Impact case study (REF3b)

Institution: University of Nottingham

Unit of Assessment: UoA2

Title of case study: QRISK – a new cardiovascular risk score to identify patients at high risk of cardiovascular disease for prevention

1. Summary of the impact (indicative maximum 100 words)

QRISK is a new algorithm which predicts an individual's risk of cardiovascular over 10 years. It was developed using the QResearch database and is in routine use across the NHS. It is included in national guidelines from NICE and the Department of Health and in the GP quality and outcomes framework. It is incorporated into > 90% of GP computer systems as well as pharmacy and secondary care systems. The web calculator has been used >500,000 times worldwide. ClinRisk Ltd was incorporated in 2008 to develop software to ensure the reliable widespread implementation of the QRISK algorithm into clinical practice.

2. Underpinning research (indicative maximum 500 words)

Cardiovascular disease is a leading cause of morbidity and mortality worldwide. Clinicians need reliable information about an individual's risk of developing cardiovascular disease since interventions exist which can reduce risk of cardiovascular disease in individuals at high risk. Historical methods for quantifying cardiovascular disease risk were based on an American equation (Framingham) developed more than 20 years ago based on a study of white people from a small American town. Consequently the Framingham equation is not suitable for use in a contemporary ethnically diverse UK population as it doesn't reliably identify those at high risk and tends to over-predict risk in low risk individuals. New approaches to cardiovascular risk estimation were needed to take account of the characteristics of the population to which the tool should be applied and which can be updated over time as the population changes and national guidelines for prevention evolve. QRISK was therefore developed as a new approach to cardiovascular risk estimation. The research was led by Professor Julia Hippisley-Cox and Dr Carol Coupland and assisted by Ms Vinogradova from the University of Nottingham with collaborators from other institutions.

The new QRISK algorithm was developed using the QResearch database which is a large anonymised repository of electronic health records for medical research created as part of a not-for-profit partnership between the University of Nottingham and EMIS – a leading supplier of GP clinical computer systems in the UK (www.qresearch.org). The original QRISK algorithm was developed using health records from a cohort of 1.3 million adults aged 35-74 years from 318 general practices across the UK. A statistical model was developed to estimate associations between occurrence of cardiovascular disease during follow-up and a range of risk factors including age, sex, deprivation, smoking, cholesterol, blood pressure, treated hypertension, body mass index and family history. The model estimates were combined to give an algorithm for predicting absolute risk of cardiovascular disease at 10 years. The algorithm was validated in a separate validation cohort containing 610,000 people from 160 different practices. An updated algorithm QRISK2 was derived from a cohort of 1.5 million adults and incorporated additional terms for ethnicity, type 2 diabetes, rheumatoid arthritis, renal disease, and atrial fibrillation. It is the largest cardiovascular risk prediction study to date globally. Because it is derived from clinical information collected in primary care, rather than on a specially assembled research cohort, it is less likely to be affected by selection bias. It can be updated to reflect changes in populations, data quality and improvements in statistical methods.

Validation studies have shown that QRISK is more accurate than the Framingham score at assessing risk for UK individuals. QRISK has weightings for deprivation and ethnicity and so is less likely to under-estimate cardiovascular risk in high-risk patients and can therefore help avoid widening health inequalities. Unlike the Framingham score, QRISK does not over estimate risk in low-risk UK patients thereby avoiding unnecessary medication. Overall it is a more efficient tool for

the quantification of cardiovascular risk which is then used to guide treatment decisions.

3. References to the research (indicative maximum of six references)

The underlying research was the development and validation of the QRISK algorithm which was initiated and lead by Professor Julia Hippisley-Cox and Dr Carol Coupland from the University Nottingham in collaboration with colleagues from Bristol, Queen Mary's and Edinburgh University. The publications listed below include four in the BMJ which is one of the highest rated general medical journals internationally with an impact factor of > 14.

- Hippisley-Cox J, Coupland C, Vinogradova Y, Robson J, May M, Brindle P. Derivation and validation of QRISK, a new cardiovascular disease risk score for the United Kingdom: prospective open cohort study. BMJ 2007;335:136-41 doi:10.1136/bmj.39261.471806.55
- Hippisley-Cox J, Coupland C, Vinogradova Y, et al. Predicting cardiovascular risk in England and Wales: prospective derivation and validation of QRISK2. BMJ 2008:bmj.39609.449676.25 doi: 10.1136/bmj.39609.449676.25
- Hippisley-Cox J, Coupland C, Vinogradova Y, et al. Performance of the QRISK cardiovascular risk prediction algorithm in an independent UK sample of patients from general practice: a validation study. Heart 2008;94:34-39 doi: 10.1136/hrt.2007.134890
- Hippisley-Cox J, Coupland C, Robson J, et al. Derivation, validation, and evaluation of a new QRISK model to estimate lifetime risk of cardiovascular disease: cohort study using QResearch database. BMJ 2010;341:c6624 doi: http://dx.doi.org/10.1136/bmj.c6624
- Hippisley-Cox J, Coupland C. Unintended effects of statins in men and women in England and Wales: population based cohort study using the QResearch database. BMJ 2010;340:c2197 doi: 10.1136/bmj.c2197[published Online First: 21 May 2010]
- Hippisley-Cox J, Coupland C. Individualising the risks of statins in men and women in England and Wales: population-based cohort study. Heart 2010;96(12):939-47 doi: 10.1136/hrt.2010.199034 [published Online First: 20 May 2010]

4. Details of the impact (indicative maximum 750 words)

The assessment of individual patients is possible using a purpose designed publically available website www.qrisk.org which displays the patient's risk using approaches which the patient is likely to understand (smiley faces to represent absolute risk). The website is can be used by anyone to determine whether they are at high risk or not. QRISK is also integrated into another website as a decision aid (www.qintervention.org) which can be used to help determine how interventions may lower the risk. The QRISK web calculator is in constant use around the world with > 500,000 hits since 2011[1]. **www.qintervention.org website was rated by the Times as one of the top five medical Websites in 2013**[2]

Formation of ClinRisk Ltd
With the University's support, Julia Hippisley-Cox set up a company (ClinRisk Ltd) in 2008 to develop software to ensure the reliable and widespread implementation of the QRISK into clinical practice across the UK. ClinRisk has since developed the public facing website (www.qrisk.org) and software which integrates the algorithm into clinical computer systems. The University provided legal support to enable licensing of the algorithm, trademark and software to industry for use across the NHS. Since 2008, QRISK software has been licensed by a number of companies including the leading suppliers to primary and secondary care within the NHS.

Clinical utility of QRISK at population level

QRISK is also used to risk-stratify entire populations. The software, which is now embedded in > 90% of UK GP clinical computer systems, runs calculations every night which generate a rank-ordered list of those at high risk of heart disease or stroke. The software is used daily by clinicians during consultations with patients and as a risk stratification tool to identify patients for recall for further assessment. Patients at high risk of cardiovascular disease can therefore be identified and given interventions to lower risk where appropriate. Interventions include weight reduction,

smoking cessation, blood pressure lowering treatment and cholesterol lowering treatment.

The NHS Health Checks programme and Department of Health Policy
The NHS Health Checks Programme offers a cardiovascular risk assessment to adults aged 40-74 years in England. The Department of Health endorsed QRISK on publication and used it to develop the economic modelling underpinning the NHS Checks programme in 2008, recommending its use for the start of the programme in 2009[3].

Changes to NICE guidance and GP contract Quality and outcomes framework
Use of QRISK was ratified by NICE guidance in 2010[4,9]. A favourable independent appraisal of QRISK2 [8] and other risk prediction tools concluded that "QRISK emerges with the greatest potential. It is most likely to be sensitive to the equity issues of great current concern, it reflects best the contemporary British population and its initial results are encouraging. The uncertain approach of NICE's guideline development group illustrates how difficult it can be to judge how much evidence is needed before a change in practice can be recommended, but if QRISK lives up to its promise, it will in time become established as the risk assessment method of choice." Use of QRISK is also an integral part of the UK GP contract since vascular screening is one of the quality indicators for which GPs are paid. The new indicator for primary prevention of cardiovascular disease was introduced in 2010/11[5]

Implementation in NHS clinical computer systems
QRISK has now been implemented by all four major GP computer suppliers covering in excess of 90% of all UK general practice: EMIS (5500 general practices), InPractice Systems (1800 practices), The Phoenix Partnership (2000 practices) and Microtest (~300 practices). Other suppliers use QRISK in community and pharmacy contexts including Oskis, Wellpoint (kiosk/pharmacies), Telehealth (kiosk/pharmacies). These pharmacy and other community schemes use QRISK as part of the NHS Health Checks programme. QRISK is also available as an app for the iphone.

Clinical Beneficiaries
The main beneficiaries of QRISK are the patients whose risk is assessed more accurately, especially those high risk patients from ethnic minorities or deprived areas who would otherwise have missed out on effective treatments if the Framingham score had been used.
Other beneficiaries include clinicians using QRISK since it is better able to identify high risk patients than Framingham. Health care professionals can use the web interface to display an individual's risk of cardiovascular disease in a way which the patient is likely to understand thereby involving patients in decisions regarding their care. Clinical Commissioning Groups also benefit from the integrated automated electronic population tools which are efficient at identifying those at high risk and summarise the number of patients at high risk and those with modifiable risk factors.

Development of new technologies and approaches.
To our knowledge, QRISK is the first risk prediction tool to be developed using routinely collected electronic data from primary care medical records. It has stimulated development of a new research area resulting in other similar tools to predict risks of other major clinical diseases.

Application of new technologies into clinical practice
The integration of QRISK software into multiple clinical computer systems in a scalable, sustainable reliable way which can be regularly updated has also provided a model which can be extended to other preventable clinical conditions.

5. Sources to corroborate the impact (indicative maximum of 10 references)

1. Google Analytics report, which gives uses of the web calculator over the last 2 years, there have been 503,397 uses from 169 countries. A PDF of the report is available, with a map indicating international usage (PDF supplied).
2. The Times Newspaper - it was in the top 5 of the top '50 medical websites you can't live without' http://www.thetimes.co.uk/tto/technology/internet/article3668490.ece (PDF supplied).

3. Department of Health. NHS Health Check: Vascular Risk Assessment and Management Best Practice Guidance. In: Department of Health, ed. London, 2009 *(Chapter 1, pgs 2 & 4; Chapter 7, pgs 13-15; Chapter 11, pgs 25-26)* http://webarchive.nationalarchives.gov.uk/20130107105354/http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_097489 (PDF supplied)

4. National Institute for Clinical Excellence (NICE). Change to lipid modification guidance CG67. Secondary Change to lipid modification guidance CG67 2010. http://www.nice.org.uk/newsroom/news/ChangeToLipidModificationGuidelineCG67.jsp (Screenshot supplied)

5. National Institute for Clinical Excellence (NICE). Quality and Outcomes Framework: QRISK is included in the GP contract (also known as the "Quality and Outcomes Framework"). Quality and outcomes framework (QOF) indicator guidance: primary prevention of cardiovascular disease. Secondary Quality and outcomes framework (QOF) indicator guidance: primary prevention of cardiovascular disease 2011. http://bma.org.uk/-/media/Files/PDFs/Practical%20advice%20at%20work/Contracts/gpqofguidance20132014.pdf (PDF supplied)

6. External validation: Three studies undertaken by an independent team of Oxford academics which have validated the performance of QRISK on external datasets:
    a. Collins GS, Altman A. Predicting the 10 year risk of cardiovascular disease in the United Kingdom: independent and external validation of an updated version of QRISK2. BMJ 2012;344: e4181 doi:10.1136/bmj.e4181 http://www.bmj.com/highwire/filestream/590813/field_highwire_article_pdf/0/bmj.e4181.full.pdf (PDF supplied)
    b. Collins GS, Altman DG. An independent and external validation of QRISK2 cardiovascular disease risk score: a prospective open cohort study. BMJ 340: 340:c2442 doi:10.1136/bmj.c2442 http://www.bmj.com/highwire/filestream/362442/field_highwire_article_pdf/0/bmj.c2442 (PDF supplied)
    c. Collins GS, Altman DG. An independent external validation and evaluation of QRISK cardiovascular risk prediction: a prospective open cohort study. BMJ 2009;339:b2584 doi:10.1136/bmj.b2584 http://www.bmj.com/highwire/filestream/381004/field_highwire_article_pdf/0/bmj.b2584.full.pdf (PDF supplied)

7. Independent editorial by international expert, Professor Rod Jackson, New Zealand: Jackson R, Marshall R, Kerr A, et al. QRISK or Framingham for predicting cardiovascular risk? BMJ 2009;339:b2673 doi:10.1136/bmj.b2673 [published Online First: 7 July 2009] http://www.bmj.com/highwire/section-pdf/8958/1/1 (PDF supplied)

8. Independent appraisal of QRISK2 by PHG Foundation. *Dent T. Predicting the risk of Coronary Heart Disease with conventional genetic & novel molecular biomarkers. Cambridge: PHG Foundation for Genomics and Population Health, January 2010 ISBN 978-1-907198-02-1* http://www.phgfoundation.org/reports/5160/ (PDF supplied)

9. National Institute for Clinical Excellence (NICE). Lipid modification - Cardiovascular risk assessment and the modification of blood lipids for the primary and secondary prevention of cardiovascular disease. In: NICE, ed. London: NICE, 2008 (Revised March 2010) http://www.nice.org.uk/nicemedia/live/11982/40689/40689.pdf (PDF supplied)