PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form (**http://bmjopen.bmj.com/site/about/resources/checklist.pdf**) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below.

ARTICLE DETAILS

TITLE (PROVISIONAL)	Contactless monitoring of respiratory rate (RR) and heart rate (HR) in non-acuity settings: A clinical validity study
AUTHORS	Varma, Muralidhar; Sequeira, Trevor; Naidu, Navaneetha; Mallya, Yogish; Sunkara, Amarendranath; Patil, Praveen; Poojary, Nagaraj; Vaidyanathan, Manikanda Krishnan; Balmaekers, Benoît; Thomas, Joseph; Prasad, Shankar; Badagabettu, Sulochan

VERSION 1 – REVIEW

REVIEWER	Diao, James Harvard University
REVIEW RETURNED	10-Jul-2022

GENERAL COMMENTS	This is an interesting and valuable addition to the set of validation studies on non-contact monitoring of vital signs. My suggestions primarily involve best practices for methodological and statistical reporting. 1. I could not find a description (or citation of methods paper) that details the algorithm used to derive RR and HR from video data. Please provide a description or reference where you have already done so. 2. Typo in Table 1: "Wight" should be "Weight". 3. For Tables 2-3: it is not recommended to list p-values in lieu of effect sizes. Please report the effect size (e.g., absolute RR difference) alongside a confidence interval, with asterisks to indicate significance (*: <0.05, **: <0.01, ***: <0.001). Please indicate in the caption whether significance values are corrected for multiple testing. 4. For Figure 1, please indicate whether the participant signed informed consent for their image to be used. Consider also anonymizing the participant's face on the bed and on the screen. 5. Please upload high-res images for Figure 5-7 and combine as subpanels to the same figure. Figure 7 would be better represented as a table. Same for figures 9-11. 6. Please combine figures 8 and 12 as panels of the same figure. 7. Would application of a bandpass filter improve discrimination of true measurements vs. outliers? 8. Please report error measures (e.g., mean squared error or mean absolute error) for both HR and RR in the abstract. 9. Please report comparisons to other validation studies in similar and dissimilar settings; e.g. Villarroel, M. et al. Non-contact vital-sign monitoring of patients undergoing haemodialysis treatment. Sci. Rep. 10, 18529 (2020). 10. Please report the observation setting (ward and dialysis) in the abstract.

REVIEWER	Webster, Craig University of Auckland, Centre for Medical and Health Sciences Education
REVIEW RETURNED	17-Jul-2022

GENERAL COMMENTS	This is a generally well-written and interesting paper. Wireless monitoring in hospitals is an important and emerging technology, but the monitoring modality described in this paper goes a step further, using only video analysis of the patient to monitor heart rate and respiratory rate. There has been a number of publications recently about the value of wireless monitoring which you should mention in the introduction, fore example: Webster CS, Scheeren TWL, Wan YI. Patient monitoring, wearable devices, and the healthcare information ecosystem. Br J Anaesth. 2022 May;128(5):756-758. doi: 10.1016/j.bja.2022.02.034. Epub 2022 Mar 29. PMID: 35365293. Page 3, line 10: “the patient may go unnoticed…” – do you mean deterioration of the patient? Page 4, line 12-17: the second and third bullet points here appear to be very similar – combine them? Also, none of these points emphasise the accuracy of the novel approach for monitoring HR and RR – this is a key strength of your paper? Check grammar in bullet points. Page 8, line 33: “Monitoring extracts pulse and related signals…” – how does it do this? Using video in this way seems very novel and technically challenging, but you give very little detail. I notice on page 15 of discussion you mention chest movements and “blood flow in the patient’s face” – but this detail needs to be expanded and in the methods. How is blood flow in the face detected on video? Are changes in colour able to be detected this way? This would seem to require great sensitivity? Presumably this is also why you comment on skin tone in your paper, but without explaining this detail. Please expand on all these mechanisms. Page 14, line 12: “post pandemic” – post is a prefix not a word, post-pandemic. You have too many figures, most of which are not publication standard since the writing and other details are much too small to be read. Pie charts are also rather uninformative and should be deleted. Some of the other figures could be combined and redrawn.

VERSION 1 – AUTHOR RESPONSE

Reviewer: 1

Dr. James Diao, Harvard University

1. I could not find a description (or citation of methods paper) that details the algorithm used to derive RR and HR from video data. Please provide a description or reference where you have already done so. Reference is given and cited too in the paper.
   ***Response*:** the reference (given below) is being provided.

de Haan G, van Leest A. Improved motion robustness of remote-PPG by using the blood volume pulse signature. Physiol Meas. 2014 Aug 27;35(9):1913-1926. doi: 10.1088/0967-3334/35/9/1913. PMID: 25159049.

2. Typo in Table 1: "Wight" should be "Weight". – Corrected in the table 1
   ***Response*:** corrected.
3. For Tables 2-3: it is not recommended to list p-values in lieu of effect sizes. Please report the effect size (e.g., absolute RR difference) alongside a confidence interval, with asterisks to indicate significance (*: <0.05, **: <0.01, ***: <0.001). Please indicate in the caption whether significance values are corrected for multiple testing.
   Response: has been modified accordingly and given below

Table 3 ANOVA Marginal Test results on categorical data for pulse rate

effect	effect size	p
Alice NightOne (118 wrt 52 BPM)	0.46 (10.043—1.9) BPM	0.09
Age (85 wrt 20 years)	-0.21 (-0.42—0.36) BPM	0.34
Weight (97 wrt 28 kg)	-0.52 (-0.69—0.12) BPM	0.08
Gender:_Female wrt Male	-0.21 (-0.35—0.029) BPM	0.08
Skin type: V wrt IV	0.11 (-0.17—0.7) BPM	0.53
Skin type: III wrt IV	-0.1 (-0.25—0.18) BPM	0.39
Skin type: II wrt IV	0.13 (-0.23—1.1) BPM	0.62
Ward:_ General wrt Dialysis	-0.51 (-0.7—-0.095) BPM	0.02*

Effect sizes reported based on median expected values in absolute PR difference in BPM (for categorical independent variables computed with respect to an arbitrary base category, for continuous variables computed between minimum and maximum of independent effect values in the model data). 95% Confidence Intervals shown in parentheses. Effects with p<0.05 (not corrected for multiple testing) denoted with an asterisk (*).

Table 2 ANOVA Marginal Test results on categorical data for respiration rate

effect	**effect size**	**p**
Contactless Monitoring vs Alice NightOne		
Age (80 wrt 20 years)	-0.044 (-0.29—0.38) BPM	0.79
Gender: Female wrt Male	-0.037 (-0.18—0.15) BPM	0.67
weight (97 wrt 32 kg)	0.16 (-0.2—0.9) BPM	0.47
Skin type: V wrt IV	0.067 (-0.15—0.39) BPM	0.60

Skin type: III wrt IV	0.0095 (-0.17—0.27)	BPM	0.93
Skin type: II wrt IV	-0.12 (-0.36—0.33)	BPM	0.50
Ward: General wrt Dialysis	0.092 (-0.13—0.43)	BPM	0.47
Alice NightOne (38 wrt 11 BPM)	0.59 (0.078—1.6)	BPM	0.02 *
Contactless Monitoring & Manual count			
Age (80 wrt 20 years)	-0.11 (-0.3—0.17)	BPM	0.38
Gender: Female wrt Male	0.021 (-0.095—0.17)	BPM	0.74
weight (97 wrt 32 kg)	-0.012 (-0.26—0.42)	BPM	0.94
Skin type: V wrt IV	-0.053 (-0.2—0.15)	BPM	0.56
Skin type: III wrt IV	-0.044 (-0.18—0.13)	BPM	0.59
Skin type: II wrt IV	0.088 (-0.19—0.55)	BPM	0.60
Ward: General wrt Dialysis	-0.099 (-0.26—0.12)	BPM	0.34
Alice NightOne (38 wrt 11 BPM)	0.29 (-0.043—0.87)	BPM	0.10
Manual count & Alice NightOne			
Age (80 wrt 20 years)	0.073 (-0.11—0.48)	BPM	0.54
Gender: Female wrt Male	-0.071 (-0.16—0.06)	BPM	0.25
weight (97 wrt 32 kg)	0.031 (-0.17—0.6)	BPM	0.84
Skin type: V wrt IV	0.14 (-0.027—0.45)	BPM	0.12
Skin type: III wrt IV	0.055 (-0.065—0.26)	BPM	0.44
Skin type: II wrt IV	0.12 (-0.11—0.73)	BPM	0.41
Ward: General wrt Dialysis	0.093 (-0.057—0.37)	BPM	0.29
Alice NightOne (38 wrt 11 BPM)	0.38(0.014—1.4)	BPM	0.04 *

Effect sizes reported based on median expected values in absolute RR difference in BPM (for categorical independent variables computed with respect to an arbitrary base category, for continuous variables computed between minimum and maximum of independent effect values in the model data). 95% Confidence Intervals shown in parentheses. Effects with $p<0.05$ (not corrected for multiple testing) denoted with an asterisk (*).

4. For Figure 1, please indicate whether the participant signed informed consent for their image to be used. Consider also anonymizing the participant's face on the bed and on the screen.
   Response: Yes, consent is obtained, and face will be anonymized and resubmitted once again.
5. Please upload high-res images for Figure 5-7 and combine as subpanels to the same figure. Figure 7 would be better represented as a table. Same for figures 9-11.
   Response: the fig 5 and 7 is resized and contained. Figure 7 has been depicted in table too and fig 9.11 too.
6. Please combine figures 8 and 12 as panels of the same figure.
   Response: the fig 8 and 12 is resized and contained
7. Would application of a bandpass filter improve discrimination of true measurements vs. outliers?
   Response: Bandpass filtering is used; however remaining outliers consist of estimates that deviate from the reference but still fall within the physiologically plausible ranges that we aim to cover.
8. Please report error measures (e.g., mean squared error or mean absolute error) for both HR and RR in the abstract.
   Response: Reported in the abstarct
9. Please report comparisons to other validation studies in similar and dissimilar settings; e.g. Villarroel, M. et al. Non-contact vital-sign monitoring of patients undergoing hemodialysis treatment. Sci. Rep. 10, 18529 (2020).
   Response: data of this paper was incorporated
10. Please report the observation setting (ward and dialysis) in the abstract.
    Response: done

Reviewer: 2

Dr. Craig Webster, University of Auckland

1. This is a generally well-written and interesting paper. Wireless monitoring in hospitals is an important and emerging technology, but the monitoring modality described in this paper goes a step

further, using only video analysis of the patient to monitor heart rate and respiratory rate. There has been a number of publications recently about the value of wireless monitoring which you should mention in the introduction, for example: Webster CS, Scheeren TWL, Wan YI. Patient monitoring, wearable devices, and the healthcare information ecosystem. Br J Anaesth. 2022 May;128(5):756-758. doi: 10.1016/j.bja.2022.02.034. Epub 2022 Mar 29. PMID: 35365293.
Response: the reference was cited in the current paper.

2. Page 3, line 10: “the patient may go unnoticed…” – do you mean deterioration of the patient?
Response: modified accordingly.
3. Page 4, line 12-17: the second and third bullet points here appear to be very similar – combine them? Also, none of these points emphasize the accuracy of the novel approach for monitoring HR and RR – this is a key strength of your paper? Check grammar in bullet points.
Response: the pictures were combined and reported.
4. Page 8, line 33: “Monitoring extracts pulse and related signals…” – how does it do this? Using video in this way seems very novel and technically challenging, but you give very little detail. I notice on page 15 of discussion you mention chest movements and “blood flow in the patient’s face” – but this detail needs to be expanded and in the methods. How is blood flow in the face detected on video? Are changes in colour able to be detected this way? This would seem to require great sensitivity. Presumably this is also why you comment on skin tone in your paper, but without explaining this detail. Please expand on all these mechanisms.
Response: Details are provided with clarification on pages 7, 15 of this documentation, as well as a reference(quoted) for additional reading is provided.
5. Page 14, line 12: “post pandemic” – post is a prefix not a word, post-pandemic.
Response: done
6. You have too many figures, most of which are not publication standard since the writing and other details are much too small to be read. Pie charts are also rather uninformative and should be deleted. Some of the other figures could be combined and redrawn.
Response: Some of the figures are modified and combined accordingly.