Reviewer's report

Title: Improved risk adjustment for surveillance of healthcare-associated bloodstream infections: a retrospective cohort study

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Reviewer: Emma McBryde

Reviewer's report:

General comments
This is an important study for infection control especially as league tables of hospitals are soon to be compulsorily introduced in Australia. This paper goes some way towards making this fairer, by stratifying hospitals based on the mix of ward services that the hospital delivers.

I can comment to a point about the statistics used but don’t feel fully qualified to comment on (for example) QICs, hence have recommended additional statistical review.

Answering the standard review questions
1. Is the question posed by the authors well defined? Yes
2. Are the methods appropriate and well described? Yes, and as far as I am qualified they appear appropriate and well justified. As explained I do not feel fully qualified to comment fully.
3. Are the data sound? Yes with the caveat that there are missing data that need a little further explanation as detailed below
4. Does the manuscript adhere to the relevant standards for reporting and data deposition? Yes
5. Are the discussion and conclusions well balanced and adequately supported by the data? Yes
6. Are limitations of the work clearly stated? Some more information is required on missing data and generalisability as detailed below.
7. Do the authors clearly acknowledge any work upon which they are building, both published and unpublished? Yes
8. Do the title and abstract accurately convey what has been found? Mostly. I have commented below on some small suggested changes.
9. Is the writing acceptable?
   Yes
- Discretionary Revisions
I would recommend commencing the discussion in a way that is a little more meaningful to the target audience.
Perhaps something like “This study aimed to determine the need for risk adjustment for BSI rates at a hospital level based on services provided by those hospitals. We found that for OBSI, our results supported risk adjustment…”
Consider adding “hospital level” (after “Improved”) in the title, as most studies of risk adjustment are at the individual level.

- Minor Essential Revisions
Abstract Background. You have written the study aims. Put “aims” in front of the sentence, or restructure the sentence.

I don’t quite understand the second sentence of conclusions in the abstract. Do you mean that the sparse datasets of MRSA and IVD-STAPH require individual risk score, whereas OBSI can rely upon a hospital-specific risk adjustment? Please clarify.
The data appear sound. It is unfortunate that 3 hospitals had significant missing data and were excluded. This can potentially introduce a bias into the outcome which should be mentioned.

Of the hospitals that were included in the analysis, 11.3 % of data were missing. How were these missing data managed?

How generalizable are these results? Are these relevant only to Queensland hospitals? For example, is the high IRR of MRSA in infectious diseases wards a reflection of the use of these wards for isolation of MRSA patients?

Given that the target audience is not particularly interested in the specifics of the methods, and more interested in the interpretation of the results, I strongly contend that the second paragraph in the conclusions beginning “Figure 1A showed a Bayesian shrinkage plot” belongs in the results section.

As an example one could write the following in the results..

Figure 1A showed a Bayesian shrinkage plot18 for five years of MRSA surveillance data with risk adjustment by the original crude levels. Shrinkage estimators have been used extensively to derive better estimates of the true infection rate for each hospital. They minimize the mean squared error of parameter estimates between hospitals, adjust for variation in sample size and account for regression to the mean for individual hospitals. Hospitals 1 and 12 performed significantly worse than average at the 2 and 3 sigma control limits. Figure 1B shows that when risk adjustment was performed by regression with hospital-level reclassification, hospital 12 remained an outlier but hospital 1 was clearly within the 2 and 3 sigma control limits.
When deriving the shrinkage ratios, the estimate of the between hospital variation of the true rates was obtained. With the original levels, the variation between hospitals was 0.332. With the new levels, the variation decreased to 0.138.

Then in the discussion write…

Shrinkage plots demonstrate that hospital 1, reported as an outlier using the crude hospital size classification, was found to be under control using the hospital level reclassification. Table 5 indicated that the hospital was in fact, reclassified as a level 1 hospital from the logistic regression model.

Between hospital variation in rate estimates were higher for the original crudely adjusted values than in the new risk adjusted values. This is further evidence to support the reclassification as the new levels produced a more homogenous group of true rates within each level.

- Major Compulsory Revisions

nil

**Level of interest:** An article of importance in its field

**Quality of written English:** Acceptable

**Statistical review:** Yes, but I do not feel adequately qualified to assess the statistics.

**Declaration of competing interests:**

I declare that I have no competing interests