Author's response to reviews

Title: Factors influencing hospital length of stay outliers

Authors:

Alberto Freitas (alberto@med.up.pt)
Tiago Silva-Costa (tcosta@med.up.pt)
Fernando Lopes (fernando@med.up.pt)
Armando Teixeira-Pinto (tpinto@post.harvard.edu)
Pavel Brazdil (pbrazdil@inescporto.pt)
Altamiro Costa-Pereira (altamiro@med.up.pt)

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Dear editor,

We are pleased to submit a revised version of the manuscript previously entitled "Factors influencing hospital high length of stay". Below we detail our response to the reviewers' helpful comments. We tried also to go deeper on the discussion of the relation between hospital complexity and amount of outliers, and whether hospital should receive or not extra payment for these cases.

Yours sincerely,

Alberto

Alberto Freitas (corresponding author)
Assistant Professor
Dpt. of Health Information and Decision Sciences, Faculty of Medicine, University of Porto
Al. Prof. Hernâni Monteiro
4200-319 Porto
Portugal
Telephone: +351 22 551 3622
Email: alberto@med.up.pt
Response to the reviewers:

Reviewer 1: Stefan Felder

Reviewer: "The authors use the type of hospital as one explanatory variable for the share of outliers. I would advise to take advantage of the Panel structure of the model, i.e. for every hospital many different observations are available, and to apply a fixed-effects model which would allow them to take into account the heterogeneity of hospitals even further."

Reply: Thank you for the valuable comment. We acknowledge the problem and asked assistance to a statistician (now and author in this version) to help us with the analysis.

To take into account the dependence on the data due to hospital clustering we fitted the logistic regressions using Generalized Estimating Equations (GEE). In this procedure the standard errors are computed using the sandwich estimator which is robust to misspecification of the covariance matrix in the model. We used "independent" as the working covariance matrix because of the size of the dataset. We also tried another structure ("exchangeable") but the program was running for more than 10 days in a SAS server without producing any results. In any case we compared the results of the two covariances structures in a sample of the data and the results were identical. This is not surprising because the method is robust to the wrong covariance structure.

The results of the GEE were identical to the previous results in terms of point-estimates of the regression parameters. However, the standard errors and, consequently, the confidence intervals had significant changes. We updated the results accordingly. Once again we thank the reviewer to point this important flaw in the analysis that would lead us to the wrong inference for some variables.

Considering the other comments, we included additional information (page 6) about the inclusion/exclusion of outliers in the Portuguese DRG system (the computing of case-mix indexes ceased to contemplate high length of stay outliers in 2006). These issues, and the variance of outliers among similar hospitals, are further discussed on pages 15 and 16.

Reviewer 2: Ceu Mateus

Major compulsory revisions: we correct the manuscript considering all your suggestions.

1&2 - we corrected “DRG (HCFA1 version 21.0)” to “DRG (AP-DRG version 21.0)” in all occurrences

3 - table 2, we deleted the average of the period

Discretionary revisions: we also considered all your valuable comments.

1 - Yes, the database includes all public acute care hospitals (corrected in the manuscript)
2 - We clarified the used normative classification (Portaria 281/2005)
3&4 - we add a reference and cleared up the definition of teaching groups
5 - Yes, groups were built based on the relative weights of the DRGs (now explicit in the manuscript)
6 – We clarified it the manuscript (“For this analysis we only considered DRGs with more than 10,000 discharges over the ten-year period”)
7 - The group composed by the 3 traditional and oldest teaching hospitals in Portugal are responsible for 4.5% outliers (which is significantly more than in the reference group); we included additional information about the number of hospitals in each year (table 2)
8 - As suggested, we used the Portaria to estimate the impact of high outliers in hospitals costs/funding (page 16)
9 - We now highlight other factors with influence in high outliers (page 14)
10 - We estimate the impact of costs for Portuguese data but we do not have comparable data for Spain or Belgium
11 - We do not have data for all the episodes with discharges in 2009; we added the annual number of cases (table 3)