

Reviewer Assessment

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Surgical data science: the new knowledge domain

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Reviewers' Comments to Original Submission

Reviewer 1: anonymous

Jan 30, 2017

Reviewer Recommendation Term: Accept with Minor Revision
Overall Reviewer Manuscript Rating: 80

Custom Review Questions

	Response
Is the subject area appropriate for you?	5 - High/Yes
Does the title clearly reflect the paper's content?	4
Does the abstract clearly reflect the paper's content?	4
Do the keywords clearly reflect the paper's content?	4
Does the introduction present the problem clearly?	4
Are the results/conclusions justified?	4
How comprehensive and up-to-date is the subject matter presented?	5 - High/Yes
How adequate is the data presentation?	4
Are units and terminology used correctly?	4
Is the number of cases adequate?	N/A
Are the experimental methods/clinical studies adequate?	N/A
Is the length appropriate in relation to the content?	4
Does the reader get new insights from the article?	4
Please rate the practical significance.	4
Please rate the accuracy of methods.	N/A
Please rate the statistical evaluation and quality control.	N/A
Please rate the appropriateness of the figures and tables.	3
Please rate the appropriateness of the references.	4
Please evaluate the writing style and use of language.	4
Please judge the overall scientific quality of the manuscript.	4
Are you willing to review the revision of this manuscript?	Yes

Comments to Authors:

The manuscript upon Surgical Data Science (SDS) - an emerging hot topic within the surgical and computer scientist society. The manuscript is well written and worthwhile to be considered for publication. Minor aspects are 1. could the authors please give key clinical applications for SDS and 2. what is the importance of SDS as compared to RCTs in terms of creating reliable treatment algorithms.

Reviewer 2: anonymous

Jan 30, 2017

Reviewer Recommendation Term: Revise with Major Modifications
Overall Reviewer Manuscript Rating: N/A

Custom Review Questions

	Response
Is the subject area appropriate for you?	5 - High/Yes
Does the title clearly reflect the paper's content?	3
Does the abstract clearly reflect the paper's content?	3
Do the keywords clearly reflect the paper's content?	3
Does the introduction present the problem clearly?	4
Are the results/conclusions justified?	4
How comprehensive and up-to-date is the subject matter presented?	4
How adequate is the data presentation?	3
Are units and terminology used correctly?	3
Is the number of cases adequate?	N/A
Are the experimental methods/clinical studies adequate?	N/A
Is the length appropriate in relation to the content?	3
Does the reader get new insights from the article?	4
Please rate the practical significance.	3
Please rate the accuracy of methods.	N/A
Please rate the statistical evaluation and quality control.	N/A
Please rate the appropriateness of the figures and tables.	3
Please rate the appropriateness of the references.	5 - High/Yes
Please evaluate the writing style and use of language.	5 - High/Yes
Please judge the overall scientific quality of the manuscript.	4
Are you willing to review the revision of this manuscript?	Yes

Comments to Authors:

The manuscript is a very well-written position paper.

The current scope of the paper is „Surgical Data Science“, which can be considered an emerging field.

My main question concerns the relation of the manuscript to the international Surgical Data Science initiative (www.surgical-data-science.org). According to the website, the initiative has organized an international workshop on the topic, resulting in a short position paper (<https://arxiv.org/abs/1701.06482>) and the announcement of a longer position paper. In relation to these activities, what is the contribution of the submitted manuscript? How does it differ in its scope from the initiative? Is the paper rather competing or complementary? In light of the two parallel activities, is it possible to fine-tune the scope of this manuscript (e.g. to surgical training), or does the paper present an alternative view? If yes, in what sense?

Further comments:

In the section „What is Surgical/Interventional Data Science (SDS), and what is it not“, reference to the consensus definition of SDS should be made <https://arxiv.org/abs/1701.06482>. Also, the definition includes interventional radiology and other non-surgical disciplines but the entire paper appears to be just on surgery.

Categorization of research scope: I could not fully follow the categorization of the research scope. The last three categories appear to have quite some overlap. Also, they do not reflect the five subsections of that same section. Finally, it would be helpful to write down explicit research questions related to all categories. This would also be important for consistency because currently, only one category has included corresponding research questions.

Overall, the existing literature was reviewed well but I was missing explicit mentioning of the *primary* challenges that need to be overcome - both from a medical and a technical point of view. Also, more concrete statements about the key clinical applications would be helpful.

Data acquisition and curation:

- It would be helpful to make explicit what data is already captured and what data is not.
- Existing initiatives on the topic should be mentioned (e.g. OntoSPM, OR.net)

Analytics to transform existing quality improvement methodologies

- To me, the paragraph sounds like a paragraph on biomedical data science. What makes the methods and applications mentioned different from those in a biomedical data science context?

Analytics to inform and improve surgical care processes

- It should be clarified that there is not generic answer to the research questions stated. Instead, the answer will depend crucially on the application.

Analytics to enable intelligent collaboration between care providers and technology

- From the title, I was expecting different content in this paragraph. The aspect of „collaboration“ seems to be neglected. Instead, the majority of the section talks about decision-making

What are potential risks associated with SDS?

Authors' Response to Reviewer Comments

Feb 15, 2017

Reviewer #1:

1. Key clinical applications for SDS

While clinical applications for SDS are encompassed within the five conceptual areas listed in the manuscript, bringing together relevant stakeholders to prioritize and identify key clinical applications and to specify an actionable agenda for SDS are now explicitly discussed in the section on Future directions and research gaps. We believe a conceptual discussion is appropriate in this manuscript and refer the readers to consensus writings by authors of the SDS initiative for particulars.

2. Importance of SDS as compared to RCTs

We addressed this in both the original and revised versions of the manuscript. See fifth paragraph in the section on Future directions and research gaps.

Reviewer #2:

1. Relevance to initiative described at www.surgical-data-science.org, and correspondence to short position paper from the workshop.

Thank you for this note. This manuscript provides a conceptual overview of surgical data science and thus complements the community consensus described in the short position paper from the workshop, which is now cited here. See first paragraph under What is Surgical/Interventional Data Science (SDS) and what it is not?

2. Reference to consensus definition of SDS in the short position paper on Arxiv.

This paper is now cited. In the current manuscript, we do not attempt to define SDS. Instead, we describe our perspective on how it aims to improve healthcare and training.

3. Categorization of research scope

We clarified these categories to match the subsequent narrative. See section on “Research scope for SDS”.

4. Primary challenges that need to be overcome and key clinical applications

While clinical applications for SDS are encompassed within the five conceptual areas listed in the manuscript, we now discuss in the section on Future directions and research gaps, bringing together relevant stakeholders to identify and prioritize key clinical applications, and to specify an actionable agenda for SDS. We believe that a conceptual discussion is appropriate in this manuscript and refer the readers to consensus writings by authors of the SDS initiative for particulars.

5. Data acquisition and curation - making explicit what data is already captured and what is not, and citing existing initiatives.

While we agree that an exhaustive listing of what data is now captured and what is not can be informative, we have adopted a more conceptual narrative for this paper. However, we have added OR.net to the narrative on data acquisition as suggested by the reviewer. See third paragraph in section on data acquisition and curation.

6. Analytics to transform existing quality improvement methodologies - what makes the methods and applications mentioned different from those in a biomedical data science context?

This is now explained in the first paragraph in the section on analytics to transform existing quality improvement methodologies.

7. Analytics to inform and improve surgical care processes - application-specific nature of solutions to research questions.

This is now acknowledged as suggested by the reviewer. See paragraph preceding the list of research questions in the section on analytics to inform and improve surgical care processes.

8. Analytics to enable intelligent collaboration between care providers and technology.

We intended to emphasize that context-aware decision-support is an important aspect of intelligent collaboration between care providers and technology, because such collaboration can not only have a direct impact on quality of care but also because achieving it is realistic in the short-term. We also discuss physical collaboration between technology and care providers later in this section.

9. Potential risks associated with SDS.

While we believe that the risks associated with SDS are not different in magnitude or nature relative to those with any other data-intensive discipline affecting clinical care, these are now briefly discussed in the first paragraph in the section on future directions and research gaps.

Reviewers' Comments to 1st Revision

Reviewer 1: anonymous

Feb 21, 2017

Reviewer Recommendation Term:	Accept
Overall Reviewer Manuscript Rating:	90
Custom Review Questions	Response
Is the subject area appropriate for you?	5 - High/Yes
Does the title clearly reflect the paper's content?	4
Does the abstract clearly reflect the paper's content?	5 - High/Yes
Do the keywords clearly reflect the paper's content?	4
Does the introduction present the problem clearly?	4
Are the results/conclusions justified?	5 - High/Yes
How comprehensive and up-to-date is the subject matter presented?	5 - High/Yes
How adequate is the data presentation?	5 - High/Yes
Are units and terminology used correctly?	4
Is the number of cases adequate?	N/A
Are the experimental methods/clinical studies adequate?	N/A
Is the length appropriate in relation to the content?	4
Does the reader get new insights from the article?	5 - High/Yes
Please rate the practical significance.	5 - High/Yes
Please rate the accuracy of methods.	4
Please rate the statistical evaluation and quality control.	N/A
Please rate the appropriateness of the figures and tables.	4
Please rate the appropriateness of the references.	5 - High/Yes
Please evaluate the writing style and use of language.	5 - High/Yes
Please judge the overall scientific quality of the manuscript.	4
Are you willing to review the revision of this manuscript?	Yes

Comments to Authors:

Thank you for revising the manuscript according to the reviewers recommendations.

Reviewer 2: anonymous

Feb 28, 2017

Reviewer Recommendation Term:	Revise with Major Modifications
Overall Reviewer Manuscript Rating:	N/A
Custom Review Questions	Response
Is the subject area appropriate for you?	1 - Low/No
Does the title clearly reflect the paper's content?	1 - Low/No
Does the abstract clearly reflect the paper's content?	3
Do the keywords clearly reflect the paper's content?	4
Does the introduction present the problem clearly?	1 - Low/No
Are the results/conclusions justified?	3
How comprehensive and up-to-date is the subject matter presented?	1 - Low/No
How adequate is the data presentation?	3
Are units and terminology used correctly?	5 - High/Yes
Is the number of cases adequate?	N/A
Are the experimental methods/clinical studies adequate?	N/A
Is the length appropriate in relation to the content?	5 - High/Yes
Does the reader get new insights from the article?	3
Please rate the practical significance.	N/A
Please rate the accuracy of methods.	N/A
Please rate the statistical evaluation and quality control.	N/A
Please rate the appropriateness of the figures and tables.	5 - High/Yes
Please rate the appropriateness of the references.	5 - High/Yes
Please evaluate the writing style and use of language.	5 - High/Yes
Please judge the overall scientific quality of the manuscript.	2
Are you willing to review the revision of this manuscript?	Yes

Comments to Authors:

The authors have responded to a few of the reviewers' concerns but most of the review comments remain to be addressed. From what I understand from the response, the paper can be seen complementary to the state of the art. However, this is not yet reflected in the manuscript.

Most important comments:

Reviewer #2 (Comment #1) Relevance to initiative described at www.surgical-data-science.org, and correspondence to short position paper from the workshop: This comment has not been adequately addressed. In the introduction of the manuscript, the authors should clearly explain the contribution of the manuscript in the context of related work. Among others, the reader should understand how the paper relates to the international initiative and it is complementary or contradictory to the positional paper [16]. If complementary, this contribution in the context of the state of the art in the field should be reflected also by the title of the paper.

Reviewer #2 (Comment #2) Reference to consensus definition of SDS [16]: A consensus definition of an international consortium should be given high weight in the context of an emerging research field. The authors state in their response that they do not want to define SDS but only provide their perspective on how it can change healthcare and training. The manuscript reads differently, though. The „What is Surgical Data Science“ section should address agreement and disagreement, thus citing the consensus definition and adding further information if required (although I have not understood what further information the paragraph provides).

Further major remarks:

Reviewer #2 (Comment #3) Categorization of research scope: This part of my comment „Finally, it would be helpful to write down explicit research questions related to all categories. This would also be important for consistency because currently, only one category has included corresponding research questions.“ has not been addressed in the revision.

Reviewer #2 (Comment #5) Data acquisition and curation: I would like to come back to my comment in the previous review „It would be helpful to make explicit what data is already captured and what data is not.“ I believe that such details are essential for making this paper more than a „positional paper“.

Reviewer #2 (Comment #6) Analytics to transform existing quality improvement methodologies - what makes the methods and applications mentioned different from those in a biomedical data science context?: The authors claim to have addressed this aspect but I could not find it. In fact, there is no mention of the term „biomedical data science“ in the document.

Reviewer #2 (Comment #8) Analytics to enable intelligent collaboration between care providers and technology: I could not find any changes in the document related to this comment.

Reviewer #1 (Comment #1) Key clinical applications for SDS: The other reviewer asked for an actionable agenda. I did not see this comment addressed but would find it very beneficial for the paper.

Authors' Response to Reviewer Comments

Mar 14, 2017

Reviewer #1: Thank you for revising the manuscript according to the reviewers recommendations. Thank you for your time in guiding a revision of our manuscript.

Reviewer #2: The authors have responded to a few of the reviewers' concerns but most of the review comments remain to be addressed. From what I understand from the response, the paper can be seen complementary to the state of the art. However, this is not yet reflected in the manuscript.

Authors' response: Thank you. We attempted to re-address your comments in this revision.

Most important comments:

Reviewer #2 (Comment #1) Relevance to initiative described at www.surgical-data-science.org, and correspondence to short position paper from the workshop: This comment has not been adequately addressed. In the introduction of the manuscript, the authors should clearly explain the contribution of the manuscript in the context of related work. Among others, the reader should understand how the paper relates to the international initiative and it is complementary or contradictory to the positional paper [16]. If complementary, this contribution in the context of the state of the art in the field should be reflected also by the title of the paper.

Authors' response: We added text in the Introduction to address this comment. See last paragraph of the Introduction section.

We did not attempt to change the title because it was the Editor's suggestion included in the original correspondence regarding this manuscript. We brought it to the Editor's notice and are happy to be responsive if the Editor prefers a change to the title.

Reviewer #2 (Comment #2) Reference to consensus definition of SDS [16]: A consensus definition of an international consortium should be given high weight in the context of an emerging research field. The authors state in their response that they do not want to define SDS but only provide their perspective on how it can change healthcare and training. The manuscript reads differently, though. The "What is Surgical Data Science" section should address agreement and disagreement, thus citing the consensus definition and adding further information if required (although I have not understood what further information the paragraph provides).

Further major remarks:

Authors' response: We agree that a consensus statement is authentic. The discordance noted by the reviewer seems to arise from the subheading used to entitle these two paragraphs. As the reviewer observed, we did not attempt to define surgical data science in this manuscript. Instead, we focus on our perspective of how surgical data science aims to improve healthcare through data and evidence and fits with existing alternative approaches to this end.

We edited the subheading for this section to match the narrative. See title for section on Aims and Relevance of SDS.

Reviewer #2 (Comment #3) Categorization of research scope: This part of my comment "Finally, it would be helpful to write down explicit research questions related to all categories. This would also be important for consistency because currently, only one category has included corresponding research questions." has not been addressed in the revision.

Authors' response: We added research questions for the remaining categories.

Reviewer #2 (Comment #5) Data acquisition and curation: I would like to come back to my comment in the previous review „It would be helpful to make explicit what data is already captured and what data is not." I believe that such details are essential for making this paper more than a "positional paper".

Authors' response: The data that are being captured is highly dependent on the context. For example, none or minimal data are captured in some settings such as in a developing country. Thus it is not feasible to make a generic statement about what data are already captured and what data are not captured. We added a comment to this effect. See second paragraph in the section on Data acquisition and curation.

Reviewer #2 (Comment #6) Analytics to transform existing quality improvement methodologies - what makes the methods and applications mentioned different from those in a biomedical data science context?: The authors claim to have addressed this aspect but I could not find it. In fact, there is no mention of the term "biomedical data science" in the document.

Authors' response: The section on quality improvement methods emphasizes a contrast between traditional registry-based approach and a data science approach. We believe that this contrast is important because of the central role that registries currently play in surgical quality improvement.

Furthermore, we are not attempting to draw hard technical boundaries between data sciences in various biomedical fields. In our search of the literature, we have been unable to identify a consensus definition for biomedical data. However, we note that historically, biomedical data science, for which one definition is available at <http://med.stanford.edu/dbds.html>, did not include evaluation of human performance

in healthcare. This is one of the unique aspects of SDS - studying human performance and its impact on the clinical (and biological) problem at hand.

We added a comment to this effect in the first paragraph under the renamed section on Aims and relevance of SDS.

Reviewer #2 (Comment #8) Analytics to enable intelligent collaboration between care providers and technology: I could not find any changes in the document related to this comment.

Authors' response: We revised this section in response to the comment. See section on Analytics to enable intelligent collaboration between care providers and technology.

Reviewer #1 (Comment #1) Key clinical applications for SDS: The other reviewer asked for an actionable agenda. I did not see this comment addressed but would find it very beneficial for the paper.

Authors' response: Below is our earlier response to this comment from the other reviewer.

“While clinical applications for SDS are encompassed within the five conceptual areas listed in the manuscript, bringing together relevant stakeholders to prioritize and identify key clinical applications and to specify an actionable agenda for SDS are now explicitly discussed in the section on Future directions and research gaps. We believe a conceptual discussion is appropriate in this manuscript and refer the readers to consensus writings by authors of the SDS initiative for particulars.”

Our objective for the current manuscript is to spur discussion and consequently, engagement amongst stakeholders across a broad spectrum of scientific disciplines, roles within healthcare, and geography/clinical settings. We added a comment to this effect - see first paragraph under Future directions and research gaps.

Reviewers' Comments to 2nd Revision

Reviewer 2: anonymous

Mar 17, 2017

Reviewer Recommendation Term:	Accept with Minor Revision
Overall Reviewer Manuscript Rating:	50

Custom Review Questions	Response
Is the subject area appropriate for you?	3
Does the title clearly reflect the paper's content?	1 - Low/No
Does the abstract clearly reflect the paper's content?	3
Do the keywords clearly reflect the paper's content?	3
Does the introduction present the problem clearly?	3
Are the results/conclusions justified?	3
How comprehensive and up-to-date is the subject matter presented?	3
How adequate is the data presentation?	N/A
Are units and terminology used correctly?	N/A
Is the number of cases adequate?	N/A
Are the experimental methods/clinical studies adequate?	N/A
Is the length appropriate in relation to the content?	3
Does the reader get new insights from the article?	3
Please rate the practical significance.	3
Please rate the accuracy of methods.	N/A
Please rate the statistical evaluation and quality control.	N/A
Please rate the appropriateness of the figures and tables.	3
Please rate the appropriateness of the references.	3
Please evaluate the writing style and use of language.	3
Please judge the overall scientific quality of the manuscript.	3
Are you willing to review the revision of this manuscript?	Yes

Comments to Authors:

Reviewer #2 (Comment #5) Data acquisition and curation: I would like to come back to my comment in the previous review „It would be helpful to make explicit what data is already captured and what data is not.“ I believe that such details are essential for making this paper more than a „positional paper“.

Authors' response: The data that are being captured is highly dependent on the context. For example, none or minimal data are captured in some settings such as in a developing country. Thus it is not feasible to make a generic statement about what this effect. See second paragraph in the section on Data acquisition and curation.

The reviewer will let the editor decide whether the challenges are satisfactory. It appears to the reviewer that the paper should state the technological Challenges and initiatives (actionable agenda).

„What technological challenges need to be overcome to developing surgical data capture systems that integrate multi-modal data from a variety of sensors and devices? What are consensus standards for how different types of surgical data are curated to create shared databases?“

The reviewer will let the editor decide whether the title is appropriate. The reviewer would expect an explanation for not changing title.
