Performance of the UKPDS Risk Engine and the Framingham risk equations in estimating cardiovascular disease in the EPIC-Norfolk cohort

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Background and aims: Individuals with type 2 diabetes have a 2 to 4 fold increased risk of cardiovascular disease (CVD) compared to those without diabetes. Multifactorial treatment can significantly reduce this risk. Multivariate equations such as Framingham are used to estimate CVD risk in order to target therapy to those at highest absolute risk, and to provide patients and practitioners with prognostic information. This study examines the performance of the UKPDS Risk Engine (version 3) and the Framingham risk equations in estimating CVD incidence in three population sub-groups: (i) individuals with known diabetes (DM); (ii) individuals with non-diabetic hyperglycaemia, defined as HbA_{1c} ≥6.0% (HG); and, (iii) individuals with HbA_{1c} < 6.0% (normoglycaemia) (NG).
Materials and methods: The data are from a population-based prospective cohort (EPIC-Norfolk). Participants aged 40-79 years recruited from UK general practices attended a health examination (1993-1998) and were followed for CVD events/death until April 2007. CVD risk estimates were calculated for 10,138 individuals with complete data on age, sex, ethnicity, smoking status, diabetes, total cholesterol, HDL-cholesterol, systolic blood pressure and HbA_{1c} using the UKPDS Risk Engine and Framingham CVD risk equation. Estimation of events by each score was compared using the area under the receiver operating characteristic curve (aROC) and the Net Reclassification Improvement (NRI) statistic.
Results: Over 10.5 years of follow-up there were 69 CVD events in the 272 individuals with diabetes, 160 in the 906 with non-diabetic hyperglycaemia and 732 in the 8,960 with normoglycaemia (Table 1). The estimated CVD 10-year risk in individuals with diabetes was 26% and 28% using the UKPDS and Framingham scores respectively. In the HG group, estimated CVD risk was 28% and 31% respectively, and for the NG group, 19% and 23% respectively. In the DM and HG groups, there was no significant difference in the ability of the two risk scores to either discriminate between or correctly reclassify individuals at different risk of CVD events (Table 1). The discrimination of both scores was poor in the NG group.
Conclusion: The UKPDS and Framingham risk equations perform reasonably well at estimating CVD risk in individuals with diabetes in EPIC-Norfolk. These scores can therefore assist with targeting of therapy to those at highest absolute risk. The UKPDS Risk Engine unsurprisingly overestimates risk in those without diabetes. The overestimates of risk in those without diabetes by the Framingham score confirm previous findings. Our results highlight that care is still needed when using scores to communicate risk information to individuals.

Table 1: Actual and estimated CVD risk using UKPDS and Framingham scores in EPIC-Norfolk

	Individuals with prevalent diabetes (n=272)	**Individuals with non-diabetic hyperglycaemia (n=906)**	**Normoglycaemic individuals(n=8,960)**
Actual mean CVD risk, %	25.4	17.7	8.2
Estimated CVD 10-yr risk: UKPDS score, % (95% CI)	26.4 (25.5 - 27.3)	27.5 (27.0 - 28.0)	19.2 (19.1 - 19.3)
Estimated CVD 10-yr risk: Framingham score, % (95% CI)	27.6 (26.8 - 28.4)	31.4 (30.9 - 31.9)	23.1 (23.0 - 23.2)
aROC* (95% CI) for the UKPDS score	0.61 (0.53 - 0.69)	0.65 (0.60 - 0.70)	0.53 (0.51 - 0.55)
aROC (95% CI) for the Framingham score	0.60 (0.52 - 0.68)	0.67 (0.62 - 0.71)	0.52 (0.49 - 0.54)

NRI** (%), p-value comparing UKPDS and Framingham models	-7.0%, p=0.290	-6.9%, p=0.111	-9.7%, p<0.001

*Area under the receiver operating characteristic curve

**The NRI refers to the net gain in correct reclassification. A positive NRI indicates an improvement in classification, while a negative NRI corresponds to a worsening in classification. The negative NRIs in the table above indicate that the UKPDS risk engine correctly reclassified risk of CVD events in more individuals than the Framingham score