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Letter to the Editor

A Perspective on the Scientific Registry of Transplant Recipients' Migration to Bayesian Methods

To the Editor:

The articles by Salkowski et al (1,2) outline the recent review of the flagging rule for transplant centers. These articles have also been commented upon in references (3) and (4). The previous rule flagged any facility with fewer than 10 transplants in a given 30 month period if there was one or more deaths; a facility with 10 or more transplants was flagged if: (i) Observed/Expected > 1.5; (ii) Observed-Expected > 3; and (iii) the one sided p-value < 0.05. This rule worked well for larger centers, but not for smaller. For example, one consequence was that a center with nine (or fewer) transplants in the 30 month period is flagged if it has one or more deaths whereas a center with 10 transplants is flagged only if it had four or more deaths. This peculiar discontinuity is due to the criterion ''Observed – Expected > 3.'' It is this aspect of the previous rule that results in the oddities identified in Figures 4 and 5 (1).

According to reference (1), the goal of the Bayesian methodology is ''*maximizing true positives while holding false positive flagging rates to approximately 5% regardless of program volume.*'' A very basic result in statistics tells us that this aim is essentially accomplished by a hypothesis test and the simple rule ''flag if one-sided p-value $< 5\%$.'' As also noted in reference (4) and illustrated in Table 1, this simple approach yields thresholds or cutoffs that are very similar to the SRTR's Bayes rule. Note that although the thresholds are increasing with increasing facility size for the observed number of events, the result is not monotone for the SMR for either rule.

In references (1) and (2), the Bayes approach is justified in part through reference to the ''COPSS report'' (Ash et al [5]) which recommended, subject to some discussion and caveats, use of a hierarchical or *empirical* Bayes model for profiling of hospitals. The approach being used by the SRTR, however, is *fundamentally different* from that approach; in hierarchical models, the prior distribution of hazard ratios (HRs) is estimated using the data to reflect the actual distribution of HRs in the population of centers, whereas the SRTR proposal assumes the prior distribution of HRs is known in advance and is not updated, even when contradicted by the data. The prior is specified in (2) and is claimed to describe belief about the distribution of HRs although it is not stated whose belief and, in apparent contradiction, it is also noted that the prior is more diffuse than the distribution of HRs in the population of centers. This difference is substantial as Figure 1 and comments in (4) illustrate. Much is made of being able to present probabilities, but the probabilities as statements of belief are only valid if the prior distribution truly reflects prior belief.

Table 1: Entries give the cutoff values or thresholds in terms of number of failures (Observed) and SMR = Observed/Expected for a facility with N transplants in 30 months. If Observed $\geq O^*$ or SMR $\geq$ SMR*, then the facility would be flagged. It is assumed that the one-year mortality rate is 3%

	N = 10	N = 20	N = 25	N = 50	N = 100	N = 200	N = 400	N = 800
Flagging rule				Thresholds in terms of Observed (O^*)				
p-value <5%	2	3	3	5	7	11	19	33
Bayes Proposed flag	2	2	3	4	7	11	18	34
				Thresholds in terms of SMR (SMR*)				
p-value <5%	6.67	5.00	4.00	3.33	2.33	1.83	1.58	1.38
Bayes Proposed flag	6.67	3.33	4.00	2.67	2.33	1.83	1.50	1.42

SMR, standardized mortality ratio.

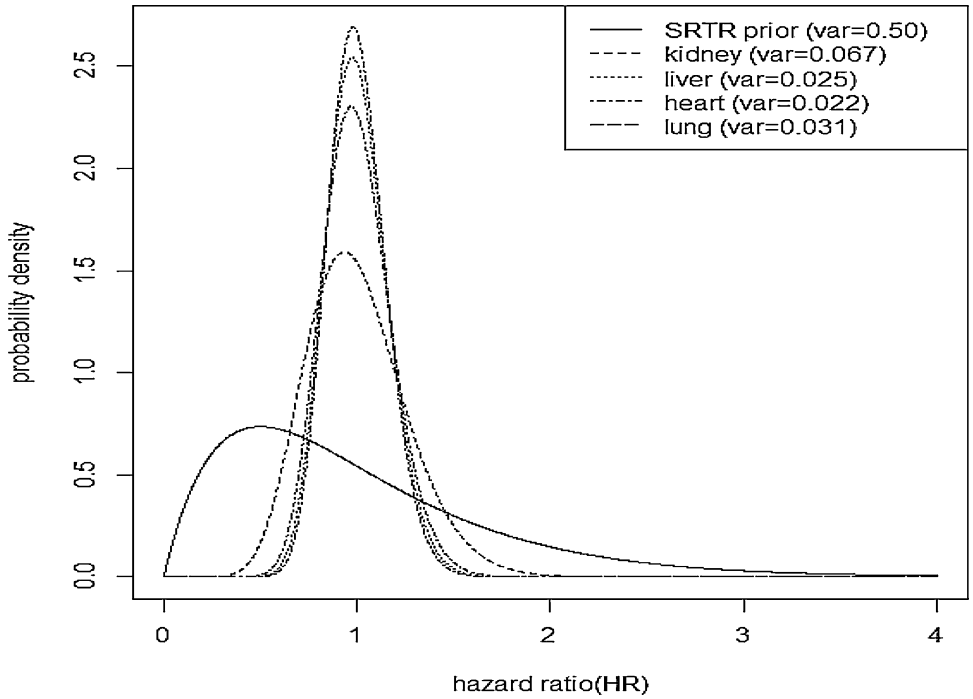

Figure 1: The distribution of the hazard ratio as assumed in the SRTR model and as estimated for adult transplants in kidney, liver, heart, and lung. In each case, the distribution is assumed to be of the gamma form (as assumed by the SRTR), but in the disease cases, the variance of the HR is estimated from the data. HR, hazard ratio; SRTR, Scientific Registry of Transplant Recipients.

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Disclosure

The authors of this manuscript have no conflicts of interest to disclose as described by the *American Journal of Transplantation.*

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