Identifying individuals for primary cardiovascular disease prevention in UK general practice:
priorities and resource implications

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ABSTRACT

Targeted cardiovascular disease prevention relies on risk-factor information held in primary care records. A risk algorithm, the 'e-Nudge', was applied to data from a population of ≥50-year-olds in 19 West Midlands practices, to identify those individuals at risk of cardiovascular disease. Altogether, 5.9% were identified aged 50–74 years at ≥20% 10-year risk based on existing data, and a further 26.4% were potentially at risk but had missing risk-factor information; 9.2% of patients aged over 50 years with established cardiovascular disease had at least one modifiable risk factor outside the audit target of the Quality and Outcomes Framework. Implications for resource allocation are discussed.

Keywords

algorithms; cardiovascular diseases; medical informatics; medical record systems, computerised; risk assessment; risk factors.

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Submitted: 19 October 2007; **Editor's response:** 20 December 2007; **final acceptance:** 11 April 2008.

DOI: 10.3399/bjgp08X319468

INTRODUCTION

Current UK guidelines recommend that individuals at ≥20% risk of cardiovascular disease over the next 10 years should be identified for primary prevention interventions,[1–3] including lipid-lowering therapy. However, such activity is not commissioned through the Quality and Outcomes Framework (QOF),[4] and practice teams must balance the resource implications against other priorities, including the care of those with established cardiovascular disease.

The identification of individuals at risk is assisted by the 'e-Nudge' software tool, developed by the current research team and programmed by EMIS, to identify individuals likely to justify either intervention or further assessment of cardiovascular risk. The e-Nudge tool is an automated system of continually updated searches and screen alerts currently under trial. Its name reflects the role of the software to act as a subtle prompt in consultations to support cardiovascular disease prevention during routine care. The aim of the current survey was to compare the proportions of individuals identified in different risk categories, and discuss the implications for routine practice.

In addition to the practical challenge of fitting risk assessments into busy practice, there is concern over identifying cardiovascular risk in older individuals that may be attributable largely to non-modifiable factors.[5,6] This study reports the proportion of the population aged 50 years and over identified, using the e-Nudge algorithm, as at ≥20% risk, the proportion who may be at risk but have missing risk factor information, and the proportion with diagnosed cardiovascular disease or diabetes who have at least one modifiable risk factor outside of the audit target of the QOF.

METHOD

The e-Nudge tool identifies several groups of patients based on clinical variables and the availability of risk-factor information in the practice database. It also identifies individuals with

How this fits in

Despite recent improvements in the recording of cardiovascular risk factor data in primary care, for every individual with complete risk factor information, there are perhaps four or five in the practice who would require further data collection. They are also outnumbered by individuals with established cardiovascular disease whose risk factors are both uncontrolled and modifiable.

insufficient recorded information for a risk estimate. For those with sufficient data and no diagnosis of cardiovascular disease or diabetes, it estimates cardiovascular risk using the Framingham cardiovascular disease equation.[7] Details of its structure are published elsewhere.[8]

It takes into account an average of up to three systolic blood-pressure values in the past 3 years, and the most recent total and high-density lipoprotein cholesterol levels. Where information is missing, dummy values are inserted to calculate a potential risk score. When smoking status is unknown, the patient is assumed to be a non-smoker. Where blood-pressure or cholesterol values are missing, the algorithm uses median values of the 50–74-year-old group from the Health Survey for England 2003.[9]

As glucose testing is important in cardiovascular risk assessment, the e-Nudge tool assumes a positive diabetes status for those aged 50–74 years who are not on the diabetes register and have had no blood–glucose measurement in the past 3 years, and calculates the Framingham cardiovascular disease risk. If this is ≥20%, the individual is identified as being in the group requiring further data collection. This information helps to target those most likely to benefit from testing for diabetes. The Framingham equation was not applied to those with known diabetes or cardiovascular disease, but in these groups it identifies those outside the QOF audit targets for blood pressure and/or total cholesterol level.

The e-Nudge software was installed in 19 general practices in north and south Warwickshire, Coventry, and Rugby as part of a randomised controlled trial of it.[8] After installation, baseline data on the proportion of the population identified in the various categories were extracted to provide the data for this survey. These provide information on the levels of data available to support a programme of primary cardiovascular disease prevention and the likely workload implications for general practice. For the primary prevention group, all individuals above the risk threshold of ≥20% are flagged up, with no stratification of risk above this level. The age of the patient is known to the clinician during the consultation but there is no breakdown by age of identified individuals in this survey.

Table 1. Numbers and proportions of patients identified in each risk category (aggregated data from all 19 practices).

Group definition	Number identified	Proportion of population aged ≥50 years (%)
Patients aged 50–74 years at ≥20% cardiovascular risk based on existing data	2152	5.9
Patients aged 50–74 years with missing risk factor information who would be at ≥20% risk when assumed values are inserted (see Method)	9657	26.4
Patients aged ≥50 years with known cardiovascular disease or diabetes whose blood pressure or cholesterol level was not in target in the past 15 months (Quality and Outcomes Framework audit target)	3346	9.2

[a]*Total number of patients = 36 546*

RESULTS

The 19 practices had a total list size of approximately 121 000, with 36 546 patients aged ≥50 years. Median list size was 5200 (ranging between <2000 and >12 000). Age structure closely matched that of the UK population and all quartiles of the English Index of Multiple Deprivation were represented. Based on the Super Output Areas of the practice postcodes, the coronary heart disease standardised mortality ratios ranged from 74 to 110.

Altogether, 5.9% of the population aged ≥50 years were identified as aged 50–74 years and with ≥20% cardiovascular disease risk based on existing data; 26.4% were aged 50–74 years and possibly at risk, but some risk-factor information was missing, and 9.2% aged over 50 years (no upper age limit) were already diagnosed with cardiovascular disease or with diabetes, but had a total serum cholesterol or blood-pressure measurement out of the QOF audit target range for the relevant group (Table 1). Some patients identified were already on treatment for at least one risk factor but remained at ≥20% estimated risk, with the potential in some cases to benefit from further risk reduction.

DISCUSSION

Summary of main findings

This study demonstrates that primary care data may be combined with practice-based software to identify individuals at risk of cardiovascular disease. Around 6% of the population aged ≥50 years and <75 years, appears to be at raised risk (≥20%)

based on existing data. In some cases, raised risk was only apparent when a number of factors were combined, demonstrating the potential for the software to assist practitioners in determining actual risk (Box 1, Case 1).

Strengths and limitations of the study

This survey involved a range of practices from urban, suburban, and rural environments, and used 'live' data collected during routine practice. However, there are a number of problems with this approach: pre-treatment values of blood pressure and lipids are not always available, and e-Nudge uses the most recent values; risk may be underestimated in some cases as the Framingham risk equation, on which the e-Nudge is based, should ideally use pre-treatment values; as a case-finding tool, this limitation increases its specificity at the expense of some sensitivity.

The e-Nudge tool is designed to assist practice teams that may then assess individual risk based on the broader context, including risk factors such as ethnicity, obesity, waist circumference, family history, and deprivation. An age cut-off of 50 years was chosen for the e-Nudge randomised controlled trial,[7] as the outcomes will include cardiovascular events that are more common above this age; this threshold was used in the current survey. If patients aged 40–49 years, who are at lower overall risk, were included, the number of patients requiring intervention would increase, although the proportion of the population that was identified would fall.

Unknown diabetes status accounts for the relatively high number of people that were identified with no recent glucose value on record but who would get a high Framingham risk score if a positive input was assumed for their diabetes status. This is a pragmatic manoeuvre to avoid identifying the entire population of those aged ≥50 years who have no recent blood–glucose level on record, many of whom will be at low estimated risk. This compromise allows a user of e-Nudge to identify the patients most likely (from a cardiovascular disease risk-profiling perspective) to benefit from blood glucose testing. The use of 'assumed' values for missing data is a common technique but may have a significant detrimental effect on the effectiveness of a screening programme.[10]

There are also problems with basing risk calculations on single risk-factor values. Although e-Nudge uses an average of up to three systolic blood-pressure measurements, it uses only single values for cholesterol levels (as commonly occurs in clinical practice). At the 20% threshold, 95% confidence intervals for cholesterol values may produce a range of risk estimates from 14% to 26%.[11]

Comparison with existing literature

Studies using cardiovascular disease risk algorithms applied to primary care data include those of Muir *et al*,[12] Mitchell *et al*,[13] and Marshall.[14] However, all of these studies used data collected before the introduction of the QOF, which led to a widespread standardisation of electronic coding of cardiovascular risk factors. More recently, a new cardiovascular risk algorithm (QRISK) has been developed based on this approach.[15] This study by Hippisley-Cox *et al* found that 13% of the 35–74-year-old age group would be at ≥20% risk according to the Framingham algorithm. This is a higher figure than the 6% found in the present study, mainly because the QRISK figure (using a different denominator population) includes those patients with substituted values for missing risk-factor data. The figure in the present study for the 'incomplete data but potentially at risk' group

Box 1. Vignettes of patients at risk of cardiovascular disease.

- Case 1
  - A 50-year-old male
  - Smoker
  - Average of recent systolic blood pressures = 140 mmHg
  - Total cholesterol = 4.6 mmol/l
  - High-density lipoprotein (HDL) cholesterol = 0.8 mmol/l

  This person has modifiable risk factors: as well as help with stopping smoking, his cholesterol ratio might be improved through drug therapy and dietary advice. However, he might be difficult to spot as 'at-risk of cardiovascular disease' without help from the software, as his blood pressure and total cholesterol are not particularly high.
- Case 2
  - A 74-year-old male
  - Non-smoker
  - Average of recent systolic blood pressures = 145 mmHg
  - Total cholesterol = 5.2 mmol/l
  - HDL cholesterol = 1.3 mmol/l

  It will be more difficult to modify this patient's risk, as his age is a significant factor. However, his blood pressure might justify treatment under current guidelines if it remains in the range 140–159 mmHg, and his lipid profile might also be further improved.

Either of these people might benefit from modification of the other factors not included in the risk algorithm, such as physical activity, weight, and waist circumference. Both justify low-dose aspirin therapy.

(26.4%) is higher because of the 'uncertain diabetes status' described above.

Implications for future research and clinical practice

Current guidelines recommend that those with a ≥20% 10-year risk of cardiovascular disease should be treated and followed up with a similar priority to those with established disease.[2] For every individual with complete risk-factor information, there are perhaps four or five in the practice who would require further data collection. This additional investigation implies a considerable resource commitment, although risk stratification might optimise this process.[14]

Individuals identified include those whose risk is difficult to modify (Box 1, Case 2). At the same time, secondary prevention patients with uncontrolled but more clearly modifiable risk factors are also easy to identify. Such patients are already labelled with a significant medical problem and are usually already used to taking drug therapy. It is hoped that the current randomised controlled trial of the e-Nudge software[8] will provide further evidence on the feasibility of primary cardiovascular disease prevention as part of routine care in UK general practice.

Funding body

This study was supported by a Department of Health PhD Studentship through Warwick Medical School

Ethical approval

Ethical approval was granted by Warwickshire LREC, reference 05/Q2803/85

Competing interests

The authors have stated that there are none.

Acknowledgements

We thank all the practice teams participating in the 'e-Nudge' trial for their support during this research, and to the primary care trusts of Warwickshire and Coventry. We are also grateful to Ranjit Lal and Nigel Stallard for statistical advice, and to EMIS for programming the study software

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REFERENCES

1. Williams B, Poulter NR, Brown MJ, *et al*. Guidelines for management of hypertension: report of the fourth working party of the British Hypertension Society, 2004-BHS IV. *J Hum Hypertens* 2004; **18(3):** 139–185.
2. JBS 2. Joint British Societies' guidelines on prevention of cardiovascular disease in clinical practice. *Heart* 2005; **91(Suppl 5):** v1–v52.
3. National Institute for Health and Clinical Excellence. *Statins for the prevention of cardiovascular events in patients at increased risk of developing cardiovascular disease or those with established cardiovascular disease. Technology appraisal TA094*. London: NICE, 2006.
4. British Medical Association. *Quality and Outcomes Framework guidance.* London: BMA, 2006.
5. Bonneux L. Cardiovascular risk models. *BMJ* 2007; **335(7611):** 107–108.
6. Mangin D, Sweeney K, Heath I. Preventive health care in elderly people needs rethinking. *BMJ* 2007; **335(7614):** 285–287.
7. Anderson KM, Odell PM, Wilson PW, Kannel WB. Cardiovascular disease risk profiles. *Am Heart J* 1991; **121(1 Part 2):** 293–298.
8. Holt TA, Thorogood M, Griffiths F, Munday S. Protocol for the 'e-Nudge trial': a randomised controlled trial of electronic feedback to reduce the cardiovascular risk of individuals in general practice. *Trials* 2006, **7:** 11. http://www.trialsjournal.com/content/7/1/11 (accessed 21 Apr 2008).
9. Department of Health. *Health Survey for England 2003. Volume 2: Risk factors for cardiovascular disease*. London: Department of Health, 2003. http://www.dh.gov.uk/assetRoot/04/09/89/11/04098911.pdf (accessed 21 Apr 2008).
10. Reynolds TM, Twomey PJ, Wierzbicki AS. Concordance evaluation of coronary risk scores: implications for cardiovascular risk screening. *Curr Med Res Opin* 2004; **20(6):** 811–818.
11. Reynolds TM, Twomey PJ, Wierzbicki AS. Accuracy of cardiovascular risk estimation for primary prevention in patients without diabetes. *J Cardiovasc Risk* 2002; **9(4):** 183–190.
12. Muir J, Fuller A, Lancaster T. Applying the Sheffield tables to data from general practice. *Br J Gen Pract* 1999; **49(440):** 217–218.
13. Mitchell E, Sullivan F, Grimshaw JM, *et al.* Improving management of hypertension in general practice: a randomised controlled feedback derived from electronic patient data. *Br J Gen Pract* 2005; **55(511):** 94–101.
14. Marshall T. The use of cardiovascular risk factor information in practice databases: making the best of patient data. *Br J Gen Pract* 2006; **56(529):** 600–605.
15. Hippisley-Cox J, Coupland C, Vinogradova Y, *et al.* Derivation and validation of QRISK, a new cardiovascular disease risk score for the United Kingdom: prospective open cohort study. *BMJ* 2007; **335(7611):** 136.