Reviewer’s report

Title: Towards an efficient hospital bed management by reducing admission and discharge variation

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Reviewer: Rene Bekker

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General comments:
This paper seems to quantify the effect of a better managed admission and discharge process on the number of cancelled scheduled admissions and delays in emergency admissions. The quantitative impact of such an improved admission and discharge management is of interest.

Major Compulsory Revisions:
As the authors mention, they focus on reducing the variation in the admission and discharge processes. It is not a priori clear what they mean by reducing variation. The main focus seems from a qualitative (process management) point of view as most of the interventions essentially involve standardizing the processes. For discharges, such standardization should reduce the mean length of stay, and not so much the variation. Also, the interventions clearly involve admission and discharge management, but its relation with variation reduction is often only in a broad sense; examples are ‘admission on the same day of surgery’ and ‘enhance day-surgery rates of selected processes’, which essentially aim to make clinical capacity available instead of reducing variation. The paper and its title would benefit from a clearer description of ‘reducing variation’ or a different phrasing.

More importantly, from the current (description of the) results it is difficult to draw any sound conclusions. The reduction of the global average length of stay from 9.3 days in 2007 to 9.14 days in 2009 is rather modest and is in line with the globally increasing focus on shortening lengths of hospital stay. Note that the shift in the number of day surgery admissions may affect these numbers. The length of stay has been significantly reduced for scheduled patients (from 5.07 in 2007 to 4.33 in 2009), but, combined with almost equal number of scheduled and emergency admissions, this also directly implies that the length of stay has increased for emergency patients. This raises questions about the effect of the modified discharge management process. In addition, there seems to be a remarkable drop in the number of emergency admissions (the total number of admissions decreased rather severely from 2007 to 2009 whereas the number of scheduled admissions increased). This shift in patient mix also reduces global length of stay and should be taken into consideration.

The drop in the number of cancelled interventions and the number of emergency
patients waiting for an in-hospital bed at 8:00 am (which seems to be chosen arbitrarily) are hopeful. Such a decrease also strongly depends on the available capacity and its utilization. In Table 2, the hospital occupancy seems to have increased from 83% in 2007 to 85% in 2009, but I was not able to reproduce these numbers. Assuming that the length of stay is based on the time patients actually spend in the hospital (and not on another definition), an application of Little’s law gives that the average number of occupied beds in 2007 is:

\[
\text{average number of admissions per day} \times \text{average length of stay} = \frac{33750}{365} \times 9.3 = 860
\]

This number is larger than the available number of beds (820), which seems infeasible. A similar calculation and conclusion applies for 2009. An explanation of these numbers (or its definition) in the paper is required. In addition, in the results section a total of 33,750 admissions for 2007 is reported, giving 33,750/365 = 92.5 admissions per day, whereas in Table 2 there are only 51 + 35 = 86 admissions per day. There might be a difference in the reported number of day surgery admissions/interventions between the result section and Table 2 as well, but this could be caused by a different definition (which should then be stated).

Minor Essential Revisions

In the background section it is mentioned that reducing variation should start with the discharge process. This is true for variation reduction in process management (standardization), but not necessarily from a quantitative point of view, i.e., more stable admission and discharge patterns.

On the second line of the discussion section, it is mentioned that the hospital productivity has increased. This seems to contrast the decline in the number of admissions. Could this statement be motivated?

The number of decimals places should be consistent throughout the paper (preferably two).

A space is lacking in various places.

Discretionary Revisions

The reference to [11] and its relations to reducing variation in admission and discharges seems beyond the scope of this paper.

Why is the mean number of elective admissions in the third line of the method section measured in months, in contract to the remainder of the paper?

On the second page of the discussion section a description of the surgery admission unit is provided. This seems to relate to the interventions and the reader might benefit from moving this part to the methods section.

**Level of interest:** An article whose findings are important to those with closely related research interests
Quality of written English: Needs some language corrections before being published

Statistical review: No, the manuscript does not need to be seen by a statistician.

Declaration of competing interests:

I declare that I have no competing interests’