Author's response to reviews

Title: Smart Wearable Body Sensors for Patient Self-Assessment and Monitoring

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Author's response to reviews: see over
Response to reviewers

Dear Editor,

Thank you for your review of our manuscript. Please find hereafter our responses.

Reviewer 1:

1-the paper indicated this is a systematic review, but the authors fail to indicate how they ensured the review was indeed systematic.

The editorial team provided an update e-mail that noted that there was a major error in the title of the manuscript as it is not a systematic review but a commentary on smart wearable body sensors.

2-the paper would benefit from an illustration (maybe a Table)

Thank you for this comment, we agree that a table would be a useful tool to summarize the vast amount of information for readers, and we have added one.

3-it seems to me that in the glucose monitoring section a word about the contact lens glucose sensor would be welcome.

This is a great comment and we have added this into the manuscript. We initially did not know whether to add this or not since the data on this technology is still relatively new but we believe that this addition will appeal to the readers.

The level of precision is too high in Page 10 (decimals)

We have removed the decimals and margin of errors as to not detract from the body of the paper.
Reviewer 2:

1) The title refers to a systematic review. Nevertheless, there is no method section in the paper explaining how the systematic research synthesis was performed in order to minimize bias. If the authors decided not to follow the recommended inclusion of a clear description of all stages of the review process and the design of the review, they should at least explain why this choice was made to make the distinction with a traditional systematic review. However, a short and clear description of the methodology in the paper would be worthwhile to be considered as a systematic review. If not, the title should be adapted accordingly.

We thank you for this observation. The editorial team provided an update e-mail that noted that there was a major error in the title of the manuscript as it is not a systematic review but a commentary on smart wearable body sensors. Please refer to the manuscript for an updated introduction that elucidates the method for how we did our review.

2) In the same way, the recommended results and discussion sections are not distinguished, allowing not the provision of an evidence-based synthesis. I guess that the research field encompassed by this paper is too broad for this kind of analysis, but the authors should also mention that in the method or in the limitation section.

We agree that this would strengthen our manuscript. We have added a section in the current limitations section that addresses the fact that this is a non-systematic review and as such is susceptible to biases. We also stated that the research fields are broad for a systematic review. We believe that this is a new field and most researchers and clinicians are not familiar with this technology and potential for research.

Minor Essential Revisions

1) The papers often refer to the US to explain how a focus on SWS could change the actual healthcare system: i.e., in the conclusion section, "These changes will alter the way that this country spends money on healthcare". Because this review is not only focused on the US, the conclusions limited to this country should be avoided, or at least accompanied by a more global view.

Thank you for this insight. We addressed this issue in the new version of the manuscript by including the possibility that the integration of sensors will have utility in other countries as well.

2) Some parts of the paper do not rely on literature evidence that could ensure the legitimacy of the statements:
- The first paragraph of the “Wearable body Sensors” section
- The statement about the ability of the AliveCor’s device to provide accurate and reliable data
- The definition and the description of the “quantified self” concept

We agree with these comments. Please refer to the manuscript for the description of the literature evidence, which has been added.
3) Some abbreviations are presented without an earlier full form: BP, EKG and FDA. We have corrected this mistake in the manuscript.

4) It is not always clear that numbers in parentheses referred to mean values, confidence interval or square deviation. We have carefully revised the manuscript to clarify the meaning of the numbers in parentheses.

5) In the second paragraph of the limitation sections, some references do not respect the referencing style (3-6).
This formatting error was corrected.

6) In the first paragraph of the Cardiopulmonary and Vascular Monitoring section, a zero number must be deleted in the middle of the word “patterns”.
This formatting error was corrected.

Discretionary Revisions

1) Regarding to the actual title of the paper, the reader could expect a systematic and evidence-based overview of the main SWS in the field. After reading the paper, it is difficult for the reader to capture a clear synthesis of the current situation. A summary (e.g., in a table) of the actual sensors (and their main characteristics) used in each clinical application would then help to understand the contribution of this review in the field.
We agree that a table would be helpful to categorize all of the information in the paper and we added one to the manuscript.

2) Bring up to date information about SWS in the last paragraph of the introduction section would be appropriate. Next to Smart Vest, new monitoring tools such as Smart shirts are even more convenient (e.g., see the paper of Sardini & Serpalloni about “T-Shirt for Vital Parameter Monitoring”).
We would like to thank reviewer 2 for this insight. After reading this chapter, we agreed that it would be a good addition to this section which allows the reader to understand the potential benefits of this technology. We have added a section in the manuscript.

3) In the current limitations section, I recommend to the author to consider the literature about the Actiheart Monitor, another multiple sensor combining accelerometry and heart rate monitoring used in health-related studies (e.g., doi: 10.2337/dc12-2671).
This has been added to the limitation section.
Reviewer 3:

1-The authors should consider rewrite the Introduction section. In general, this section was disconnected from the rest of manuscript, and the topics of the study were not clearly delimited. Even the main topic of the study, the “smart wearable body sensors” (SWS) was not clearly well-defined. Please, define clearly what kind of device can be considered as SWS.

Thank you for this. We have rewritten the introduction to follow the recommendation and structure.

In the first sentence of the second paragraph, the authors try to define: “wellness and fitness wearable device”. Is this synonym for SWS? If yes, the authors should consider the use of the same terms throughout the manuscript to facilitate the understanding. Are there other papers that review the use of SWS in medicine?

The wording of this section was ambiguous and we have restructured the introduction. Rather than “wellness and fitness wearable device” we used SWS. There have been other papers that review SWS in medicine but none have described the clinical implications explicitly as we do in this paper.

What is the relevance of pointing out the “three approaches for outpatient monitoring”? What is their relation to the SWS? It is not clear if SWS is a type of telemonitoring or “Quantifying self-hybrid models” (QSHM).

These three approaches were incorporated in order to explain to the reader the different models under which SWS would be utilized in a clinical setting. We clarified the role of SWS and what category they fit into.

**Cardiopulmonary and Vascular Monitoring** Different kinds of sensors are revised in this sub-section, however no clinical studies in which these sensors are tested with patients are discussed (as in the second paragraph of Glucose Home Monitoring Sub-section or in Neurological Function Monitoring Sub-section). Are there no studies with patients monitoring SWS use in Cardiopulmonary and Vascular area?

Thank you for this input. Please refer to the updated manuscript for the addition of the clinical studies in this section.

**Neurological Function Monitoring**
In some cases the results of papers are discussed too deeply, even percentages are cited. The purpose of citing others papers is to give examples of how SWS can be used or discuss the reliability of the SWS, but not discuss the main results of the paper. Eg.: line 12 “This study showed that patients with CP related gait disorders had a 21.70 (36.06) % (...)” line 23 “They also mention the the physical activity was very low, with 58% of the participants (...)”

In order to clarify the examples that we used in the paper, we took away the decimal places and margins of errors.
Maybe the authors could consider discussing both benefits and limitations of the sensors in each sub-section and then in the conclusion resume both sides and conclude if the use of SWS should be recommended or not to patients. The discussion between carried item versus wearable item in the beginning of the Glucose home monitoring subsection is very interesting and should be more explored in the Introduction section.

This is a great comment. We have debated on which format was better and ultimately believe that having the pro’s/con’s in each section would be too cumbersome for the reader. However, we did try to clarify the concepts and in the limitations section. Please refer to the updated manuscript for changes in glucose home monitoring subsection.

Reviewer 4

1- The editorial team provided an update e-mail that noted that there was a major error in the title of the manuscript as it is not a systematic review but a commentary on smart wearable body sensors. This important change allows the content to better fit the criteria’s of the selected article type and it would be good to see these “article type” changes implemented throughout the article. A good number of relevant scientific articles have been used to comment on the aforementioned topic. However, it is unclear how relevant sources where found. It would be good to describe what the approach was to obtain the relevant literature. This is especially important in a field that uses a range of names to cover the same concept. A more specific definition of Smart wearable body sensors (SWS) will also help readers to understand how this differs from other often used terms such as Body Sensor Networks (BSN).

If preferred a flowchart can be added to explain the search procedure. It would be useful to explain search procedures, as this topic crosses the boundaries of more traditional fields. It will also explain why certain articles might have been left out in the commentary.

We added a methods section in order to explain our review process for ascertaining articles, keywords, and selection criteria. We also modified the definition of SWS for clarity. The nature of our review may not lend itself to an orderly flow chart, but should you think this would help the reader better navigate the manuscript, we are happy to provide this for you. Furthermore, we did acknowledge the possibility of a bias with this review, as with any commentary.

The study should also highlight which other literature reviews and commentaries have been conducted within the scope of this research question. For example, the commentary might draw on Bonato’s paper from 2010. Ideally the commentary would point out the limitations (and strengths) of those other reviews and perspectives. It will also be good to subsequently highlight the additional value this commentary will bring.

We would like to thank reviewer 4 for his suggestion. Bonato’s paper is an interesting general description of wearable technology published a couple of years ago. The fast growing world of SWS has had more time to produce verifiable results and make their devices more commercially available to consumers. Please refer to the updated manuscript for the reflection of these additions.
In general, the articles referenced seem to be assessed with minimum criticism. There is little scrutiny regarding the validity of the devices presented. It would be good to describe the quality of the studies that apply these devices? How did these systems hold up against a gold reference system? What is the bias towards positive results in a field where many of the authors are also the system developers? Missing information regarding critical assessment might provide a view that less than balanced. It would be good to comment on other major issues, such as the increase of data, analysis and management to often goes hand in hand with applying SWS.

The value of wearable clinical technologies needs to be set by randomized controlled trials. At the moment there is a lack of this kind of studies making it hard to state it has a major impact on the current clinical care. “Valid” applications in the laboratory often does not necessary translate to proper real-world applications, due to interference, motion artifacts, etc. This discrepancy between research and current clinical care will be important and interesting to comment on.

We agree with reviewer 4 that there is little evidence because it is a new field and we have amended our discussion section to make the reader aware of these issues. Unfortunately, due to the dearth of randomized clinical trials, it is very difficult to truly scrutinize some of the results that were reported. We have expended our discussion section in the manuscript to raise these points. Further studies are definitely needed to validate the general use.

Minor Essential Revisions
Page 10 states that: “... 21.70(36.06) % residual short-term improvement in walking speed and 8.72(9.47) % increase in stride length with visual feedback, and 25.43(28.65) % in walking speed and 13.58 (13.1) % ...” I assume that the percentage and absolute values are given, but this is not very clear. Maybe add the units to clarify. Page 15. “...reduce this number3-6.” It seems like reference format has been changed for this sentence

After review we realized that this level of detail was unnecessary and detracted from the paper; therefore, we omitted the margins of error and decimal places.