Reviewer's report

Title: Use of hierarchical models to evaluate performance of cardiac surgery centres in the Italian CABG outcome study

Version: 3 Date: 9 May 2007

Reviewer: David Spiegelhalter

Reviewer's report:

General

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Major Compulsory Revisions (that the author must respond to before a decision on publication can be reached)

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Minor Essential Revisions (such as missing labels on figures, or the wrong use of a term, which the author can be trusted to correct)

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p. 3 This is much better and now I think I understand the concern about ‘single-level’ models that assume independence. However I believe the discussion here is still confused and confusing. The standard ‘two-stage’ method used by New York and other centres comprises (i) pooling all the data to create a risk-adjustment model, (ii) calculate an O and E and risk-adjusted mortality rate for each centre. Stage (i) assumes the patients are independent and so is not strictly appropriate, but only influences the risk-adjustment model – the RAMR explicitly allows for a centre-effect and so patients are not assumed independent (otherwise one would just fit an overall rate). The authors carry out a one-stage analysis in which centre effects and risk-adjustment is done simultaneously. However one could also do a one-stage analysis in which centre-effects were considered as independent fixed-effects – this would lead to essentially indistinguishable results to the NY-style analysis, but would properly allow for dependence in the risk-adjustment process. The crucial idea is that the argument about ‘dependent patients within hospitals’ used to justify multi-level models, which has become common in this literature, is insufficient as it only suggests having a hospital-effect - it does not justify a hospital random-effect. This really requires additional argument about adjustment for ‘regression-to-the-mean’ and so on.

Page 11 line 1 ‘treat all patients as independent observations’ . Add ‘when developing the risk-adjustment equation’

Figure 1. This plot gives no idea of what the actual estimated risk-adjusted mortality rates are and the vertical scale is essentially meaningless: the vertical scale could be relabelled to be much more informative.

Discretionary Revisions (which the author can choose to ignore)

What next?: Accept after minor essential revisions

Level of interest: An article of importance in its field

Quality of written English: Acceptable

Statistical review: Yes, and I have assessed the statistics in my report.