Author's response to reviews

Title: Implementation of workflow engine technology to deliver basic clinical decision support functionality

Authors:

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Author's response to reviews: see over
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To the editor

Re: Manuscript ID: 4087600163885583
Title: Implementation of workflow engine technology to deliver basic clinical decision support functionality

Corresponding Author: Dr. Vojtech Huser
Authors: J Starren, L. Rasmussen, R. Oberg

Dear Editor:

Thank you for reviewing our article and for providing a second set of comments from reviewer 2. We have revised our article using the reviewer’s suggestions. The changes made to our manuscript are listed below and are also highlighted in the article using the track changes feature.

Reviewer 2

1. This title suggests that the R&D work is focused on implementation with the objective being to achieve basic CDSS functionality. This is still not very clear from the text or the abstract. The background defined some gaps but does not make explicit what gaps this project would address. The objectives for the paper seems incongruent with the title, mainly because the objectives of the project or R&D questions were made explicit.

Response:
Our objective is stated repeatedly as a software category article which presents our software implementation.

We have clarified the text of the abstract and reformulated the enumeration of the two challenges we address in our article.

The revised text reads:

We focus on two challenges in decision support systems: the ability to test decision logic on retrospective data prior prospective deployment and the challenge of user-friendly representation of clinical logic.

As to clearly stating which gaps we are addressing in our article and the article title: Authoring and delivering clinical decision support is extremely challenging, and we do not hope to provide solutions to all challenges that this problem entails. Our article is a
software category article which hopes to describe for other researchers the software architecture and its capabilities and the way in which it addresses exactly two specific challenges. Paragraph two and three in the background section specifically talk about these two concrete gaps (challenges) and immediately after that, the following (fourth) paragraph states: “We were able to address the two above-mentioned challenges with a system called HealthFlow, which is an implementation of a workflow engine in the context of an EHR system.”

This fact that our paper is about implementation of a workflow engine is, in our view, so important that it is reflected in the article title, and we see it as being consistent with the article type of “software article” as defined on the journal’s web site (see http://www.biomedcentral.com/bmcmedresmethodol/ifora/?txt_jou_id=2006&txt_mst_id=1009). In our first revision, we had made several changes and commented on this problem of the categorization of our submission as a software article (e.g., Reviewer 1: point 5 and Reviewer 3: points 1 and 5). The main goal of a software article is to describe a freely available software (including its use and benefit) rather than to state a research question with traditional methods and results sections.

However, in response to this current comment, we have made further changes to the article text in order to better communicate this goal and improve the consistency of the title, abstract and article text.

After considering several possible alternative titles, we have decided to keep the existing title. The title was already changed in a previous revision in response to comments from reviewers 1 and 3. At that revision, we have also considered several suitable titles and we think the current title expresses best the intent and character of the article (software type).

2. Some relevant questions appeared in the text within the context of the CDS Evaluation Framework. However, this would be better understood if the R&D questions were formulated right at the beginning, perhaps in a separate section titled R&D objectives or questions.

Response:
The journal instructions for the software article category clearly define the sections of a software article. These sections are Background, Implementation, Results, Discussion, Conclusions, and Availability and Requirements. As stated in our previous response to comments (Reviewer 1: point 5), there is a misunderstanding that our article follows the structure of a regular research article where a research question is proposed and a methods section describes which methodology is used to answer the research question. We have, however, modified the Background section to include a link to a later section where CDS-EF is used.

3. The methods described would follow on from the R&D questions. If the CDS-EF is to be the core basis for the evaluation of this work, then it makes more sense to have it up
Response:

We agree with the reviewer that the journal is focused on methodology, and we chose this journal because it reflects the aim of our article - to show that a workflow engine technology can be a possible method of delivering clinical decision support to the point of care. The second reason for selecting this journal was our review of previous software description articles published by this journal. We saw a match here with our goal to describe for other institutions our software architecture and implementation as well as the integration of an EHR system with a stand-alone, third party workflow engine.

Several aspects from our response to the previous two points are relevant to this point also (choice of a software article type, software article prescribed structure). The primary topic of our article is to describe the software, and the evaluation using the CDF-EF only complements this primary topic.

However, we have further highlighted in the background section (as suggested by the reviewer) our use of the CDF-EF evaluation model in the final sections of the article.

The point about the evaluation aspect of our article was a subject of concern by Reviewer 3 (point 1) in the previous set of comments, and we addressed them by explaining the intentions of our article. The CDS-EF section is included in the article since it is the most current and very useful architectural evaluation model for comparing decision support frameworks. The software article guidelines set by the journal do not specifically require an evaluation section; however, we chose to include one since we used it internally to evaluate our software implementation. Unfortunately, the CDS-EF model has many axes and aspects and addressing them all would make this section disproportionately long in comparison to other article sections.

4. This would assist the reader to understand the description of the implementation and relate the dimensions of the implementation to the desired functionality, which also must be described in a measurable way. The way the results would be presented would then flow from this so that the reader would understand whether the implementation processes have addressed the R&D objectives/questions posed.

Response:

Our previous response describes our main motivations regarding how and when the CDS-EF was used (i.e., later in the project, after the HealthFlow system was fully developed). To present the topic in the order suggested by the reviewer would not correctly reflect how our project evolved and what our intentions were.

However, our initial work (on RetroGuide) did start with a list of desired functionality. We have modified the background section (the paragraph where the RetroGuide component is introduced) with an additional sentence referencing our previous
publication, describing in detail our desired functional requirements. The added reference
is: Huser V, Rocha RA, James B: Use of Workflow Technology Tools to Analyze
455-460.

Our modified Background section also further explains what guided the development of
the prospective component; namely, as an effort to utilize in a healthcare context a
functionality already included in a workflow technology suite.

*Measurable way:* A quantitative evaluation of the degree of adherence (or degree of
compliance) of a given decision support architecture to the defined CDS-EF axes and
aspects would be a highly desirable feature. The CDS-EF model itself does not define
any qualitative measures, and most of the evaluated aspects are qualitative in nature. We
have followed the same methodology used by the CDS-EF authors when the CDS-EF
was used to evaluate the SANDS decision support platform (article reference [41]). To
our knowledge, our use of the CDS-EF is the second application of the CDS-EF to
evaluate a decision support platform. Development of qualitative aspects is a possible
subject for feedback to CDS-EF authors or a follow-up publication, but is beyond the
scope of our software article.

5. Perhaps the authors can edit the abstract so that the objectives are clearly expressed,
key methods described, key results presented and key conclusions made.
The conclusion in the abstract does sense because of the typo. However, reading in
between the lines, it seems to me that this is the objective of this paper: to describe the
research/evaluation methodology guiding the implementation of the application. So the
proposed methods and what actually happened needs to be described and discussed so
that the project can be replicated in other settings, etc.

**Response:**
We have made significant changes to the abstract which should address the reviewer’s
comments. We have reworded the part of the abstract where the interpretation was not
clear. (2 challenges/gaps in clinical decision supports which our software addresses). Our
abstract outline follows the prescribed structure for a software article abstract
(Background, Results, Conclusion). The abstract’s Background section introduces
workflow engine technology and states our intent to use it in the domain of decision
support.

*Objectives are expressed:* The objective is stated in the abstract’s Results section as “We
present our implementation of a workflow engine technology which addresses the above-
described challenges.” It also states: “

*Key results and conclusions presented:*
We have expanded some of the results and conclusion points presented in the original
abstract text. The original text established the following results. (“We demonstrate,…,
that clinical decision support logic can be executed … as well as … integrated with an
electronic health record system.”
The added points include: (1) the main focus on decision support content generation (and
limited decision support content delivery); (2) re-wording of the two evaluations
presented (graphical format and architectural evaluation); (3) re-written abstract conclusion to better reflect all the main points mentioned in the main article body.

6. An approach to take may be to write the paper so that another group, using the same methodology and software, can replicate the implementation and examine if the results are different and why. I would suggest that what has been published be incorporated and described in the background/methods with appropriate referencing.

Response:
We have modified the Availability and Requirements section in order to better communicate how other intuitions can benefit from our software article.

In the Availability and Requirements we state that other institutions can employ the same architecture and technical implementation. We have added additional sentences clarifying this topic. For complete replication of results, not only a decision support architecture is needed but also the concrete logic of the decision support. We provide in the article text, article appendix B, and on the project website several examples of decision support modules.

Development and testing of decision support content is very costly, and there is no clear solution regarding what business model can be used for effective distribution of decision support content. In an absolute majority of cases, a commercial model is used where fully computerized versions of decision support modules (which may implement publicly available guidelines or recommendations) are offered for a fixed price. The goal of our software article was to describe a framework but not to publish individual decision support modules. This decision support architecture versus decision support content argument is crucial in the ability of other institutions to fully replicate our results (and the ability to provide comparable measurable outputs). Replicating institutions may vary widely in their installed EHR systems, local workflows and organizational roles.

Also, as stated in our previous response to Reviewer3: Point2, we plan to report concrete results in individual clinical domains (e.g., provision of decision support in rheumatology using a workflow engine technology) in separate future articles that will reference this architecture description software article.

Editor

1. We would also request that you go through the manuscript formatting checklist one more time and ensure that your revised manuscript conforms to all of the points.

Response:
We have properly re-named the Implementation section (previously Methods section) of the article to fully comply with the software article category guidelines. We have also
removed a second set of references erroneously generated by EndNote (citation manager) at the end of the article.

2. **Finally, we ask that you include a link to the software in the abstract of your manuscript.**

**Response:**
In the revised abstract, the link is now included as part of the abstract text.

3. **Please also ensure that your revised manuscript conforms to the journal style**

**Response:**
The article received additional review by a Marshfield clinic writing center editor to further improve the article structure. We have corrected the style of several references to match the journal style (publisher mentioned in references 8, 10, 11 and 44 and journal issue properly listed for more than 15 references).

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All correspondence regarding this manuscript should be sent to Dr. Vojtech Huser. Thank you for considering my article for publication and I look forward to hearing from you.

Sincerely,

Vojtech Huser, M.D., Ph.D.