

Invited debate

NHS Health Checks—a naked emperor?

Simon Capewell¹, Margaret McCartney², Walter Holland³

¹Department of Public Health and Policy, Institute of Psychology, Health and Society, University of Liverpool, Whelan Building, Quadrangle, Liverpool L69 3GB, UK

²Glasgow, Scotland

³London School of Economics, London, UK

Address correspondence to Simon Capewell, E-mail: capewell@liv.ac.uk

Introduction

We briefly review here the evidence that the NHS Health Checks (NHSHC) programme represents an ineffective strategy and is currently wasting scarce resources.

The NHSHC programme invites everyone in England aged 40–74 without cardiovascular disease (CVD) for a check every 5 years. The NHSHC website advertises that health checks can

- prevent heart disease, diabetes, kidney disease stroke and dementia,
- provide support and advice to help individuals manage and reduce their risk of future disease.¹

However, the NHSHC programme fails to achieve both of these primary objectives. Furthermore, it relies on weak concepts, denies strong scientific counter-evidence and ignores persistent implementation issues.

The 10 World Health Organization (WHO) Screening Criteria have been evaluated and refined over four decades.² They remain a valuable test of any screening proposal (Table 1). This is crucial, because all screening has the potential for harm, and screening science can be counterintuitive.³ The NHSHC programme can be assessed against each of the 10 WHO Criteria. These cover the disease targeted, the test used and the treatment programme. We assess each of these areas in turn and whether NHSHC pass or fail on each criterion.

The disease(s) targeted

Criterion 1. The condition should be an important health problem (pass).

Criterion 2. There should be a recognizable latent or early symptomatic stage (pass).

Criterion 3. The natural history of the condition including development from latent to declared disease should be adequately understood (pass).

NHSHC clearly satisfy all three disease-based screening criteria. CVD, diabetes, dementias and other non-communicable diseases together account for some 80% of deaths and disability in the UK. All have potentially reversible latent or early stages (even some dementia). Furthermore, these diseases all share the same four major risk factors: poor diet, tobacco, alcohol and physical inactivity.⁴ However, the NHSHC programme fails all but one of the remaining WHO screening criteria.

The tests used

The NHSHC programme fails all but one of these specific WHO screening criteria: test suitability, test acceptability, continuous case finding and facilities being available (Criteria 4–7, Table 1).

Criterion 4. Test suitability (fail).

An individual patient's likelihood of future cardiovascular and related disease is usually assessed by a GP or practice nurse. This likelihood is estimated using a global risk score (most commonly QRISK in England, sometimes ASSIGN in Scotland).¹ While population prediction may be useful, prediction for an individual is imprecise. These scores have frustratingly low sensitivity and specificity for the individual patient. Most current risk calculators miss over one-third of people who subsequently have a heart attack or stroke.⁵ Indeed, that mismatch between predicted and actual events might approach 50%.⁶

Criterion 5. Test acceptability (fail).

Low acceptability of NHS Health Checks is suggested by the persistently low attendance rates (in spite of diverse stratagems tried since 2009). Uptake (proportion of eligible individuals offered who received) averages <50% of a target population. This is often even lower in young men,

Simon Capewell, Chair of Clinical Epidemiology

Margaret McCartney, General Practitioner

Walter Holland, Emeritus Professor of Public Health

Table 1 WHO classic screening criteria²

Disease	
1.	The condition should be an important health problem
2.	There should be a recognizable latent or early symptomatic stage (originally Criterion 4)
3.	The natural history of the condition including development from latent to declared disease should be adequately understood (originally Criterion 7)
Test	
4.	There should be a suitable test or examination
5.	The test should be acceptable to the population
6.	Case finding should be a continued process and not a 'once and for all' project (originally Criterion 10)
7.	Facilities for diagnosis and treatment should be available (originally Criterion 3)
Treatment	
8.	There should be an accepted and acceptable treatment for patients with the recognized disease (originally Criterion 2)
9.	There should be an agreed policy on who to treat as patients
10.	Cost-effectiveness: the cost of case finding, diagnosis and treatment should be economically balanced in relation to possible total expenditure on medical care (originally Criterion 9) (the original WHO list has been reordered according to Disease, Test and then Treatment)

smokers and some ethnic minority groups, and routinely much lower in deprived areas.⁷ These factors may potentially widen inequalities.

Criterion 6. Case finding should be a continuing process, not a 'once and for all' (fail).

Much risk management is already being done opportunistically for many patients by GPs in the course of normal consultations. Resourcing a separate NHSHC programme might therefore have unintended consequences in terms of changing the content of consultations in primary care. Additionally resources will inevitably be sometimes spent on replicating tests already done in general practice.^{3,8}

Criterion 7. Facilities for diagnosis and treatment are available (pass).

This is technically correct for CVD though less so for dementia. However Criterion 7 is rapidly superseded by Criteria 8, 9 and 10 discussed below.

The treatment programme

The NHSHC programme fails all but one of these WHO screening criteria for treatment: acceptability, eligibility and, crucially, cost-effectiveness.

Criterion 8. There is an accepted and acceptable treatment (fail).

This criterion may be considered in two parts—for individuals and for populations—and we consider these in turn.

Treatment effectiveness in individuals

Health checks have been repeatedly shown to be ineffective. Three decades of randomized trials were critically appraised in a recent Cochrane systematic review.⁹ The review team found no evidence that general health checks could reduce morbidity or mortality, although they did increase the number of diagnoses.⁹ Some critics argue about whether the diverse screening interventions in previous studies were fairly compared with those in the NHSHC programme. However, the recent Inter-99 trial used very similar interventions, and again showed no benefit.¹⁰ Similarly, screening for diabetes in high-risk groups in the UK does not significantly reduce mortality or morbidity.¹¹ Interestingly, Public Health England (PHE) have avoided committing to any future randomized controlled trial to effectively evaluate NHSHC.¹² Yet all the other research designs proposed will be notable to adequately evaluate the programme.

The overall ineffectiveness of the NHSHC is perhaps less surprising when one appreciates the weakness of its constituent interventions: advice plus primary prevention medications. Advice and short-term behavioural interventions generally have little medium or long-term benefits.^{13,14} The happy exception to this rule is smoking cessation advice and support to quit.¹⁵

Preventive medications for blood pressure have only modest benefits. The largest meta-analyses, performed for the Health Technology Assessment Programme, suggested that relative mortality risk is reduced by only 10–15%.¹⁶ The absolute risk reduction is small and the vast majority of people taking this medication will thus not benefit. Furthermore, overtreatment of blood pressure has resulted in people taking ineffective medications and yet still suffering the burden of side effects and harm. These medication side effects can be substantial including, notably, fatigue and lethargy, dizziness, impotence, diabetes and falls.¹⁷

A similar problem exists with preventive medications for elevated cholesterol levels. Statins have minimal mortality benefits in low-risk individuals. Abramson and colleagues used data presented in the 2012 Cholesterol Treatment Trialists' (CTT) patient level meta-analysis. Their calculations suggested that statin therapy might prevent one serious cardiovascular event per 140 low-risk people (5-year risk <10%) treated for 5 years. But more importantly, statin therapy in low-risk people does not reduce all-cause mortality.^{18,19}

Statin side effects are common. These side effects range from minor and reversible to serious and irreversible. Many

substantially reduce the patient's quality of life—notably muscle aches (and occasional myotoxicity), non-specific malaise, fatigue, cataracts, impotence, mood disorders and poor concentration.²⁰ There also appears to be an increased risk of diabetes.^{21,22} Thus in the real world, over half the individuals started on statins for primary prevention discontinue them within 12 months.^{23,24}

The wide ranges of side effect incidence rates quoted also highlight continuing uncertainties.²⁵ Presenting this conflicted information to patients to allow shared decision making can therefore be problematic. This becomes particularly relevant when statins are used in people at 'low risk'.²⁶ Investing so much resource in an intervention that is unacceptable to so many looks like a 'high-risk strategy'.

Treatment effectiveness in populations

The potential effectiveness of NHSHC also remains disappointingly modest when these individual benefits are extrapolated to entire populations. In 2008, Department of Health modelling estimated that the NHSHC scheme, when fully operational, seeing some five million patients per year, might postpone ~650 CVD deaths per year in the UK population. The modellers assumed that two or three times as many non-fatal events might also be prevented.²⁶ Recently, PHE arbitrarily increased this mortality reduction estimate from 650 to 2000 pa²⁷ (the full workings remain unpublished). Sadly, the true mortality reduction may soon be only half that estimate—perhaps only 1000 fewer deaths annually. This is because the long-standing and recent steep falls in UK CVD mortality rates are set to continue; perhaps 50 or 60% lower mortality by 2030.²⁸ Thus, year on year, there will be substantially fewer CVD deaths to potentially prevent.

Criterion 9. There should be an agreed policy on whom to treat as patients (debatable pass/fail).

Eligibility is problematic. In 2014, NICE controversially recommended reducing the treatment threshold to prescribe statins to individuals with a 10% 5-year event risk (previously 20%).²⁹ This was widely challenged. Indeed, some scientists and patient champions remain deeply sceptical of both the science³⁰ and of the process.^{31,32} The potential reputational costs to scientists and clinicians are discussed below.

Criterion 10. Cost-effectiveness (fail).

The NHSHC scheme is ineffective and costly. Let us first consider the fiscal costs to taxpayers, patients and the NHS.

Then the non-fiscal costs to current and future patients, professionals and politicians in the UK and beyond.

Financial costs to the UK taxpayer

The annual cost of the fully operational scheme was originally estimated at £350 million in 2008.^{26,27} Seven years later in 2015, this might well be closer to £450 million per year. Thus, preventing 1000 deaths annually could cost up to £450 000 per death avoided (£450 m/1000 deaths). And costs will obviously spiral substantially now that NICE have roughly doubled the number of potentially eligible people.²⁹ These high costs are rarely acknowledged and often dismissed. They also make the much quoted NICE estimate of 'around £3000 per QALY' look rather fanciful.^{33,34}

Financial costs to patients

Life insurance premiums are increased as a consequence of being prescribed statins or anti-hypertensive medications.

NHS resource costs

Health care professionals, services and local authorities are all mandated to implement NHSHCs. In spite of austerity policies, they are required to commit time and scarce resources to activities of debatable effectiveness and cost-effectiveness, plus needing to follow up all these additional medicalized patients. Thus, the South East London Study estimated that if multiphasic screening were introduced to the NHS its costs would increase by 10% with no reduction in mortality or morbidity.³⁵ This saps morale, particularly considering the substantial opportunity costs of failing to invest those scarce resources in alternative, more effective interventions. For instance, many child and maternal health interventions are proven to be cost-saving.^{36,37}

Costs to the patient–doctor relationship

The NHSHC programme consistently overpromises and consistently fails to outline the downsides, uncertainties and potential harms of screening. Furthermore, patient consent is simply not adequate. Individuals are given conflicting messages in the adverts, media messages and leaflets. For example, potential patients are told they can have 'more time with the grandchildren'. Yet, people are not given the information which should now be standard in screening invitations, for example information on potential harms and potential benefits, described in a way in which readers can assess (including pictorial depictions).^{3,8} Patients may also be misled by this process. For example, one study found that patients on statins eat more

fat and calories, and gain weight faster, than people not taking them, possibly because statins offered ‘false reassurance’.³⁸

Costs through ‘medicalization’

Overnight, the previously ‘healthy’ person becomes a patient. This medicalization can have substantial negative effects, notably anxiety.³⁹ Furthermore, the ‘patient’ label may remain for the rest of their life. These concerns about the personal costs of medicalization are very real, and potentially very powerful. But, they are too often downplayed or dismissed.⁴⁰ Medical primary prevention also remains highly lucrative for industry. The pharmaceutical industry provides generous funding to friendly clinicians, and lobbies hard to win political support for interventionist policies.⁴¹

Reputational costs to scientists and clinicians

Arguments have played out between groups believing more statin prescriptions will save lives versus others who are concerned about the apparent ineffectiveness and potential harms of this policy. This debate has highlighted the lack of evidence based, fair information for patients and families. Champions of NHSHC, and particularly of statins for primary prevention, have become increasingly visible following the controversial NICE threshold reduction from 20 to 10%.²⁹ Conversely, the statin sceptics have highlighted the weak scientific evidence³⁰ and potential for conflicts of interest.^{31,32,42}

Costs to current and future generations

The burden of childhood and adult obesity and diabetes is rapidly growing. Multinational corporations continue to make huge profits from junk food and sugary drinks, yet marketing and sales in the UK remain essentially unregulated.^{43–45} In this context, NHSHC are a distraction, allowing the epidemic to be characterized as one of individual behavioural choice rather than the consequence of an obesogenic environment.

Global costs

As a ‘health care exemplar’, the UK influences prevention strategies around the world. Indeed, CVD risk assessment programmes have now become WHO policy.⁴⁶ NHSHC may be uncritically adopted by very different countries. Healthcare systems are much more limited in low income countries. Thus the opportunity costs will be even greater, taking scarce resources from essential services.

Social costs: increasing inequalities

NHSHC are now mandatory, which means that doctors and nurses are obliged to perform screening on those who attend for health check-ups (particularly the affluent well). Less time

and fewer appointments are, therefore, available for deprived individuals and people with symptoms. This will clearly promote socioeconomic inequalities.^{47,48} Such inequalities have clearly been demonstrated in screening, dietary advice, smoking cessation, statin prescribing, anti-hypertensive prescribing and subsequent medication adherence.⁴⁸

Costs of deceiving the British people

The alternative approach to NHSHC is population-wide prevention policies. Many such policies are powerful, rapid, equitable and cost saving,^{49–51} for example, legislation supporting smoke-free public spaces or plain packs, alcohol minimum unit pricing, banning dietary trans-fats or slashing the daily dietary intake of salt or sugar. Furthermore, effective strategies promoting healthy food have the potential to halve the burden of premature CVD.⁵² Many previous policy successes have been based on lessons learned from the tobacco control ‘3As’ model, prioritizing affordability, availability and acceptability. Thus, UK smoking prevalence has been slashed from 70 to 20% in just four decades (thanks mostly to the ‘3As’, rather than to medical interventions).¹⁵

Conclusions

We believe that many of our colleagues in the Department of Health, Public Health England and NHS England privately agree that NHSHC are costly and ineffective. However, as civil servants they are obliged in public to ‘toe the party line’. Lacking an independent voice, they must be seen to support ministers even when the scientific evidence points in the opposite direction – they are obliged to see the Emperor’s clothes where none exist.

This dominance of political obedience over scientific objectivity is hazardous, and that hazard is manifest in the continuing flawed NHSHC strategy for CVD prevention which, we argue, is resulting in many thousands of avoidable deaths every year.^{53,54}

This is but one example of why Britain urgently needs an independent Institute of Public Health, as enjoyed, for instance, in Finland and the Netherlands.^{55,56} Only then will ministers receive objective, scientific advice on public health. The British people deserve no less.

Editor’s Note

This article is part of an invited, non-peer-reviewed debate.

Acknowledgements

We thank Ann Capewell for very helpful suggestions.

Funding

No external funding.

Provenance and peer review

Commissioned; not externally peer reviewed.

Conflict of Interest statement

None declared.

References

- NHS Health Checks. *Public Health England*. <http://www.healthcheck.nhs.uk/> (21 April 2015, date last accessed).
- Wilson JMG, Jungner G. Principles and Practice of Screening for Disease. WHO Chronicle Geneva: World Health Organization. Public Health Papers, #34, 1968, 22(11), 473 p. http://www.nature.com/gim/journal/v15/n3/fig_tab/gim2012176t1.html (11 May 2015, date last accessed)
- McCartney M. Where's the evidence for NHS health checks? *BMJ* 2013;**347**:f5834.
- Global Burden of Metabolic Risk Factors for Chronic Diseases Collaboration. Cardiovascular disease, chronic kidney disease, and diabetes mortality burden of cardiometabolic risk factors from 1980 to 2010: a comparative risk assessment. *Lancet Diabetes Endocrinol* 2014;**2**(8):634–47. Epub 2014 May 16.
- Collins GS, Altman DG. An independent external validation and evaluation of QRISK cardiovascular risk prediction: a prospective open cohort study. *BMJ* 2009;**339**:b2584.
- Jackson R, Marshall R, Kerr A *et al*. QRISK or Framingham for predicting cardiovascular risk? *BMJ* 2009;**339**:b2673.
- Public Health Outcomes Framework. <http://www.phoutcomes.info/public-health-outcomes-framework#gid/1000042/pat/6/ati/102/page/0/par/E12000002/arc/E08000012> (21 April 2015, date last accessed).
- McCartney M. NHS Health Check betrays the ethos of public health. *BMJ* 2014;**349**:g4752.
- Krogstøll LT, Jørgensen KJ, Grønhoj Larsen C *et al*. General health checks in adults for reducing morbidity and mortality from disease. *Cochrane Database Syst Rev* 2012;**10**:CD009009.
- Jørgensen T, Jacobsen RK, Toft U *et al*. Effect of screening and lifestyle counselling on incidence of ischaemic heart disease in general population: Inter99 randomised trial. *BMJ* 2014;**348**:g3617.
- Simmons RK, Echouffo-Tcheugui JB, Sharp SJ *et al*. Screening for type 2 diabetes and population mortality over 10 years (addition-Cambridge): a cluster-randomised controlled trial. *Lancet* 2012;**380**:1741–8.
- Public Health England. NHS health check: our approach to the evidence, 2013. www.gov.uk/government/uploads/system/uploads/attachment_data/file/224537/NHS_Health_Check_our_approach_to_the_evidence_v2.pdf (21 April 2015, date last accessed).
- Booth HP, Prevost TA, Wright AJ *et al*. Effectiveness of behavioural weight loss interventions delivered in a primary care setting: a systematic review and meta-analysis. *Fam Pract* 2014;**31**:6. <http://fampra.oxfordjournals.org/content/early/2014/10/08/fampra.cmu064.long> (11 May 2015, date last accessed).
- Heath GW, Parra DC, Sarmiento OL *et al*. Evidence-based intervention in physical activity: lessons from around the world. *Lancet* 2012;**380**(9838):272–81. <http://www.ncbi.nlm.nih.gov/pubmed/22818939> (11 May 2015, date last accessed).
- Royal College of Physicians of London. Fifty Years Since Smoking and Health. <https://www.rcplondon.ac.uk/resources/fifty-years-smoking-and-health> (21 April 2015, date last accessed).
- Law M, Wald N, Morris J. Lowering blood pressure to prevent myocardial infarction and stroke: a new preventive strategy. *Health Technol Assess* 2003;**7**(31).
- Diao D, Wright JM, Cundiff DK *et al*. Pharmacotherapy for mild hypertension. *Cochrane Database Syst Rev* 2012;**8**:CD006742.
- Ray KK, Seshasai SR, Erqou S *et al*. Statins and all-cause mortality in high-risk primary prevention: a meta-analysis of 11 randomized controlled trials involving 65 229 participants. *Arch Intern Med* 2010;**170**(12):1024–31.
- Abramson JD, Rosenberg HG, Jewell N *et al*. Should people at low risk of cardiovascular disease take a statin? *BMJ* 2013;**347**:f6123.
- Bang CN, Okin PM. Statin treatment, new-onset diabetes, and other adverse effects: a systematic review. *Curr Cardiol Rep* 2014;**16**(3):461.
- Currie O, Mangin D, Williman J *et al*. The comparative risk of new-onset diabetes after prescription of drugs for cardiovascular risk prevention in primary care: a national cohort study. *BMJ Open* 2013;**3**:e003475.
- Bell DSH, DiNicolantonio JJ, O'Keefe JH. Is statin-induced diabetes clinically relevant? A comprehensive review of the literature. *Diabetes Obes Metab* 2014;**16**(8):689–94.
- Davidson MH, Sun SX, Nag SS *et al*. Risk factors for discontinuation of statin medications: evidence from a large National Pharmacy Claims database. *Circulation* 2007;**116**:II847.
- Lewey J, Shrank WH, Bowry AD *et al*. Gender and racial disparities in adherence to statin therapy: a meta-analysis. *Am Heart J* 2013;**165**:665–678.e1.
- Hawkes N. Two papers in the BMJ with statin side effect errors shouldn't be retracted, independent panel concludes. *BMJ* 2014;**349**:g4993.
- Department of Health. *Putting Prevention First. Vascular Checks Risk Assessment and Management Impact Assessment*. London: DH, 2008. http://webarchive.nationalarchives.gov.uk/+www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_090351 (11 May 2015, date last accessed).
- Public Health England Annual Report and Accounts 2013/14. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/325522/PHE_Annual_Report_and_Accounts_2013_to_2014.pdf (21 April 2015, date last accessed).
- Guzman Castillo M, Gillespie D, Allen K *et al*. Future declines of Coronary Heart Disease mortality in England and Wales could counter the burden of population ageing. *BMJ Open* 2015;**5**:e006070.
- NICE. *Lipid Modification 2014*. www.nice.org.uk/nicemedia/live/13637/66549/66549.pdf (21 April 2015, date last accessed).
- McPherson K. NICE on statins: concerns about the latest NICE draft guidance on statins. *BMJ* 2014;**349**:g4130.

- 31 Harcombe Z. *NICE Has Ended Any Debate About Its Independence*. 2014. <http://www.zoeharcombe.com/2014/07/nice-has-ended-any-debate-about-its-independence/> (21 April 2015, date last accessed).
- 32 Ungoed-Thomas J. Statins expert 'failed to declare' drugs firm link. *Sunday Times*, 12 October 2014. http://www.thesundaytimes.co.uk/sto/news/uk_news/Health/article1470266.ece (11 May 2015, date last accessed).
- 33 National Institute for Health and Clinical Excellence. *Matrix. Economic Analysis of Interventions to Improve the Use of Statins Interventions in the General Population 08 May 2008*. <https://www.nice.org.uk/guidance/ph15/evidence/ph15-identifying-and-supporting-people-most-at-risk-of-dying-prematurely-supporting-evidence4> (21 April 2015, date last accessed).
- 34 Mitchell AP, Simpson RJ. Statin cost effectiveness in primary prevention: a systematic review of the recent cost-effectiveness literature in the United States. *BMC Res Notes* 2012;**5**:373.
- 35 The South-East London Screening Study GroupHolland WW, Creese AL *et al*. A controlled trial of multiphasic screening in middle-age: results of the South-East London Screening Study. *Int J Epidemiol* 1977;**6**(4):357–63.
- 36 Neumann P, Cohen J. *NEJM Perspective on "The Cost-Effectiveness of Environmental Approaches to Disease Prevention" The CEA Registry Blog* Julby CEA Registry Team 7/26/2012. <https://research.tufts-nemc.org/cear4/Resources/CEARegistryBlog/tabid/69/EntryId/246/NEJM-Perspective-on-The-Cost-Effectiveness-of-Environmental-Approaches-to-Disease-Prevention.aspx> (21 April 2015, date last accessed).
- 37 Report of the Secretary-General A/64/665. Keeping the Promise—A Forward-Looking Review to Promote an Agreed Action Agenda to Achieve the Millennium Development Goals by 2015. <http://www.preventionweb.net/english/professional/publications/v.php?id=13841> (21 April 2015, date last accessed).
- 38 Sugiyama T, Tsugawa Y, Tseng C-H *et al*. Different time trends of caloric and fat intake between statin users and nonusers among US adults glutony in the time of statins? *JAMA Intern Med* 2014;**174**(7):1038–45.
- 39 Moynihan R, Heath I, Henry D. Commentary: medicalisation of risk factors—selling sickness, the pharmaceutical industry and disease mongering. *BMJ* 2002;**324**:886.
- 40 Armitage J, Baigent C, Collins R. Misrepresentation of statin safety evidence. *Lancet* 2014;**384**(9950):1263–4.
- 41 Wright O. Revealed: Big Pharma's hidden links to NHS policy, with senior MPs saying medical industry uses 'wealth to influence government'. *Independent*, 11 Feb 2014. <http://www.independent.co.uk/news/uk/politics/revealed-big-pharma-links-to-nhs-policy-with-senior-mps-saying-medical-industry-uses-wealth-to-influence-government-9120187.html> (11 May 2015, date last accessed).
- 42 Harcombe Z. *It's Not About Statins—It's About Censorship*. Blog, May 19, 2014. <http://www.zoeharcombe.com/2014/05/its-not-about-statins-its-about-censorship/> (11 May 2015, date last accessed).
- 43 Khomami N. Welcome to the Coca-Cola London Eye. .but health charities are already seeing red. *The Observer*, Sunday 18 January 2015. <http://www.theguardian.com/business/2015/jan/18/coca-cola-london-eye-charity-anger> (11 May 2015, date last accessed).
- 44 Moodie R, Stuckler D, Monteiro C *et al*. Profits and pandemics: prevention of harmful effects of tobacco, alcohol, and ultra-processed food and drink industries. *Lancet* 2013;**381**(9867):670–9.
- 45 Stuckler D, Nestle M. Big food, food systems, and global health. *PLoS Med* 2012;**9**(6):e1001242.
- 46 Bonita R, Magnusson R, Bovet P *et al*. Country actions to meet UN commitments on NCDs: a stepwise approach. *Lancet* 2013;**381**(9866):575–84.
- 47 Capewell S. BMJ head to head. Will screening individuals at high risk of cardiovascular events deliver large benefits? *BMJ* 2008;**337**:a1395.
- 48 Capewell S, Graham H. Will cardiovascular disease prevention widen health inequalities? *PLoS Med* 2010;**7**(8):e1000320.
- 49 NICE. Prevention of Cardiovascular Disease. Public Health Guidance 25, 2010. www.nice.org.uk/nicemedia/live/13024/49273/49273.pdf (21 April 2015, date last accessed).
- 50 Barton P, Andronis L, Briggs A *et al*. Effectiveness and cost-effectiveness of cardiovascular disease prevention in whole populations: modelling study. *BMJ* 2011;**343**:d4044.
- 51 Vos T, Carter R, Barendregt J *et al*. Assessing Cost-Effectiveness in Prevention (ACE-Prevention): Final Report. University of Queensland, Brisbane and Deakin University, Melbourne.
- 52 Mozaffarian D, Capewell S. United Nations dietary policies to prevent cardiovascular disease. Modest diet changes could halve the global burden. *BMJ* 2011;**343**:d5747.
- 53 O'Flaherty M, Flores-Mateo G, Nnoaham K *et al*. Estimating potential cardiovascular mortality reductions with different food policy options in the UK. *WHO Bull* 2012;**90**:522–31.
- 54 Scholes S, Bajekal M, Norman P *et al*. Quantifying policy options for reducing future coronary heart disease mortality in England: a modelling study. *PLoS One* 2013;**8**(7):e69935.
- 55 International Evaluation Group. Report of the international evaluation of the National Institute for Health and Welfare. http://www.stm.fi/c/document_library/get_file?folderId=9882185&name=DLFE-30827.pdf (21 April 2015, date last accessed).
- 56 Conceição C, Leandro A, McCarthy M. National support to public health research: a survey of European ministries. *BMC Public Health* 2009;**9**:203.