1 De Backer G, Ambrosioni E, Borch-Johnsen K, Brotons C, Cifkova R, Dallongeville J, et al. European guidelines on cardiovascular disease prevention in clinical practice. Third joint task force of European and other societies on cardiovascular disease prevention in clinical practice. *Eur Heart J* 2003;24:1601-10.
2 Poole-Wilson PA, Lubsen J, Kirwan BA, van Dalen FJ, Wagener G, Danchin N, et al. Effect of long-acting nifedipine on mortality and cardiovascular morbidity in patients with stable angina requiring treatment (ACTION trial): randomised controlled trial. *Lancet* 2004;364:849-57.
3 Lubsen J, Poole-Wilson PA, Pocock SJ, van Dalen FJ, Baumann J, Kirwan BA, et al. Design and current status of ACTION: a coronary disease trial investigating outcome with nifedipine GITS. Gastro-intestinal therapeutic system. *Eur Heart J* 1998;19(suppl I):20-32.
4 Daly C, Norrie J, Murdoch DL, Ford I, Dargie HJ, Fox K. The value of routine non-invasive tests to predict clinical outcome in stable angina. *Eur Heart J* 2003;24:532-40.
5 O'Toole L, Grech ED. Chronic stable angina: treatment options. *BMJ* 2003;326:1185-8.

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Commentary: Can risk score models help in reducing serious outcome events in patients with stable angina?

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Clayton and colleagues have derived "a risk score for the combination of deaths from all causes, myocardial infarction, and disabling stroke in patients with stable symptomatic angina who require treatment for angina and have preserved left ventricular function."[1] They conclude that their proposed model "is an objective aid in deciding on further management of patients with stable angina with the objective of reducing serious outcome events."

The message is scientifically interesting. However, can the proposed risk score model become an aid to deciding on pharmacological and interventional treatment in the real world clinical setting?

First of all, the representativeness of the proposed risk score may be questioned because they used a highly selected population (20 selection criteria) from a randomised controlled study to build the model. Accordingly, the risk score may apply only to patients with left ventricular ejection fraction ≥ 0.40, with no signs of congestive heart failure, and with either previous myocardial infarction, proved angiographic coronary artery disease, a positive result on an exercise test, or documented perfusion defect on a stress imaging test, etc. The value of the model needs to be confirmed in independent study samples if it is to be used in primary, secondary, or tertiary care.[2] The bootstrap procedure used by the authors does not take this aspect of validity into account. It is also surprising that the authors did not perform any interaction analysis, even though knowledge about the stability of the model in certain subgroups could indicate whether the model can be extrapolated beyond the actual population. Independent validation is also necessary because the bootstrap procedure takes into account possible overoptimism due to the final model fitting but not due to the more informal part of the model selection process—such as, the choice of initial variables, cut points, and transformations.

Secondly, is a risk score model based on 16 parameters "easily applicable" and does a high number of parameters necessarily improve the predictive discrimination when the model is tested in an independent study population? Harrell and colleagues examined the latter issue 25 years ago when they discussed the value of risk score models in patients with stable angina.[3]

Finally, and most importantly, is the present risk score model useful "to identify patients with stable angina for whom elective revascularisation might improve prognosis," as stated by Clayton and colleagues? The covariates implemented in their model may all provide important prognostic information regarding the risk of experiencing a combined end point (all cause mortality, risk of myocardial infarction, or stroke). This, however, does not guarantee that elective revascularisation will improve prognosis in high risk patients identified from the risk score. A 90 year old man who smokes and has a history of renal insufficiency, diabetes, hypertension, previous myocardial infarction, and stroke has an inherently high risk of dying, which would also be predicted by the present risk score model, but a high risk score is not equivalent to severe coronary artery disease and does not guarantee that life expectancy would be prolonged by revascularisation.

In conclusion, we must remember that risk score models based on baseline characteristics of patients may identify those at high risk but do not provide information that allows identification of patients with severe coronary lesions in whom perfusion status will normalise and prognosis improve after coronary revascularisation.[4] Exercise test, stress imaging test, or angiography are still recommended for the identification of high risk lesions and in $>80\%$ of patients with stable angina at least one of the these investigations is performed.[5]

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1 Clayton TC, Lubsen J, Pocock SJ, Vokó Z, Kirwan B-A, Fox KAA, et al. Risk score for predicting death, myocardial infarction, and stroke in patients with stable angina, based on a large randomised trial cohort of patients. *BMJ* 2005; 331:869-72.
2 Altman DG, Royston P. What do we mean by validating a prognostic model? *Stat Med* 2000;19:453-73.
3 Harrell FE Jr, Lee KL, Califf RM, Pryor DB, Rosati RA. Regression modelling strategies for improved prognostic prediction. *Stat Med* 1984;3:143-52.
4 Abrams J. Clinical practice. Chronic stable angina. *N Engl J Med* 2005;352:2524-33.
5 Daly CA, Clemens F, Sendon JL, Tavazzi L, Boersma E, Danchin N, et al. The clinical characteristics and investigations planned in patients with stable angina presenting to cardiologists in Europe: from the Euro heart survey of stable angina. *Eur Heart J* 2005;26:996-1010.

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