**Author's response to reviews**

**Title:** Benchmarking of hospital information systems: Monitoring of discharge letters and scheduling can reveal heterogeneities and time trends

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**Author's response to reviews:** see over
Reviewer 2:

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

1. You should more precisely define, what you mean by the term HIS. What part of the functions to be supported by the information system of a hospital is actually supported by your installation of ORBIS?

   **Methods section, paragraph 2, was updated to answer this question.**
   In this manuscript we focus on two specific HIS-functions: clinical documentation (discharge letters) and scheduling.

2. p.4 "measured time to switch users": What part of the action has been measured? Have user interactions been incorporated or not?

   **Methods section, paragraph 3, was updated to clarify this issue.**
   User interactions have been incorporated for measurements.

3. p.5, second paragraph: You should more precisely define this calculation. Did you divide the number of discharge letters by the average number of appointments? It would be more reliable and informative if you would divide the number of discharge letters by the actual number of cases documented in the specialty within the time range you counted the number of letters.

   **This is a misunderstanding. Analysis of the scheduling system was independent of discharge letter analysis. P.5, second paragraph was updated to clarify this issue.**

4. p.7, chapter "Scheduling": This chapter should be rewritten according to the following notes:
   4.1 I do not understand the diagram in Figure 6. Do the columns stand for the frequency of an interval? How are the intervals defined? Where can I find the "average numbers" in the diagram?

   **Yes, the columns stand for the frequency of an interval. The intervals are defined as less than 20, 20-40, 40-60 etc. appointments per day per department. Chapter "Scheduling" and figure legend 6 were updated to clarify this issue.**

   4.2 "it becomes evident...": This is not evident to me. Please help readers to derive this conclusion from Figure 6.

      see 4.1

   4.3 "This is influenced by ...": What is the reason for this conclusion?

      "Big departments" - in terms of number of cases - are expected to manage more appointments than "small" departments.
      **Chapter "Scheduling" was updated to clarify this issue.**

5. There is a disproportion concerning the length of the chapters
Methods/Results at one hand and the chapter Discussion at the other hand. Methods and Results need a more elaborate and precise description.

According to the reviewer’s suggestion, methods and results were updated, in particular regarding methods and results of scheduling.


Thank You, a relevant reference! Discussion was updated.

Reviewer 1:
Major Compulsory Revisions (that the author must respond to before a decision on publication can be reached)
Overall, the paper is focused on methods and results. The introduction section remains somewhat general. The following questions are not or not sufficiently addressed in introduction:
1. What is the relation between structure, process and outcome quality of HIS? How is this related to the discussion of success and failure criteria? Why do the authors chose the criteria they finally used? Why is benchmarking important at all?
2. What is the state of the art of HIS benchmarking? What do others propose here? How is the approach of the authors different/new/better from other approaches?
3. What is the scientific problem the paper wants to solve, what is the scientific question(s)/the scientific objective they want to answer?

From my point of view, this is a misunderstanding. The introduction section was completely rewritten to clarify approach and objectives of the manuscript. It is not within the scope of the paper to address structure, process and outcome quality of HIS. Now a definition of benchmarking is provided and scientific objectives are presented explicitly.

The discussion session focusses on the heterogeneity of departemnts, presenting "organizational issues" and some technical aspects as reasons. They then discuss the benefit of benchmarking, stating that this helps to "elucidate options for improvement activities", and that in fact their results readily to "various projects to improve patient scheduling". While those statements are not wrong, they seem a bit general and not really surprising. Overall, it would be better if the discussion section focuses more stronlge on other questions such as:

Discussion section was updated. More specific examples of improvement activities are provided (user training for secretary personnel in two departments, implementation of additional patient schedules).

4. Do the results conflict with other research? If yes, what could be the reasons?
As stated in the discussion section, "publications regarding HIS performance indicators that can be determined automatically from routine HIS are very sparse at present". We added a reference (Müller U, Winter A 2006; A monitoring infrastructure for supporting strategic information management in hospitals based on key performance indicators) and compared this approach with our concept.

5. How can benchmarking of the HIS usage contribute to improve process and outcome quality?

We added more specific examples of improvement activities like user training for secretary personnel in two departments and implementation of additional patient schedules.

6. What are limitations of the methods and results presented by the authors?

The following limitations of methods and results are now addressed in the manuscript:
- Focus on a very specific aspect of HIS (time-to-completion of discharge letters and scheduling)
- Internal benchmarking within one hospital

7. "So what" - what can the reader learn from the paper? What is the scientific innovativeness that is presented? What is new and challenging?

We developed and implemented a generic method to assess completeness and timeliness of discharge letters for a commercial HIS. We found several distinct patterns of discharge letter documentation indicating a large heterogeneity of HIS usage between different specialties. We assume that this finding is relevant for other hospitals. From our point of view, this approach is innovative and there is very limited literature available on it (see 4.).

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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)

1. The summary does not mention the scientific objectives of the paper. Scientific objectives are now presented explicitly in the background section.

2. The papers cited in the introduction seem not always to be the best choice. Just one example: The authors say that "success factors are important ", but cite a specific paper that deals with success factors for CPOE. Aren't there more appropriate general paper on IT success factors? Same is true for many of the other references used.

Background section was completely rewritten.

3. The term benchmarking is not defined and explained.

Background section was updated with a definition of benchmarking.
4. In the methods section, the duration of time period of the analysis is not given.

This information is provided in the results section.

5. Why does the discussion mention CPOE evaluation studies as important evaluation studies? What does this have to do with the topic of the paper?

Physicians are responsible for discharge letters and CPOE. CPOE was evaluated in various settings, but there is limited literature regarding delayed and incomplete discharge letters. Patients are at risk, if important treatment information is incomplete or delayed (analog to issues with CPOE usage).

6. Figure 1 - 6 are not completely clear to me. Each bullet seems to be one discharge letter (this should be mentioned), but besides that, I do not understand how they are developed and what they really mean. How comes that completeness is rising from letter to letter?

Figure 1 - 5 and associated figure legends were updated to address this comment. Figure 1 to 4 are empirical cumulative distribution functions, which are monotone ascending. Example (figure 4): completeness 0.2 at 20 days means that 20 days after patient discharge 20% of letters were completed.