
Effect of outcome misclassification on CHD risk prediction: Can the area under the receiver-operator curve (AUC) always reach 1.0?

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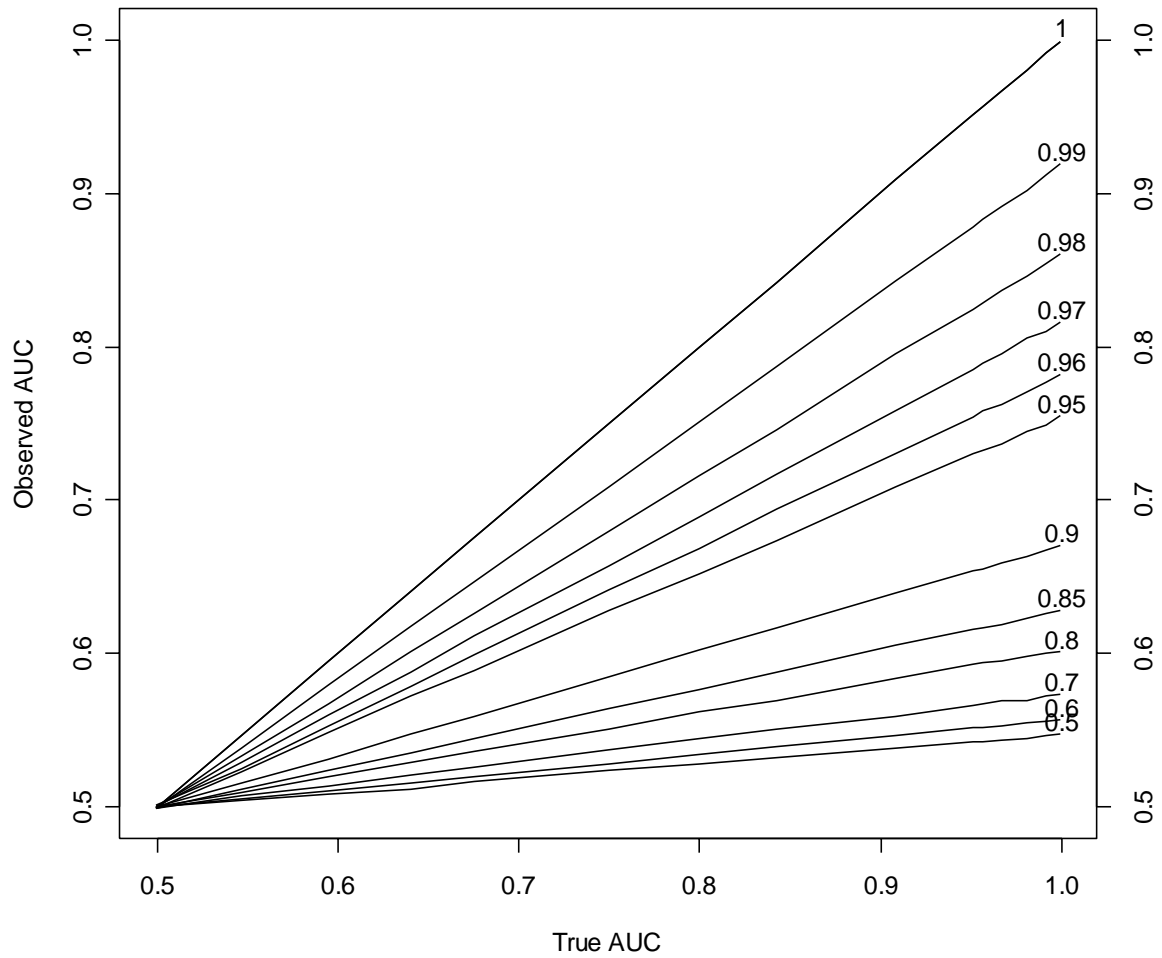
BACKGROUND: The effect of outcome misclassification on area under the receiver-operator curve (AUC) is not well known. The AUC is used to compare the predictive ability of models, such as those using traditional to those using novel CHD risk factors.

METHODS: We used a simulation study of 100 replications of 20,000 observations with sensitivity fixed at 100% and varied specificity, true AUC, and true incidence of the outcome. Since random censoring is analogous to decreased sensitivity and for outcomes with a low incidence such as coronary heart disease (CHD) imperfect sensitivity causes little bias, logistic prediction models approximate AUCs from Cox models. Following Hanley (1988), a risk score was drawn from two normal distributions, one for each true value of the outcome with their separation determining the true AUC. The outcome was misclassified using the assigned specificity and the observed AUC was generated from the risk score.

RESULTS: Figure 1 shows true and observed AUC after misclassification for an outcome with a 5% true cumulative incidence. For specificities of 95%, 96%, 97%, 98% and 99% the maximum observable AUC is .76, .78, .82, .86 and .92 respectively. Studies estimate the specificity for CHD death at 70% compared to autopsy. Cohort studies with fatal and non-fatal events will have a higher but imperfect specificity.

CONCLUSIONS: Our results indicate that even if risk factors increase the true AUC, their effect on the observed AUC in the face of misclassification would be smaller. The specificity of event classification is an important aspect of assessing risk prediction and can affect the upper bound beyond which additional risk factors cannot improve the AUC.

Figure 1: True vs Observed AUC, Event Incidence 5%



Each line shows the relationship at the specificity labeled on the right.