co-morbidity in these two groups, we matched attendees and non-attendees (1:2 ratio) on CCG, NHS Health Check year, age, gender, and ethnic group in order to reduce bias. We did not use other CVD risk factors for matching because recording of smoking, blood pressure and QRisk2 was less complete in non-attenders. Deprivation was not used as the vast majority of people were highly deprived by national standards.

### **Outcome assessment**

First diagnosis of chronic kidney disease (CKD) was identified by a record of eGFR  $<60\text{ml/min/1.73m}^2$  and diabetes and hypertension were based on coded diagnoses conforming to the national Quality and Outcomes Framework (QOF) code set.<sup>39</sup> QRisk2 was used to estimate the 10 year risk of a CVD event.<sup>40</sup> For attendees, co-morbidity was identified within 12 months after the NHS Health Check and for non-attendees, new co-morbidity was identified within 12 months of the 1<sup>st</sup> April index date. Outcome data were collected until the end of follow up on 31<sup>st</sup> March 2014 with the first co-morbid diagnosis considered in the analysis.

### **Statistical analysis**

To account for the clustered nature of the data, we used Individual Patient Data (IPD) meta-analysis techniques,<sup>41</sup> using mixed effects models with binomial family and logit link to account for paired cluster data. We considered including random effects terms for CCG and match-id to account for clustering in our models. However, as the CCG term was not statistically significant in any of our models we opted for the parsimonious model with only match-id as the random effect. Further, a second set of models with appropriate interaction terms were fitted to explore whether

the impact of Health Checks was moderated by CCG. All analyses were conducted using Stata version 12.1. The p-values were two sided with statistical significance set at 0.05.

## Results

A total of 85,122 people attended over the five years 2009-14. Attendance progressively increased from 7.3% (10,900/149,867) in 2009, 12.7% in 2010, 16.1% in 2011, 14.0% in 2012 and 17.0% (18,459/108,525) in 2013. Coverage increased from 36.4% in 2009 to 85.0% in 2013.

### Age, deprivation, ethnic group

Attendees were older than non-attendees, and more likely to be from more deprived quintiles or from South Asian ethnic groups. Attendees aged 60 years or more comprised 40.8% (9775/23,977) of the eligible population and attendees under 60 years comprised 33.0% (75,347/228,282). The two most deprived quintiles 4 and 5 comprised 33.8% (164,222/248,238) of the eligible people that attended compared to 29.0% (189/651) in least deprived quintiles 1 and 2. By ethnic group, attendees as a proportion of those eligible comprised 35.5% (37,977/107,085) for White people, 38.0% (18,229/47,961) for black African/Caribbean, 45.0% (21,392/47,560) for South Asian and 15.1% (7,524/42,129) for other ethnic groups or those with no record.

### Assessment of CVD risk

CVD risk using QRisk2 was recorded in 96.2% of attendees, compared to 72.0% of non-attendees. **Table 2** shows that attendance among people at higher CVD risk (QRisk2 20% or more) was highest in earlier years and the proportion of attendees at high CVD risk declined over time. This was most pronounced in Tower Hamlets where 31.2% of attendees were at high CVD risk in 2009 and 3.3% in 2013, in City and Hackney 19.4 % and 3.5% respectively and in Newham; 8.7% and 3.2%. This occurred because people at highest risk were called first leaving a 'pool' of eligible people at lower risk in later years; most pronounced in Tower Hamlets CCG which pursued this invitation strategy most rigorously.

Over the 5 years, 8.8% of all attendees in Tower Hamlets, 6.4% in City & Hackney and 6.4% in Newham were identified at 20% or more CVD risk. Overall 7.1% were at 20% or more CVD risk, 19.1% were 10-19% CVD risk. 44.6% were less than 5% CVD risk. **Table 3**

## Prescribing statins

New statin prescriptions were higher in attendees, 11.5% (9802/85,122) than in non-attendees, 8.2%. (13,741/167,137). **Table 4** describes statin prescription in those people at high CVD risk (20% or more CVD risk), in whom the proportion prescribed statins fell steadily from 41.8% in 2009 to 28.6% in 2013 and averaged 37.2% over all five years because of the declining risk profile of attendees over time. Over the full 5 years the proportion of high CVD risk attendees prescribed statins differed between CCGs; 52.9% in Tower Hamlets 28.3% in City & Hackney and 28.4% in Newham.

## Diagnosis of new co-morbidities

**Table 5** shows the adjusted odds ratio (OR) of co-morbidities diagnosed in attendees of the NHS Health Check in comparison to a matched group of non-attendees up to 12 months after the index date. Among attendees across all CCGs there were more new diagnoses of co-morbidities than in non-attendees; diabetes, OR 1.30 (95% CI: 1.22 to 1.39), hypertension, OR 1.50 (1.43 to 1.57) and CKD, OR 1.83 (1.52 to 2.21) ( $p < 0.001$ ).

**Table 6** shows differences between CCGs in the extent to which co-morbidities were identified. Tower Hamlets demonstrated the highest yield of new hypertension OR 2.53 (95% CI: 2.31 to 2.28), followed by City and Hackney OR 1.61 (1.42 to 1.93) (interaction terms were  $P < 0.001$ ). The odds ratio in Newham was not significantly increased OR 1.058 (0.984 to 1.138).

For new diabetes, the OR was 1.66 (1.43 to 1.93) in City and Hackney, 1.35 (1.20 to 1.52) in Tower Hamlets and 1.14 (1.04 to 1.26) in Newham (interaction terms were  $P < 0.01$ ). For CKD the interaction terms suggested no difference across CCGs and the CKD results in Table 5 apply to all three CCGs.

## Discussion

### Principal findings

These data from the first five years of implementation of the NHS Check showed year on year increase in coverage to 85% in 2013/14, with no evidence of inequity of provision. Older people, those in the most deprived quintiles and South Asians were more likely to attend than younger, least deprived or other ethnic groups. New diagnoses of diabetes were 30% more likely in attendees than non-attendees, hypertension 50% and CKD 80%. Attendees were more likely to be prescribed statins. Of the attendees at high CVD risk (20% or more), 37% were prescribed statins.

Our results also suggest that a targeted approach to invitation may be more efficient than non-targeted invitation. There was more new diabetes, hypertension and CKD diagnosed in the CCGs using a targeted approach. In Tower Hamlets, which used targeted invitation most extensively, 8.8% were identified at high CVD risk over 5 years compared to 6.4% in Newham using unselective invites; a 38% increase in those identified at high CVD risk. Statin prescription of 52.9% in those at high CVD risk was also highest in Tower Hamlets though local managed practice networks also contributed to performance.

### Strengths and weaknesses

This large unselected study included almost all local practices. Standard data entry templates and a single computer system ensured fidelity of coding, high levels of data entry and use of QRisk2 as the validated risk score. Although we matched individuals on major CVD risk factors - age, gender, ethnic group and locality - we cannot exclude the possibility of residual confounding contributing to the observed differences.<sup>42</sup>

The three CCGs are atypical and serve very disadvantaged populations with high CVD risk. All three CCGs benefited from a strong local improvement infrastructure including web-enabled IT support with near real-time performance dashboards which may not be available in other CCGs. In Tower Hamlets managed practice networks including financial incentives may also have contributed to high performance<sup>35 43 44</sup>

## **Comparison with relevant literature**

Coverage of 85% in this study compares to around 50% nationally. Highest coverage and treatment, were associated with invites targeting those at highest risk first and managed practice networks.

Our results are similar to most comparable analyses, which show attendees have higher statin prescribing.<sup>45 46</sup> A matched comparison by Chang et al.<sup>31</sup> of NHS Health Checks nationally also showed more increase in new diagnoses of diabetes and hypertension among attendees in comparison to non-attendees. They also showed higher statin prescribing in attendees 9.1% versus 3.1% in non-attendees, in comparison to our own study of 11.5% and 8.2% respectively. The increase in new co-morbidities has not been demonstrated in all studies.<sup>47</sup>

Internationally, the Danish Inter99 study is relevant. In attendees in comparison to non-attendees, risk factors were significantly reduced and mortality fell by 37%. Analysis by randomised group - invited versus not invited - showed no mortality difference; a not unsurprising result as only 35% randomised to invitation actually attended.<sup>48</sup> A study of the Scottish Keep Well health check showed increased statin prescribing in practices using checks compared to those that didn't.<sup>49</sup>

## **Selective invitation and outcomes**

More new diagnoses were identified in the two CCGs targeting higher risk individuals for first invitation. In Newham with a non-selective approach to invitation, new hypertension in attendees did not increase and despite non-fasting glucose testing of every attendee, new diagnoses of diabetes were lower than in the other two CCGs. The lower rates of diagnoses in Newham are likely to have been due to the selection of a population at overall lower risk in this CCG with 8.7% at high CVD risk in 2009 as compared to 31.2% in Tower Hamlets. The proportion of people at high CVD risk prescribed statins fell over time from 41.8% in 2009 to 28.6% in 2013 reflecting a reduction in average risk over time as people at highest risk were selected first.

## **Implications for policy, practice and research**

Over the five years, 40% more attendees were prescribed statins than non-attendees; 11.5% of attendees were prescribed statins in comparison to 8.2% of non-attendees. This 3.3% absolute difference represents 2800 more people prescribed statins among attendees over 5 years. Assuming a 15% 10 year CVD risk among those treated, this would prevent heart attack or stroke in an

estimated 50 people. In England, with 1.5 million attendees annually, this additional statin use would prevent an estimated 4600 to 8400 heart attacks, strokes or death from these causes in 5 years as a result of attending an NHS Health Check. Treatment of hypertension, diabetes and kidney disease would further reduce CVD events. These results are of public health importance and a full economic analysis based upon contemporary data would provide useful information.

Our study indicates that higher levels of coverage are achievable in the NHS Health Checks programme than is currently the case in England.<sup>50</sup> Treatment with statins in people at high CVD risk was less than 30% in two of the three CCGs and could be improved. Statins are highly effective, safe and well tolerated.<sup>51</sup> Targeted invitation requires further confirmation as a more efficient method of implementation.<sup>52 53</sup> The subsequent management of those identified with co-morbidities or high CVD risk and reasons for non-uptake of treatment or behavioural support also merit further investigation.

## **Conclusion**

This analysis of the first full five-year cycle of the NHS Health Check programme in three entire co-terminous CCGs, shows equitable access by 85% of the eligible population with higher uptake among older and more disadvantaged people and South Asians who are known to have the greatest CVD risk.

In a matched analysis, new co-morbidities were identified more extensively in people who attended, than in people who did not attend. Attendees were more likely to be prescribed statins than non-attendees. Identification of high CVD risk, statin treatment and new co-morbidity was highest in the CCGs targeting invitations at higher risk groups. Managed practice networks may also improve performance. The NHS Health Check programme is likely have an impact of public health importance with need for further improvement in management of identified risks.

## **Acknowledgements**

The study depended on the work and cooperation of the CCGs, GPs and practice staff in Newham, City and Hackney and Tower Hamlets.

## **Contributors**

JR was the principal investigator and guarantor of the study for which CG, SE, KB, SH, VM (Centre for Primary Care and Public Health, Queen Mary University of London) and AS (University of Edinburgh) were steering group members. ID carried out all data extraction and collation and VM conducted the statistical analysis. All authors contributed to the preparation of the manuscript.

## **Competing interests**

JR, SE and ID received personal fees from the funding grant. JR is an author of QRisk2 used in the assessment of CVD risk and chaired the NICE Lipid Modification guideline CG67 2008 which recommended use of CVD risk assessment in routine care. JR, SH and KB supported the implementation of the NHS Health Check programme for the three east London CCGs in this study and received personal fees from these organisations. VM, AS and CG have no competing interests to declare.

## **Funding**

This study was independent research commissioned and funded by the Department of Health Policy Research Programme (as the NHS Health Check Programme evaluation 009/0052). All authors are also funded by their host organisation.

## **Ethics approval**

All data were anonymised and managed according to the UK NHS information governance requirements. Ethical approval was not required for the use of routinely collected anonymised data in this observational study.

**Disclaimer** The views expressed in this publication are those of the authors and not necessarily those of the Department of Health.

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## Tables

**Table 1: Numbers and percentages of eligible attendees and non-attendees by population characteristics. 5 years 2009/10-2013/14.**

Patient characteristics	Non-Attendee		Attendee	
	No	%	No	%
<b>Total</b>	<b>167,137</b>	<b>100.0%</b>	<b>85,122</b>	<b>100.0%</b>
<b>CCG</b>				
City and Hackney	64,053	38.3%	24,631	28.9%
Newham	56,620	33.9%	35,765	42.0%
Tower Hamlets	46,464	27.8%	24,726	29.0%
<b>Gender</b>				
Female	67,620	40.5%	40,591	47.7%
Male	99,516	59.5%	44,530	52.3%
Not specified	1	0.0%	1	0.0%
<b>Age band (years)</b>				
40-59	152,935	91.5%	75,347	88.5%
60-74	14,202	8.5%	9,775	11.5%
<b>Ethnicity</b>				
White	69,108	41.3%	37,977	44.6%
Black	29,732	17.8%	18,229	21.4%
South Asian	26,168	15.7%	21,392	25.1%
Other/Not Recorded	42,129	25.2%	7,524	8.8%
<b>Townsend quintile of deprivation (national rankings)</b>				
1 (most affluent)	81	0.0%	33	0.0%
2	381	0.2%	156	0.2%
3	1,596	1.0%	794	0.9%
4	30,814	18.4%	14,943	17.6%
5 (most deprived)	133,408	79.8%	69,073	81.1%
Not recorded	857	0.5%	123	0.1%

**Table 2:**  
**Proportion of attendees by CVD risk and CCG. 2009/10 and 2013/14**

QRisk band		City & Hackney		Newham		Tower Hamlets		East London	
		2009	2013	2009	2013	2009	2013	2009	2013
0-<5%	<i>n</i>	237	2799	3794	4497	313	2614	4344	9910
	%	33.0%	50.9%	44.1%	57.6%	19.9%	50.8%	39.9%	53.7%
5-<10%	<i>n</i>	156	1376	2295	1536	347	1327	2798	4239
	%	21.7%	25.0%	26.6%	19.7%	22.1%	25.8%	25.7%	23.0%
10-<15%	<i>n</i>	100	596	1025	665	238	565	1363	1826
	%	13.9%	10.8%	11.9%	8.5%	15.2%	11.0%	12.5%	9.9%
15-<20%	<i>n</i>	83	268	509	303	181	279	773	850
	%	11.6%	4.9%	5.9%	3.9%	11.5%	5.4%	7.1%	4.6%
20%+	<i>n</i>	139	190	745	250	490	172	1374	612
	%	19.4%	3.5%	8.7%	3.2%	31.2%	3.3%	12.6%	3.3%
Not Recorded	<i>n</i>	3	275	244	559	1	188	248	1022
	%	0.4%	5.0%	2.8%	7.2%	0.1%	3.7%	2.3%	5.5%

**Table 3:**  
**Number and percentage of attendees by CVD risk and CCG. 5 years 2009/10-2013/14.**  
**Number, %**

QRisk band	City & Hackney	Newham	Tower Hamlets	Total East London	% of all attendees
0-<5%	10,556	17,730	9678	37,964	44.6%
5-<10%	6290	8284	6942	21,516	25.3%
10-<15%	3225	3786	3533	10,544	12.4%
15-<20%	1804	1900	2021	5725	6.7%
20%+	1585	2276	2170	6031	7.1%
Not Recorded	1171	1789	382	3342	3.9%
Total attendees	24,631	35,765	24,726	85,122	100.0%

**Table 4:**

**Number and percentage of new statin prescriptions in high CVD risk attendees.  
All east London; 5 years 2009/10-2013/14.**

Health Check year	Prescribed statins				Total
	No		Yes		
	No.	%	No.	%	
2009	799	58.2%	575	41.8%	1374
2010	1137	63.5%	653	36.5%	1790
2011	929	62.9%	549	37.1%	1478
2012	486	62.5%	291	37.5%	777
2013	437	71.4%	175	28.6%	612
Locality CCG					
City & Hackney	1,136	71.7%	449	28.3%	1,585
Newham	1,630	71.6%	646	28.4%	2,276
Tower Hamlets	1,022	47.1%	1,148	52.9%	2,170
East London	3,788	62.8%	2,243	37.2%	6,031

**Table 5:**

**Odds Ratios of attendees compared to matched non-attendees, for new co-morbidity diagnosed within 12m of NHS Health Check.**

	Odds Ratio (95% CI)	p value
Diabetes	1.300 [1.215 to 1.390]	<0.001
Hypertension	1.499 [1.428 to 1.574]	<0.001
CKD 3-5	1.833 [1.521 to 2.210]	<0.001

**Table 6:**

**Odds Ratios of attendees compared to matched non-attendees, for new diabetes or hypertension diagnosed within 12m of NHS Health Check; by CCG.**

CCG	Odds Ratio (95% CI)	p value
<b>Diabetes</b>		
City & Hackney	1.660 [1.425 to 1.933]	<0.001
Newham	1.145 [1.037 to 1.263]	0.007
Tower Hamlets	1.353 [1.204 to 1.521]	<0.001
<b>Hypertension</b>		
City & Hackney	1.612 [1.463 to 1.776]	<0.001
Newham	1.058 [0.984 to 1.138]	0.130
Tower Hamlets	2.531 [2.306 to 2.779]	<0.001