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# JMIRx Med

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MPA, PhD, CEng, FBCS, EUR ING

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## Contents

### Peer-Review Reports

Peer Review of “Telerehabilitation for People With Physical Disabilities and Movement Impairment: A Survey of United Kingdom Practitioners” (e35848) Anonymous. ....	3
Peer Review of “Telerehabilitation for People With Physical Disabilities and Movement Impairment: A Survey of United Kingdom Practitioners” (e35850) Anonymous. ....	5
Peer Review of “Telerehabilitation for People With Physical Disabilities and Movement Impairment: A Survey of United Kingdom Practitioners” (e35852) Katelyn Brehon. ....	7
Peer Review of “Telerehabilitation for People With Physical Disabilities and Movement Impairment: A Survey of United Kingdom Practitioners” (e35853) Maria Stein. ....	9
Peer Review of “Continuous User Experience Monitoring of a Patient-Completed Preoperative Assessment System in the United Kingdom: Cross-sectional Study” (e35509) Mathew Mbwogge. ....	12
Peer Review of “Continuous User Experience Monitoring of a Patient-Completed Preoperative Assessment System in the United Kingdom: Cross-sectional Study” (e35507) Andrea Mahnke. ....	16
Peer Review of “COVID-19 Infection and Symptoms Among Emergency Medicine Residents and Fellows in an Urban Academic Hospital Setting: Cross-sectional Questionnaire Study” (e36207) Reza Shahriarirad. ....	18
Peer Review of “Measuring Integrated Novel Dimensions in Neurodevelopmental and Stress-Related Mental Disorders (MIND-SET): Protocol for a Cross-sectional Comorbidity Study From a Research Domain Criteria Perspective” (e36235) Emma Palmer. ....	22
Peer Review of “Measuring Integrated Novel Dimensions in Neurodevelopmental and Stress-Related Mental Disorders (MIND-SET): Protocol for a Cross-sectional Comorbidity Study From a Research Domain Criteria Perspective” (e36237) Max Birk. ....	24

## Original Papers

Peer Review of “COVID-19 Infection and Symptoms Among Emergency Medicine Residents and Fellows in an Urban Academic Hospital Setting: Cross-sectional Questionnaire Study” ([e36209](#))  
 Jorge Tavares. . . . . 20

Continuous User Experience Monitoring of a Patient-Completed Preoperative Assessment System in the United Kingdom: Cross-sectional Study ([e31679](#))  
 Inocencio Maramba, Arunangsu Chatterjee. . . . . 45

COVID-19 Infection and Symptoms Among Emergency Medicine Residents and Fellows in an Urban Academic Hospital Setting: Cross-sectional Questionnaire Study ([e29539](#))  
 Stacey Frisch, Sarah Jones, James Willis, Richard Sinert. . . . . 58

Telerehabilitation for People With Physical Disabilities and Movement Impairment: A Survey of United Kingdom Practitioners ([e30516](#))  
 Sarah Buckingham, Krithika Anil, Sara Demain, Hilary Gunn, Ray Jones, Bridie Kent, Angela Logan, Jonathan Marsden, E Playford, Jennifer Freeman. . . . . 83

## Authors’ Response to Peer Reviewss

Authors' Responses to Peer Review of “Telerehabilitation for People With Physical Disabilities and Movement Impairment: A Survey of United Kingdom Practitioners” ([e35845](#))  
 Sarah Buckingham, Krithika Anil, Sara Demain, Hilary Gunn, Ray Jones, Bridie Kent, Angela Logan, Jonathan Marsden, E Playford, Jennifer Freeman. . . . . 27

Authors' Response to Peer Reviews of “Continuous User Experience Monitoring of a Patient-Completed Preoperative Assessment System in the United Kingdom: Cross-sectional Study” ([e35504](#))  
 Inocencio Maramba, Arunangsu Chatterjee. . . . . 34

Authors' Response to Peer Reviews of “COVID-19 Infection and Symptoms Among Emergency Medicine Residents and Fellows in an Urban Academic Hospital Setting: Cross-sectional Questionnaire Study” ([e36198](#))  
 Stacey Frisch, Sarah Jones, James Willis, Richard Sinert. . . . . 37

Authors' Response to Peer Reviews of “Measuring Integrated Novel Dimensions in Neurodevelopmental and Stress-Related Mental Disorders (MIND-SET): Protocol for a Cross-sectional Comorbidity Study From a Research Domain Criteria Perspective” ([e36212](#))  
 Philip van Eijndhoven, Rose Collard, Janna Vrijsen, Dirk Geurts, Alejandro Vasquez, Arnt Schellekens, Eva van den Munckhof, Sophie Brolsma, Fleur Duyser, Annemiek Bergman, Jasper van Oort, Indira Tendolkar, Aart Schene. . . . . 40

## Protocol

Measuring Integrated Novel Dimensions in Neurodevelopmental and Stress-Related Mental Disorders (MIND-SET): Protocol for a Cross-sectional Comorbidity Study From a Research Domain Criteria Perspective ([e31269](#))  
 Philip van Eijndhoven, Rose Collard, Janna Vrijsen, Dirk Geurts, Alejandro Vasquez, Arnt Schellekens, Eva van den Munckhof, Sophie Brolsma, Fleur Duyser, Annemiek Bergman, Jasper van Oort, Indira Tendolkar, Aart Schene. . . . . 65

# Peer Review of “Telerehabilitation for People With Physical Disabilities and Movement Impairment: A Survey of United Kingdom Practitioners”

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Anonymous

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## KEYWORDS

telerehabilitation; physical disabilities; movement impairment; remote assessments; telehealth; rehabilitation; training; health care practitioners; physiotherapy; occupational therapy

*This is a peer-review report submitted for the paper “Telerehabilitation for People With Physical Disabilities and Movement Impairment: A Survey of United Kingdom Practitioners.”*

## Round 1 Review

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### General Comments

This paper [1]: The manuscript has been well written and well organized; it needs some minor revisions.

### Minor Comments

1. It is not clear how the authors have used a combination of “opportunity” and “snowball” sampling methods considering that these are two separate methods of purposeful sampling. Additionally, it is not clear how these methods have been used, so the sampling method and justification should be explained

in more detail in the Methods section; although, it has been reported as a limitation of the study.

2. The first sentence of the Conclusions/Abstract is not based on the findings.

3. Delete this sentence from the Methods: “No statistical correction (such as weighting of items or use of propensity scores) was used; this was not felt to be appropriate as this was not a probabilistic sample.”

4. Authors have reported their results for “pre covid-19 lock down,” “during,” and “post-covid national lock down”; this should be explained in the Methods section.

5. Providing a “Table” for reporting the results that have been reported in Figure 3 is more appropriate and readable.

6. Making some policy recommendations especially for reported obstacles of using telerehabilitation strengthens the Discussion.

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## Conflicts of Interest

None declared.

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## Reference

1. Buckingham SA, Anil K, Demain S, Gunn H, Jones RB, Kent B, et al. Telerehabilitation for people with physical disabilities and movement impairment: a survey of United Kingdom practitioners. *JMIRx Med* 2022;3(1):e30516 [[FREE Full text](https://doi.org/10.2196/30516)] [doi: [10.2196/30516](https://doi.org/10.2196/30516)]
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# Peer Review of “Telerehabilitation for People With Physical Disabilities and Movement Impairment: A Survey of United Kingdom Practitioners”

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Anonymous

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telerehabilitation; physical disabilities; movement impairment; remote assessments; telehealth; rehabilitation; training; health care practitioners; physiotherapy; occupational therapy

*This is a peer-review report submitted for the paper “Telerehabilitation for People With Physical Disabilities and Movement Impairment: A Survey of United Kingdom Practitioners.”*

## Round 1 Review

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### General Comments

This paper [1] reports a mixed methods survey of UK practitioners’ use of telerehabilitation for people with physical disabilities and movement impairment. It investigated practitioners’ experiences of telerehabilitation (including use, perceived benefits and obstacles, and physical outcomes assessed remotely), perceived confidence and competence, knowledge and training needs, and best practice and recommendations. It provides practical clinical recommendations for practitioners delivering telerehabilitation and has identified a number of training needs. This is very important research due to the huge uptake of virtual consultations/remote rehabilitation due to the COVID-19 pandemic and much uncertainty over its effectiveness and best

practice. This paper is well written and clear to understand. I have a couple of minor comments.

### Minor Comments

1. The Data Analysis section could include more detail regarding the qualitative analysis method used. The authors state they followed the guidance of Braun and Clarke but more detail on exactly how this was conducted would be beneficial to the readers. Relatedly, it is unclear which results they used this method for; it appears it is the *concerns of practitioners regarding the reliability and validity of remote physical assessments* (Table 4) and *practitioners’ perceived benefits and obstacles of video-based consultations* (Figure 2) sections, but this is unclear. Perhaps the authors could clarify exactly how they conducted their qualitative analysis and which data/results they used this method for.

2. There are a number of clinical practice implications from the results of this study, particularly with the recommendations for carrying out telerehabilitation in Textbox 1. It would be useful to have a clinical implications section in the Discussion, outlining how the results of this study might be useful for clinical practice.

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## Conflicts of Interest

None declared.

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## Reference

1. Buckingham SA, Anil K, Demain S, Gunn H, Jones RB, Kent B, et al. Telerehabilitation for people with physical disabilities and movement impairment: a survey of United Kingdom practitioners. *JMIRx Med* 2022;3(1):e30516 [[FREE Full text](#)] [doi: [10.2196/30516](https://doi.org/10.2196/30516)]
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Peer-Review Report

# Peer Review of “Telerehabilitation for People With Physical Disabilities and Movement Impairment: A Survey of United Kingdom Practitioners”

Katelyn Brehon<sup>1</sup>, BHSc (Hons), MPH

Faculty of Rehabilitation Medicine, University of Alberta, Edmonton, AB, Canada

**Related Articles:**

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**KEYWORDS**

telerehabilitation; physical disabilities; movement impairment; remote assessments; telehealth; rehabilitation; training; health care practitioners; physiotherapy; occupational therapy

*This is a peer-review report submitted for the paper “Telerehabilitation for People With Physical Disabilities and Movement Impairment: A Survey of United Kingdom Practitioners.”*

## Round 1 Review

**General Comments**

This paper [1] adds to the literature base on a very timely and important topic. I appreciated how the qualitative and quantitative results are presented together to highlight each of the major findings. I have provided some comments to help improve the readability and overall quality of the paper, but in general, great work!

**Specific Comments****Major Comments**

1. In the Discussion regarding survey design and development, there is a discussion about how respondents could only submit responses after every relevant section was filled out. Did each question include an option of prefer not to disclose or open ended response option? If not, consider adding this in the future.
2. When you are including quotes in a manuscript, usually if the quote is less than 40 words, you embed it directly in the text. If it is more than 40 words, you do what you have done currently except with indentation on both sides of the quote.

**Minor Comments**

1. Introduction, first paragraph: “...many people received no face-to-face rehabilitation” should read “many people did not receive any face-to-face rehabilitation”

2. Introduction, second paragraph: “In response, practitioners adapted their practice” should read “In response, practitioners adapted their practices”

3. Introduction, second paragraph: “in the United Kingdom (UK) as worldwide” should read “in the United Kingdom (UK) as well as worldwide”

4. Introduction, third paragraph: “...published guidance, training and support in how to undertake...” should read “...published guidance, training and support on how to undertake...”

5. Methods, second paragraph on design and development: “This process involved informal discussions (e-mail and verbal) with specialists in rehabilitation and physical disabilities, including health and social care practitioners and academics, within and external to the project team” should read “This process involved informal discussions (e-mail and verbal) with specialists in rehabilitation and physical disabilities, including health and social care practitioners and academics within, and external to, the project team”

6. Add info regarding how long the survey took approximately to the Methods

7. In your tables, I suggest aggregating any values that are less than 5, as this could be potentially identifying.

8. Consider reorganizing Figure 2 so that patient benefits and obstacles are side-by-side for ease of comparison

9. You provide examples of the various types of obstacles encountered by practitioners but do not provide examples of organizational and governance obstacles; consider adding some examples of what these included.

10. For Table 4, you list key themes and descriptions, which is great, but this table would benefit from an exemplar quote from each theme.

11. Under “self-perceived confidence and competence,” you report “although most respondents reported that they felt confident in delivering video-based consultations, fewer had confidence in undertaking standardised clinician-rated physical assessments using this method” but do not include any actual numbers from your survey. Please add the numbers in the text rather than leaving it up to the reader to glean numbers from the figure. Additionally, you say that most respondents reported

that they felt “confident,” but the questions you are discussing here have to do with proficiency/competence; consider rephrasing.

12. Discussion, paragraph 5: “Understanding the actual versus perceived safety risks, and how risk averseness may impact on the type and quality...” should either read “Understanding the actual versus perceived safety risks, and how risk averseness may impact the type and quality...” or “Understanding the actual versus perceived safety risks, and how risk averseness may have an impact on the type and quality...”

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## Conflicts of Interest

None declared.

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## Reference

1. Buckingham SA, Anil K, Demain S, Gunn H, Jones RB, Kent B, et al. Telerehabilitation for people with physical disabilities and movement impairment: a survey of United Kingdom practitioners. *JMIRx Med* 2022;3(1):e30516 [FREE Full text] [doi: [10.2196/30516](https://doi.org/10.2196/30516)]

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Peer-Review Report

# Peer Review of “Telerehabilitation for People With Physical Disabilities and Movement Impairment: A Survey of United Kingdom Practitioners”

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School of Allied and Public Health Professions, Faculty of Medicine, Health and Social Care, Canterbury Christ Church University, Canterbury, Kent, United Kingdom

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**KEYWORDS**

telerehabilitation; physical disabilities; movement impairment; remote assessments; telehealth; rehabilitation; training; health care practitioners; physiotherapy; occupational therapy

*This is a peer-review report submitted for the paper “Telerehabilitation for People With Physical Disabilities and Movement Impairment: A Survey of United Kingdom Practitioners.”*

## Round 1 Review

**General Comments**

The content of this paper [1] is of interest to the journal readership especially post COVID-19 pandemic and the rapid move to online practice in the rehabilitation field. It is reasonable to assume that online rehabilitation interventions are here to stay albeit to a different extent than during the pandemic. The manuscript as it stands reads well; however, the quality can be further improved by considering the following.

**Specific Comments**

Please be consistent with terminology, either the authors use “in person” or “face to face” but avoid using both terms to refer to the same method. Preferable to free text and fixed option, consider replacing with open and closed ended questions; it reads more professional.

**Main Comments****Title**

Insert the word “interventions” next to Telerehabilitation.

**Abstract**

The Results section could be further summarized. Suggest referring to *challenges* rather than *obstacles*.

**Introduction**

There is a reasonable introduction that could be further supported with actual figures. For example, how common are the physical disabilities being referred to? Include an operational definition of physical disabilities. This would normally include motor impairment, so why does the paper refer to physical disabilities and movement impairment. I think this needs clarification supported by the literature.

It would also strengthen the rationale for the study if slightly more context were provided for key studies cited in this section [2-7].

**Methods**

1. Design and development: the first sentence should read “findings from the scoping review...” The authors refer to “experts,” please indicate which experts these were.

Second paragraph: this sentence does not read well or make sense on its own: “To maximise accuracy and completeness of data, formatting and compulsory items [8] were used in the questionnaire design.” Suggest rewriting or providing a little more explanation.

Third paragraph: re: questionnaire: How long was the estimated time of completion? Could the same respondent complete it a second/multiple times? Were any measures in place to prevent this from happening?

Make it clear that the questionnaire was anonymous but with an option for contact details if the respondent chose to include these.

2. Recruitment and data collection: as a general comment, the selection criteria are not clearly explained. For example, who was classified as a rehabilitation practitioner and therefore could participate in the survey? Were there any measures in place to check that respondents were genuinely professional people (ie, verification of identity)?

Were there any exclusion criteria?

Clarify consent: was this if they returned the completed survey, then it was taken as automatic consent?

3. Data analysis: Delete this sentence: “No statistical correction (such as weighting of items or use of propensity scores) was used; this was not felt to be appropriate as this was not a probabilistic sample.” It is redundant.

## Results

The authors write “Of the 247 respondents, 207 (84%) reported having used video-based consultations.” The reviewer is wondering why did the other 40 not use video consultations. Was this not an inclusion criterion? Please explain.

Further down, the authors write “In free text responses, reduced travel and improved flexibility were deemed particularly beneficial for those with physical disabilities and fatigue.” Consider referring to open ended questions instead of free text. Additionally, clarify who benefited from reduced travel and improved flexibility—does this refer to professional, client, or both?

The next sentence refers to multidisciplinary working. Please explain which aspects pertain to being multidisciplinary (eg, communication or decision-making).

Figure 2: The title refers to perceived benefits, please clarify for whom? Is this written from a professional perspective, as only professionals completed this survey? It is important to make this distinction.

Consider replacing “obstacles” with challenges, difficulties, or barriers encountered.

Usability: Do you mean compatibility issues and unstable internet connections? If so, change in text.

It would be helpful to provide contextual examples of clients where one needs to rely on family for physical assessments. It could be that, for the client profile in question, the preferred

method recommended is face-to-face—a point to comment on in the Discussion section.

Table 3: It would be helpful to include mapping of the answers to the relevant survey questions, so the reader can link the two and has a point of reference.

With reference to sensory function (comment e below the table), I am finding it difficult to understand how one assesses sensory function using telerehabilitation methods accurately? Surely there must be validity and reliability issues with this method, please comment in the Discussion section.

Similarly, further down it refers to “clinician rated physical assessments.” Was there any concern for patient-reported outcomes? Especially patients who may have cognitive impairments or want to say what they think the professional wants to hear. Authors could comment on this point in the discussion.

## Discussion

There is a reasonable discussion in light of the findings. Further to the comments marked for the Discussion previously, the authors could also discuss/elaborate on the following.

Paragraph 5: Comment on the potential implications of avoidance in some cases as in when carrying out assessments via video or telephone.

Next, the authors make a very valid point about “Understanding the actual versus perceived safety risks” but do not elaborate. I think that this is worth further elaboration.

Paragraph 6: The first line refers to “Technical and practical support from family members and carers...” What happened in cases where family/carer support was unavailable? How did professionals get around this challenge and any implications for the practice as a result?

Paragraph 7: Line 6 refers to training. Can the authors specify the kind of training required and which areas?

Last paragraph: The authors write “future surveys and qualitative studies should explore how experiences, attitudes and training needs evolve during and after the COVID pandemic.” What about the duration/competence of the clinical experience of the professional? Did this impact confidence? Is this a question that should be included in future surveys? Please comment.

## Conflicts of Interest

None declared.

## References

1. Buckingham SA, Anil K, Demain S, Gunn H, Jones RB, Kent B, et al. Telerehabilitation for people with physical disabilities and movement impairment: a survey of United Kingdom practitioners. *JMIRx Med* 2022;3(1):e30516 [FREE Full text] [doi: [10.2196/30516](https://doi.org/10.2196/30516)]
2. Cottrell MA, Galea OA, O'Leary SP, Hill AJ, Russell TG. Real-time telerehabilitation for the treatment of musculoskeletal conditions is effective and comparable to standard practice: a systematic review and meta-analysis. *Clin Rehabil* 2017 May;31(5):625-638. [doi: [10.1177/0269215516645148](https://doi.org/10.1177/0269215516645148)] [Medline: [27141087](https://pubmed.ncbi.nlm.nih.gov/27141087/)]
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Peer-Review Report

# Peer Review of “Continuous User Experience Monitoring of a Patient-Completed Preoperative Assessment System in the United Kingdom: Cross-sectional Study”

Mathew Mbwogge, MEPA, MSc

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*This is a peer-review report submitted for the paper “Continuous User Experience Monitoring of a Patient-Completed Preoperative Assessment System in the United Kingdom: Cross-sectional Study.”*

## Round 1 Review

### General Comments

The need to enhance the quality of health care services and meet patient needs has prompted the development of applications that will improve patient flow and experience and cut back the cycle time during hospital visits. A review of telehealth interventions reported that such interventions can render the coordination of specialist services including surgery more efficient [1]. The extent to which the apps used in health care can be effective is dictated by the experiences of care users, who inevitably must be involved in the testing of these apps. This is because care user experience remains a major determinant of health care quality [2]. Common tools reported to be useful in measuring the usability of apps in mobile health interventions include the System Usability Scale (SUS), Health Information Technology Usability Evaluation Scale (ITUES), Post-Study System Usability Questionnaire (PSSUQ), Website Analysis and Measurement Inventory (WAMMI), and IBM Computer System Usability Questionnaire (CSUQ) [3].

In light of the above, the authors of the paper titled “Continuous user experience monitoring of a patient-completed preoperative assessment system: Usability evaluation and impact on completion times” [4] sought to investigate the usability of the MyPreOp app, factors affecting assessment questionnaire duration, and the effectiveness of a usability scale (the ITUES). They reported that while 80% of subjects had a good or better experience, 90% found the app easy to use based on the ITUES. The app’s usability was rated at 4.31, with a mean completion time of 46.95 (SD 25.83) minutes. The authors concluded that the user experience and usability of the app were high. Other studies have reported the testing of apps using other scales, with

the most prominent being the SUS deployed in the testing of the “Be Prepared” app among subjects undergoing surgery [5], the “Patient Journey” app among subjects booked for surgery [6], and the “Pregnancy and Work” app among pregnant women [7] in the Netherlands, as well as the “mCare” app among subjects undergoing elective surgery in the United States [8] and a non-motor symptoms app among subjects with Parkinson disease in the United Kingdom [9].

Part of the impact of COVID-19 lies in the drive towards virtual care. The postpandemic era will demand more careful use of resources and better ways of improving patient experience. As such, this paper addresses a topic of growing interest in health care delivery and ties with the present global circumstances. The authors adhered to the IMRD standard of practice and the journal guidelines. The title throws an overall light on what the study is about but not how it was conducted. The Abstract is well structured and sums up the salient points of the paper but lacks the objectives. The Introduction and the Results are well presented, but the Methods and Discussion demand more attention, the improvement of which could affect other sections. The English used is plain language for easy understanding. That said, this paper could be improved further with the below recommendations:

### Specific Comments

1. The title of the paper needs formatting to conform to the journal guidelines.
2. Tables and figures need to be formatted according to the recommended standard.
3. The Abstract needs to conform to the BOMRC format as per the guidelines.
4. Authors need to reference specific guidelines used in reporting the results.
5. The methods of the study warrant improvement to make it robust and up to standard.
6. Some sections need to be moved and others reorganized for a better flow.

7. References could be improved further.

To elucidate the above specific comments, kindly refer to the below major and minor comments:

### Major Comments

1. Kindly format your title following the guidelines [10]. A good title would be “Continuous User Experience Monitoring of a Patient-completed Preoperative Assessment System in The United Kingdom: Cross-sectional Study.”
2. I suggest improving the Methods subsection of the Abstract by also reporting (1) the study design, (2) setting and recruitment, (3) mean age and gender differences, (4) endpoints measured, (5) data collection methods, and (6) data analysis approach.
3. The below template may help in the overall structure of your paper: <https://tinyurl.com/2p8c7yw6>
4. Kindly structure your Introduction as follows:
  - Background (including the text on MyPreOp and the importance of usability)
  - Study rationale (why you thought the intervention would work, including similar studies)
  - Study aim and objectives
5. I do not understand the justification for placing the last paragraph of the Aim and Objectives subsection where it currently is. This should be moved to be part of your Rationale.
6. Your Methods section will be more robust if you could report according to:
  - Study design with justification (include studies that have used similar designs)
  - Study setting
  - Participant recruitment
  - Intervention and data collection (Phase 1 and Phase 2)
  - Endpoints measured (outcome and explanatory variables)
  - Study of the intervention (approach/measures used to assess that the outcome or observed impact was due to the intervention and not to other factors)
  - Data analysis (with justification for the approach used)
  - Ethical considerations (including ethical approval)
7. As part of your data analysis, kindly justify each analysis approach used, specifically with the usage of parametric and nonparametric tests.
8. Organize your *Data analysis* subsection (6.7 above) into:
  - Assessment of usability
  - Factors affecting questionnaire completion times
  - Effectiveness of the usability scale (also demonstrate the effect size using box plots)
9. Indicate the guidelines you used to report this study as part of your ethical considerations [11].
10. Kindly organize your *Results* section to follow your *Data analysis* subsection as follows:
  - Participant characteristics
  - Assessment of usability
  - Factors affecting questionnaire completion times
  - Effectiveness of usability scale

11. I suggest rephrasing your subtitle “Overall Data” as “Baseline” or “Participant Characteristics.”
12. There seems to be a mixup between parametric and nonparametric tests, as you talk of mean age and then the Wilcoxon rank-sum test. You report “In terms of mean age, participants in Phase 1 were younger than participants in Phase 2, and the difference was statistically significant (Wilcoxon sum rank test,  $P < 0.001$ ).” Could you please clarify? You also report “the mean scores for each question block were calculated and compared using the Kruskal-Wallis test.”
13. Based on (12) above and as reported and justified in your *Data analysis* subsection, I suggest adhering to a single statistical approach based on a normality test to report your results rather than using both parametric and nonparametric approaches, which may be confusing to readers. Report either means or medians in all your tables. You may include tables reporting both mean and median as Multimedia Appendices if very necessary.
14. Kindly correct from “Wilcoxon sum rank test” to Wilcoxon Rank Sum Test.
15. Regarding Table 3 under “Factors affecting completion times,” it will be good to announce whether the completion time was normally distributed and how this was verified. One may be tempted to ask why you used mean and not median completion times.
16. You may want to merge Tables 5, 6, and 7 as one table since all are based on a 4-point scale. I also suggest merging Tables 9 and 10 as one table.
17. It might be worthwhile to dedicate a paragraph at the end of your *Results* section to talking about contextual factors that intervened during the intervention and any unintended observed outcomes.
18. Kindly organize your Discussion into (1) Principal results, (2) Comparison with Prior studies, (3) Study limitations, and (4) Conclusion.
19. Move the text relating to ethical approval to the *Ethical Considerations* subsection in the *Methods* section.
20. Kindly list all Multimedia Appendices before the *References* section and move your list of abbreviations to the end of your paper, after the references.

### Minor Comments

1. Maintain the corresponding author in the manuscript and add all others in the metadata section of the manuscript online management system.
2. Kindly include the objective subsection in your Abstract and state the study objectives.
3. The statement “So far, there have been no published studies that have investigated factors that influence the amount of time it takes for patients to self-complete a computerised preoperative assessment” appears too general. You may want to limit this to the United Kingdom and report it as “current evidence on the factors influencing...is limited.”
4. Kindly format your tables following the journal guidelines [12].
5. Do bear in mind that the maximum acceptable number of tables is 5. It is possible to merge some of the tables.



6. Kindly report all *P* values following the guidelines (eg,  $P < .001$  and not  $P < 0.001$ ).
7. It is good to start your Conclusion with a statement of the study objectives. This should be followed by (1) a summary of findings, (2) lessons learned from your findings, (3) suggested direction of future research, and (4) recommendations.
8. Kindly replace your title “Declarations” with Acknowledgements. This should be followed by (1) Funding, (2) Author Contributions, and (3) Conflicts of Interest.
9. Your references need to be formatted following the journal guidelines. Set your reference manager to the AMA citation style and make sure to include a PubMed ID at the end of each reference. Include a DOI for all articles with a PMID and verify your DOIs using either <https://www.doi.org/> or <https://www.crossref.org> to ensure they are working.
10. Make sure to trace the pdf version of articles that have neither a PMID nor DOI wherever possible.

## Round 2 Review

### General Comments

The authors of the paper titled “Continuous User Experience Monitoring of a Patient-completed Preoperative Assessment System in The United Kingdom: Cross-sectional Study” have done a great job in improving on the paper. However, I have 1 main concern regarding the present state of the paper.

### Specific Comments

The Discussion section needs further improvement.

### Major Comments

I expect the length of your “Principal Results” in the *Discussion* section to be similar to the length of the first paragraph or at most the first two. May I please suggest that you use the text in the *Results* subsection of your Abstract as your “Principal Findings” and move any other text and discussion under “Principal Findings” to “Comparison with Prior Studies”?

### Conflicts of Interest

None declared.

### References

1. Caffery LJ, Farjian M, Smith AC. Telehealth interventions for reducing waiting lists and waiting times for specialist outpatient services: A scoping review. *J Telemed Telecare* 2016 Dec;22(8):504-512. [doi: [10.1177/1357633X16670495](https://doi.org/10.1177/1357633X16670495)] [Medline: [27686648](https://pubmed.ncbi.nlm.nih.gov/27686648/)]
2. de Silva D. No. 18 Measuring patient experience. The Health Foundation Inspiring Improvement. 2013. URL: <https://www.health.org.uk/sites/default/files/MeasuringPatientExperience.pdf> [accessed 2021-08-08]
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9. Dominey T, Mullin S, Edwards E, Whipps J, Whipps S, Carroll C. Usability Testing of a non-motor symptom app in PD. *J Neurol Neurosurg Psychiatry* 2019;90(12):e38. [doi: [10.1136/JNPP-2019-ABN-2.129](https://doi.org/10.1136/JNPP-2019-ABN-2.129)]
10. What are JMIR’s guidelines for article titles? JMIR Publications. 2021. URL: <https://support.jmir.org/hc/en-us/articles/115002943791> [accessed 2021-08-06]
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**Abbreviations**

**CSUQ:** Computer System Usability Questionnaire  
**ITUES:** Information Technology Usability Evaluation Scale  
**PSSUQ:** Post-Study System Usability Questionnaire  
**SUS:** System Usability Scale  
**WAMMI:** Website Analysis and Measurement Inventory

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Peer-Review Report

# Peer Review of “Continuous User Experience Monitoring of a Patient-Completed Preoperative Assessment System in the United Kingdom: Cross-sectional Study”

Andrea N Mahnke<sup>1,2</sup>, MS

<sup>1</sup>Customer Experience Department, Marshfield Clinic Health System, Marshfield, WI, United States

<sup>2</sup>Biomedical & Health Informatics, University of Wisconsin-Milwaukee, Milwaukee, WI, United States

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(*JMIRx Med* 2022;3(1):e35507) doi:[10.2196/35507](https://doi.org/10.2196/35507)

*This is a peer-review report submitted for the paper “Continuous User Experience Monitoring of a Patient-Completed Preoperative Assessment System in the United Kingdom: Cross-sectional Study.”*

## Round 1 Review

### General Comments

This paper [1] highlights important usability evaluations of an assessment system used by patients. These systems are often pushed out to patients without any evaluation of whether patients can use them successfully and if they are satisfying to interact with.

### Specific Comments

#### Minor Comments

1. The staggering of the eHealth usability scale items was a good idea. It would have been most likely unrealistic for patients to be willing to complete the scale including all of the items.
2. Besides further studying what things impacted completion times, it would also be helpful to further explore the impact of a message addressing the length of assessment completion at the start of the assessment.

### Conflicts of Interest

None declared.

### Reference

1. Maramba IA, Chatterjee A. Continuous user experience monitoring of a patient-completed preoperative assessment system in the United Kingdom: cross-sectional study. *JMIRx Med* 2022;3(1):e31679 [[FREE Full text](#)] [doi: [10.2196/31679](https://doi.org/10.2196/31679)]

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Peer-Review Report

# Peer Review of “COVID-19 Infection and Symptoms Among Emergency Medicine Residents and Fellows in an Urban Academic Hospital Setting: Cross-sectional Questionnaire Study”

Reza Shahriarirad<sup>1</sup>

Shiraz University of Medical Sciences, Shiraz, Iran

**Related Articles:**Companion article: <https://preprints.jmir.org/preprint/29539>Companion article: <https://med.jmirx.org/2022/1/e36198/>Companion article: <https://med.jmirx.org/2022/1/e29539/>**Abstract***(JMIRx Med 2022;3(1):e36207)* doi:[10.2196/36207](https://doi.org/10.2196/36207)**KEYWORDS**

COVID-19; emergency medicine; housestaff wellness; medical education; training; frontline health care workers; frontline; personal protective equipment; pandemic; infectious disease; emergency

*This is a peer-review report submitted for the paper “COVID-19 Infection and Symptoms Among Emergency Medicine Residents and Fellows in an Urban Academic Hospital Setting: Cross-sectional Questionnaire Study.”*

**Round 1**

1. The authors [1] describe a cross-sectional study on COVID-19 infection and symptom severity among emergency medicine residents and fellows in urban academic hospital settings. Their study consists of a rather small sample size of health care workers during the early period of the pandemic.
2. The authors noted a “high percentage of survey participation from the cohort” as a strength of their study, although only a 62% response rate was achieved, which is merely above the acceptable rate.
3. Abbreviations should be mentioned in full the first time they appear in the text, such as COVID-19, SARS, etc.
4. The manuscript should be edited for punctuation and grammatical errors.
5. Why wasn't multiple regression or linear regression analysis performed?
6. I recommend reporting local countries' protocols during the timeline of your study so that international readers could have

insight into the situation and the protective measures applied during the study period.

7. SARS-CoV-2 is the virus that causes the infection, and COVID-19 is the disease. Proper usage of these terminologies is mandatory and should be corrected throughout the manuscript.

8. What was the method for detection used in the database? Was it based on polymerase chain reaction (PCR)? I would advise reading the following report and citing it among your references:

Shahriarirad R, Sarkari B. COVID-19: clinical or laboratory diagnosis? A matter of debate. *Trop Doct.* 2021 Jan;51(1):131-132. doi: 10.1177/0049475520945446. Epub 2020 Aug 6. PMID: 32762302.

9. The authors must add more comparisons regarding the prevalence and presentation of symptoms in their Discussion section, especially with neighboring countries and particularly during that period of the pandemic:

Shahriarirad R, Khodamoradi Z, Erfani A, Hosseinpour H, Ranjbar K, Emami Y, Mirahmadzadeh A, Lotfi M, Shirazi Yeganeh B, Dorrani Nejad A, Hemmati A, Ebrahimi M, Moghadami M. Epidemiological and clinical features of 2019 novel coronavirus diseases (COVID-19) in the South of Iran. *BMC Infect Dis.* 2020 Jun 18;20(1):427. doi: 10.1186/s12879-020-05128-x. PMID: 32552751; PMCID: PMC7301075.

Alasia D, Owhonda G, Maduka O, Nwadiuto I, Arugu G, Tobin-West C, Azi E, Oris-Onyiri V, Urang IJ, Abikor V, Olofinuka AM, Adebisi O, Somiari A, Avundaa H, Alali A. Clinical and epidemiological characteristics of 646 hospitalised SARS-Cov-2 positive patients in Rivers State Nigeria: a prospective observational study. *Pan Afr Med J.* 2021 Jan 12;38:25. doi: 10.11604/pamj.2021.38.25.26755. PMID: 33777293; PMCID: PMC7955600

10. They should also compare their study with studies on health care workers worldwide such as:

Sabetian G, Moghadami M, Hashemizadeh Fard Haghighi L, Shahriarirad R, Fallahi MJ, Asmari N, Moeini YS. COVID-19 infection among healthcare workers: a cross-sectional study in southwest Iran. *Virol J.* 2021 Mar 17;18(1):58. doi: 10.1186/s12985-021-01532-0. PMID: 33731169; PMCID: PMC7968574

Please review and cite the mentioned references appropriately.

## Round 2 Review

The authors [1] have done a fine job in addressing their shortcomings and my previous comments. I only have a few more minor comments that need to be addressed:

1. Introduction, first paragraph: Please clarify and update what you mean by “to date.”
2. Add features of the first table to the second table and perform the related analysis. In other words, was there a significant difference in the antibody-positive and negative groups regarding working hours, gender, age, etc?
3. Just for consideration, if possible, the authors could also provide a receiver operating characteristic (ROC) curve analysis based on the hours of a shift to provide a cut-off. Alternatively, if possible, they should perform a multiple regression analysis for reporting risk factors in their study.

## Conflicts of Interest

None declared.

## Reference

1. Frisch S, Jones S, Willis J, Sinert R. COVID-19 Infection and Symptoms Among Emergency Medicine Residents and Fellows in an Urban Academic Hospital Setting: Cross-sectional Questionnaire Study. *JMIRx Med* 2022;3(1):e29539 [[FREE Full text](#)] [doi: [10.2196/29539](https://doi.org/10.2196/29539)]

## Abbreviations

**PCR:** polymerase chain reaction

**ROC:** receiver operating characteristic

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Original Paper

# Peer Review of “COVID-19 Infection and Symptoms Among Emergency Medicine Residents and Fellows in an Urban Academic Hospital Setting: Cross-sectional Questionnaire Study”

Jorge Tavares<sup>1</sup>, PhD

NOVA Information Management School, Universidade NOVA de Lisboa, Lisboa, Portugal

(*JMIRx Med* 2022;3(1):e36209) doi:[10.2196/36209](https://doi.org/10.2196/36209)

## KEYWORDS

COVID-19; emergency medicine; housestaff wellness; medical education; training; frontline health care workers; frontline; personal protective equipment; pandemic; infectious disease; emergency

### Round 1 Review

#### General Comments

This is a well-written paper [1] focusing on a very relevant topic. More details should be provided about the statistical approach used.

#### Specific Comments

It is a fact that the sample size is small and that is probably the reason why the Fisher exact test was used. Nonetheless, no explanation or rationale for the decision is given.

#### Major Comments

1. The sample size of this study is small and that seems to be the reason for using the Fisher exact test; however, more rationale should be provided for this decision, to explain if the assumptions required to perform the chi-square test are complied to or not. Another option for small samples is to use the Monte Carlo Simulation; why have you decided not to use that instead of the Fisher exact test?

### Minor Comments

2. For such a small sample, you have a lot of categories pertaining to the number of patients treated (Table 2). In fact, these categories contributed little to provide significant results; have you tried to run the analysis with fewer categories? Can you please explain the rationale for having so many categories for a small sample?

3. I understand that the sample is small, and you are limited by it and by the characteristics of the variables, but have you tried to explore other types of statistical analysis and variables, using, for example, age or gender, with polymerase chain reaction (PCR) test rates, etc?

4. In Table 2, it is mentioned that the values for  $P < .05$  are in bold; one value is .05 and it is bolded—are you talking about rounding in terms of the number of decimals? Was this result statistically significant according to SPSS?

### Abbreviations

PCR: polymerase chain reaction

## Reference

1. Frisch S, Jones S, Willis J, Sinert R. COVID-19 Infection and Symptoms Among Emergency Medicine Residents and Fellows in an Urban Academic Hospital Setting: Cross-sectional Questionnaire Study. *JMIRx Med* 2022. [doi: [10.2196/29539](https://doi.org/10.2196/29539)]

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Peer-Review Report

# Peer Review of “Measuring Integrated Novel Dimensions in Neurodevelopmental and Stress-Related Mental Disorders (MIND-SET): Protocol for a Cross-sectional Comorbidity Study From a Research Domain Criteria Perspective”

---

Emma Palmer<sup>1</sup>

James L Winkle College of Pharmacy, University of Cincinnati, Cincinnati, OH, United States

**Related Articles:**Companion article: <https://www.medrxiv.org/content/10.1101/2021.06.05.21256695v1>Companion article: <https://preprints.jmir.org/preprint/31269>Companion article: <https://med.jmirx.org/2022/1/e36212/>Companion article: <https://med.jmirx.org/2022/1/e31269/>*(JMIRx Med 2022;3(1):e36235)* doi:[10.2196/36235](https://doi.org/10.2196/36235)**KEYWORDS**

psychiatry; mental health; psychiatric disorders; neuropsychology; stress; comorbidity

*This is a peer-review report submitted for the paper “Measuring Integrated Novel Dimensions in Neurodevelopmental and Stress-Related Mental Disorders (MIND-SET): Protocol for a Cross-sectional Comorbidity Study From a Research Domain Criteria Perspective.”*

## Round 1 Review

---

**General Comments**

This paper [1] is interesting and sets the stage for a pretty comprehensive study.

**Specific Comments****Major Comments**

1. The background is very long, and some spaces are redundant, talking about the overlap of symptoms in comorbidities. Some of this may be better in a discussion—there is a lot of information here.
2. There are a lot of definitive/overly positive statements (eg, “...the RDoC [Research Domain Criteria] frameworks fits ideally...” “...we can disentangle.” Consider rewording as

this is a fairly small sample size in a singular area of the world.

3. Adjust the title so it is clear that this is a description of methods.
4. Anticipated limitations should be included (eg, single-center, nondiverse population, or the number of data points making differentiation challenging).

**Minor Comments**

1. Change addiction disorder to substance use disorder
2. Provide a citation for the first line about the acceptance of psychiatric comorbidities as common
3. Define abbreviations upon first use (eg, DSM-5)
4. Consider changing “healthy” to “neurotypical.” Personality traits were examined too, but there is not a lot of rationale here regarding overlap. I agree it is important to review this too, but this needs to be discussed.
5. Is microbiome included at the very end as a data point?

## Round 2 Review

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It appears that the recommended revisions have been addressed, and I have no additional comments

**Conflicts of Interest**

None declared.

**Reference**<https://med.jmirx.org/2022/1/e36235>JMIRx Med 2022 | vol. 3 | iss. 1 | e36235 | p.22  
(page number not for citation purposes)

1. van Eijndhoven P, Collard R, Vrijzen J, Geurts DE, Vasquez AA, Schellekens A, et al. Measuring Integrated Novel Dimensions in Neurodevelopmental and Stress-Related Mental Disorders (MIND-SET): protocol for a cross-sectional comorbidity study from a Research Domain Criteria perspective. *JMIRx Med* 2022;3(1):e31269 [[FREE Full text](#)]

## Abbreviations

**RDoC:** Research Domain Criteria

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Peer-Review Report

# Peer Review of “Measuring Integrated Novel Dimensions in Neurodevelopmental and Stress-Related Mental Disorders (MIND-SET): Protocol for a Cross-sectional Comorbidity Study From a Research Domain Criteria Perspective”

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Companion article: <https://www.medrxiv.org/content/10.1101/2021.06.05.21256695v1>

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(*JMIRx Med* 2022;3(1):e36237) doi:[10.2196/36237](https://doi.org/10.2196/36237)

**KEYWORDS**

psychiatry; mental health; psychiatric disorders; neuropsychology; stress; comorbidity

*This is a peer-review report submitted for the paper “Measuring Integrated Novel Dimensions in Neurodevelopmental and Stress-Related Mental Disorders (MIND-SET): Protocol for a Cross-sectional Comorbidity Study From a Research Domain Criteria Perspective.”*

## Round 1 Review

Building on the Research Domain Criteria (RDoC; Cuthbert and Insel [1]), the manuscript [2] presents the study protocol of a transdiagnostic study program to determine mechanisms that either differentiate between neurodevelopmental and stress-related psychiatric disorders or show commonalities. The authors formulate a compelling argument that the pathophysiological pathway of psychiatric disorder needs to be considered taking a developmental perspective, with an emphasis on the role of comorbidities. To address such a high level of complexity, the authors present a cross-sectional study focused on stress-related (mood, anxiety, and substance abuse) and neurodevelopmental (autism, attention-deficit/hyperactivity disorder) disorders, with four points of measurements (distance unclear), and with each point of measurement including several observational levels: genetics, physiology, neuropsychology, system-level neuroimaging, behavior, self-report, and experimental neurocognitive paradigms.

Overall, I find this to be an extremely ambitious project. The study protocol as it is provides some good direction, and the approaches taken are state of the art, but the details of the proposal are inaccessible because of its complexity. What

worries me most about the ambition of the plan is that the sample size and the requirements of the sample size are not discussed, which leads to issues with the interpretability of the collected data. An issue in a project that puts so much strain on the participants should be carefully considered.

I found the submission to be a mismatch to JMIRx Med; this is clearly a research protocol and might be better suited for JMIR Research Protocols.

Looking at the work solely from a research protocol perspective, I would like to read more details about how the authors intend to combine data or a detailed description of how they intend to pursue their analysis. The complexity prevents them from doing so, but as a result, the quality of the research protocol is difficult to judge—it is too high level to judge all aspects of the protocol responsibly. Defining the most relevant end points would be one approach that would help here.

Either way, I think the work is relevant to address, but journal fit and my mentioned points about sample and approach should be addressed, and the overall work would benefit from formatting and editing (some sections, for example, on the methods used, are redundant).

**Strengths**

- Very important topic
- The authors pose a number of highly relevant questions
- Engaging summary of effects of individual disorders on pathophysiological and shared effect between disorders



- Considering the complexity of this project, the details are well thought through and the approaches described are reasonable. To assess the quality of each approach taken in detail, a range of expertise is required.

### Major Issues

- The sample size required is huge and one of the bottlenecks of the suggested approach; while the authors seem to have one unit to recruit participants, it is unclear how many participants would take part. The issue I foresee is that, with that many levels of observation, the complexity of comorbidities, and individual differences, the analysis will remain inconclusive. I would like to hear the authors' thoughts on the sample size and interpretability of the collected data.
- The instruments used for data collection (questionnaires, biodata, etc) are all vaguely described (eg, which questionnaires will be used and, if biosamples are collected, what exactly will they be processed for). The data is provided in a later step—it is unclear to me why the same aspect is described twice with different levels of detail.
- Throughout the paper, it is not clear if the work has been performed, will be performed, or is still in the process of development and approval. This might be partially due to changes in time but also due to the overall presentation of the protocol—being more upfront about the goals of the manuscript would have helped.

### Minor Issues

- The formatting in the Word document and the PDF makes the document difficult to read. The Word document shows incorrect breaks and paragraphs, while the font in the PDF is pixelized.
- The citation format is not in line with JMIR standards.
- Acronyms like RDoC or MIND are not introduced at their first occurrence, which makes the interpretation difficult.
- Classifying autism as a disorder misses a neurodivergent perspective, which the autism community perceives, see [3].

## Round 2 Review

I want to thank the authors for such an in-depth, detailed, and carefully presented protocol. This is such a challenging study, but the presented implementation connects the different levels of inquiry and the patient groups very well. I found the decision made to be well motivated and am satisfied with the improvements.

I have one point that requires clarification:

– The authors aim to work with people diagnosed with autism spectrum disorder (ASD) but also included the command of language as an exclusion criterion (ie, “inadequate command of the Dutch language”). How will the authors make sure that not only vocal patients with ASD are included? From my understanding, selective mutism is quite common in people with ASD.

Several minor comments: overall, the manuscript requires proofreading and finishing touches.

### Abstract

“on the basis of” to “based on”

### Introduction

“the exception (1) .” to “(1).”

“on the basis of” to “based on”

### Current Approaches

“especially in light of” to “considering”

“Are depressive symptoms in someone with an autism spectrum disorder comparable to depressive symptoms in someone without an autism spectrum disorder?”; I assume that this should be attention-deficit/hyperactivity disorder in one of the cases.

“How well is someone with an autism spectrum disorder actually able to recognize and verbalize their mood symptoms, and how does this impact the diagnostic procedure, and the treatment choice and course?”; I suggest removing “actually”—it is unclear what the “actually” emphasizes, that there is little knowledge from a medical standpoint or if it emphasizes the assumption that people with autism are not aware of their own mood. I lack specialization in working with people with autism, but I would suggest to carefully frame neurotypical assumptions about neuroatypical processes.

### Comorbidity Within the RDoC Framework

“from a genetic, molecular or cellular level” to “from a genetic, molecular, or cellular level”

I stop commenting on this, but the use of the Oxford comma would help with readability when lists are used.

### Data-Driven Approaches

“has to be understood as step in” to “as a step towards”

### Study Aims and Outline

“mood, anxiety and substance abuse” to “mood, anxiety, and substance abuse”

### Methods

“are as well paid a small fee” — is there a reason the exact amount is omitted?

### Session 2: Behavioral Assessment

“faeces” to “feces”

“the Autism Spectrum Quotient ( AQ-50)” to “(AQ-50)”; “(NIDA)” to “(NIDA)”

“of the negative valence system”; unclear why underlined, maybe a subheading would differentiate the different systems discussed here better

### General Issues

Use of Oxford comma in lists

eg and ie should be followed by a comma. See [4].

Check the document for double spaces.

---

## Conflicts of Interest

None declared.

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## References

1. Cuthbert B, Insel TR. Toward the future of psychiatric diagnosis: the seven pillars of RDoC. BMC Med 2013 May 14;11:126 [FREE Full text] [doi: [10.1186/1741-7015-11-126](https://doi.org/10.1186/1741-7015-11-126)] [Medline: [23672542](https://pubmed.ncbi.nlm.nih.gov/23672542/)]
  2. van Eijndhoven P, Collard R, Vrijsen J, Geurts DE, Vasquez AA, Schellekens A, et al. Measuring Integrated Novel Dimensions in Neurodevelopmental and Stress-Related Mental Disorders (MIND-SET): protocol for a cross-sectional comorbidity study from a Research Domain Criteria perspective. JMIRx Med 2022;3(1):e31269 [FREE Full text]
  3. Heasman B, Gillespie A. Neurodivergent intersubjectivity: distinctive features of how autistic people create shared understanding. Autism 2019 May;23(4):910-921 [FREE Full text] [doi: [10.1177/1362361318785172](https://doi.org/10.1177/1362361318785172)] [Medline: [30073872](https://pubmed.ncbi.nlm.nih.gov/30073872/)]
  4. E.g. vs. I.e.–What’s the Difference? Grammarly. URL: <https://www.grammarly.com/blog/know-your-latin-i-e-vs-e-g/> [accessed 2022-03-18]
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## Abbreviations

**ASD:** autism spectrum disorder

**RDoC:** Research Domain Criteria

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Authors' Response to Peer Reviews

# Authors' Responses to Peer Review of “Telerehabilitation for People With Physical Disabilities and Movement Impairment: A Survey of United Kingdom Practitioners”

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**KEYWORDS**

telerehabilitation; physical disabilities; movement impairment; remote assessments; telehealth; rehabilitation; training; health care practitioners; physiotherapy; occupational therapy

*This is the authors' response to peer-review reports for “Telerehabilitation for People With Physical Disabilities and Movement Impairment: A Survey of United Kingdom Practitioners.”*

## Round 1 Review

**Anonymous Reviewer [1]**

This paper [2]: The manuscript has been well written and well organized; it needs some minor revisions.

Response: Thank you. We have responded to each of the points below.

1. It is not clear how the authors have used a combination of “opportunity” and “snowball” sampling methods considering that these are two separate methods of purposeful sampling. Additionally, it is not clear how these methods have been used, so the sampling method and justification should be explained in more detail in the Methods section; although, it has been reported as a limitation of the study.

Response: Opportunity and snowball sampling are separate but complementary methods. We used our existing contacts and networks to identify potential participants, and these participants were, in turn, asked to forward the survey to other potential participants. This has now been explained in the Methods section.

2. The first sentence of the Conclusions/Abstract is not based on the findings.

Response: One of the key findings was the increased frequency of the use of telerehabilitation since the COVID-19 pandemic (as shown in Figure 1 and supported by the qualitative findings). This finding has now been added to the Results section of the Abstract to be consistent with the rest of the paper.

3. Delete this sentence from the Methods: “No statistical correction (such as weighting of items or use of propensity scores) was used; this was not felt to be appropriate as this was not a probabilistic sample.”

Response: Sentence deleted.

4. Authors have reported their results for “pre covid-19 lock down,” “during,” and “post-covid national lock down”; this should be explained in the Methods section.

Response: As stated in the Methods section, this was a cross-sectional survey. We have added a clarifying sentence to state that the finding was based on retrospective recall in the Use of Telerehabilitation section in the Results. We have also added further detail on the lockdown restrictions imposed between March and June 2020 in the same section.

5. Providing a “Table” for reporting the results that have been reported in Figure 3 is more appropriate and readable.

Response: We feel that the figure is more engaging than a table and improves readability. In response to this comment and a suggestion made by another reviewer, we have instead added the percentages to the text in the Self-perceived Confidence and Competence section.

6. Making some policy recommendations especially for reported obstacles of using telerehabilitation strengthens the Discussion.

Response: Thank you. We agree that this strengthens the Discussion and have added a short section on Clinical and Policy Implications as recommended by other reviewers.

### Anonymous Reviewer [3]

#### General Comments

This paper reports a mixed methods survey of UK practitioners’ use of telerehabilitation for people with physical disabilities

and movement impairment. It investigated practitioners’ experiences of telerehabilitation (including use, perceived benefits and obstacles, and physical outcomes assessed remotely), perceived confidence and competence, knowledge and training needs, and best practice and recommendations. It provides practical clinical recommendations for practitioners delivering telerehabilitation and has identified a number of training needs. This is very important research due to the huge uptake of virtual consultations/remote rehabilitation due to the COVID-19 pandemic and much uncertainty over its effectiveness and best practice. This paper is well written and clear to understand. I have a couple of minor comments.

Response: Thank you; we are pleased that you consider the paper to be of relevance and practical use. We have responded to each of the points below.

#### Specific Comments

##### Minor Comments

1. The Data Analysis section could include more detail regarding the qualitative analysis method used. The authors state they followed the guidance of Braun and Clarke but more detail on exactly how this was conducted would be beneficial to the readers. Relatedly, it is unclear which results they used this method for; it appears it is the *concerns of practitioners regarding the reliability and validity of remote physical assessments* (Table 4) and *practitioners’ perceived benefits and obstacles of video-based consultations* (Figure 2) sections, but this is unclear. Perhaps the authors could clarify exactly how they conducted their qualitative analysis and which data/results they used this method for.

Response: Further detail on how the qualitative analysis was carried out has been added to the Data Analysis section. Qualitative analysis was used for the following questions: reasons for not using video-based consultations, concerns regarding validity and reliability of remote physical assessments, ways of overcoming challenges; recommendations for carrying out telerehabilitation with people with physical disabilities and movement impairment, recommendations for video-based consultations with people recovering from COVID-19, open responses on information and training needs, and further comments on telerehabilitation. This is now stated in the paper.

2. There are a number of clinical practice implications from the results of this study, particularly with the recommendations for carrying out telerehabilitation in Textbox 1. It would be useful to have a clinical implications section in the Discussion, outlining how the results of this study might be useful for clinical practice.

Response: Thank you. We have added a short section on Clinical and Policy Implications to the Discussion.

#### Reviewer EH [4]

##### General Comments

This paper adds to the literature base on a very timely and important topic. I appreciated how the qualitative and quantitative results are presented together to highlight each of the major findings. I have provided some comments to help

improve the readability and overall quality of the paper, but in general, great work!

Response: Thank you. We are pleased that you find the paper timely and important. We have responded to each of the points below.

### Specific Comments

#### Major Comments

1. In the Discussion regarding survey design and development, there is a discussion about how respondents could only submit responses after every relevant section was filled out. Did each question include an option of prefer not to disclose or open ended response option? If not, consider adding this in the future.

Response: We included a *prefer not to say* option for demographic questions such as gender and age but did not include this for any other questions, as we did not feel they were sensitive, and we wanted to maximize the completeness of the answers. Only the closed response questions were compulsory (and all included *other* or *none of the above* options). This has been clarified in the Design and Development section.

2. When you are including quotes in a manuscript, usually if the quote is less than 40 words, you embed it directly in the text. If it is more than 40 words, you do what you have done currently except with indentation on both sides of the quote.

Response: The formatting of quotes is in line with the editorial guidelines (ie, the use of blockquotes for quotes that are a sentence or longer).

#### Minor Comments

3. Introduction, first paragraph: "...many people received no face-to-face rehabilitation" should read "many people did not receive any face-to-face rehabilitation"

Response: Change made.

4. Introduction, second paragraph: "In response, practitioners adapted their practice" should read "In response, practitioners adapted their practices"

Response: Change made.

5. Introduction, second paragraph: "in the United Kingdom (UK) as worldwide" should read "in the United Kingdom (UK) as well as worldwide"

Response: Change made.

6. Introduction, third paragraph: "...published guidance, training and support in how to undertake..." should read "...published guidance, training and support on how to undertake..."

Response: Change made.

7. Methods, second paragraph on design and development: "This process involved informal discussions (e-mail and verbal) with specialists in rehabilitation and physical disabilities, including health and social care practitioners and academics, within and external to the project team" should read "This process involved informal discussions (e-mail and verbal) with specialists in rehabilitation and physical disabilities, including health and

social care practitioners and academics within, and external to, the project team"

Response: Change made.

8. Add info regarding how long the survey took approximately to the Methods

Response: The questionnaire took approximately 15 minutes to complete. This has been added to the Design and Development section.

9. In your tables, I suggest aggregating any values that are less than 5, as this could be potentially identifying.

Response: Table 1 is the only table that contains some values with 5 or fewer respondents. We do not feel that these responses are identifying given that the survey was UK-wide and the information (eg, occupation or location) does not contain any detail. Merging the values would result in loss of information (eg, nurses and dieticians would be in the *other* category).

10. Consider reorganizing Figure 2 so that patient benefits and obstacles are side-by-side for ease of comparison

Response: Thank you. Figure 2 has been reorganized according to this suggestion.

11. You provide examples of the various types of obstacles encountered by practitioners but do not provide examples of organizational and governance obstacles; consider adding some examples of what these included.

Response: Examples of organizational and governance obstacles have been added to the Perceived Benefits and Obstacles section (eg, organizations recommending face-to-face consultations or prohibiting the use of certain technologies).

12. For Table 4, you list key themes and descriptions, which is great, but this table would benefit from an exemplar quote from each theme.

Response: A column with an exemplar quote for each theme has been added to Table 4.

13. Under "self-perceived confidence and competence," you report "although most respondents reported that they felt confident in delivering video-based consultations, fewer had confidence in undertaking standardised clinician-rated physical assessments using this method" but do not include any actual numbers from your survey. Please add the numbers in the text rather than leaving it up to the reader to glean numbers from the figure. Additionally, you say that most respondents reported that they felt "confident," but the questions you are discussing here have to do with proficiency/competence; consider rephrasing.

Response: Numbers and percentages have been added to the text in this section, and we feel this greatly improves readability. The terms have also been changed to reflect *proficiency* rather than *confidence* where appropriate.

14. Discussion, paragraph 5: "Understanding the actual versus perceived safety risks, and how risk averseness may impact on the type and quality..." should either read "Understanding the actual versus perceived safety risks, and how risk averseness



may impact the type and quality...” or “Understanding the actual versus perceived safety risks, and how risk averseness may have an impact on the type and quality...”

Response: Rephrased according to suggestion.

## Reviewer EP [5]

### General Comments

The content of this paper is of interest to the journal readership especially post COVID-19 pandemic and the rapid move to online practice in the rehabilitation field. It is reasonable to assume that online rehabilitation interventions are here to stay albeit to a different extent than during the pandemic. The manuscript as it stands reads well; however, the quality can be further improved by considering the following.

Response: Thank you. We are pleased that you find this paper of interest. We have responded to each of the points.

### Specific Comments

1. Please be consistent with terminology, either the authors use “in person” or “face to face” but avoid using both terms to refer to the same method. Preferable to free text and fixed option, consider replacing with open and closed ended questions; it reads more professional.

Response: *In person* has been replaced with *face-to-face* for consistency throughout the paper. Similarly, *open response* and *closed response* questions are now referred to.

### Main Comments

#### Title

2. Insert the word “interventions” next to Telerehabilitation.

Response: We believe that adding *interventions* would imply that the survey was only about telerehabilitation interventions and would not accurately describe the content of the paper. We explored much more than this in the survey (including experiences, attitudes, training, and assessments, not only interventions).

#### Abstract

3. The Results section could be further summarized. Suggest referring to *challenges* rather than *obstacles*.

Response: The Results section of the Abstract has been written more concisely; if you have any suggestions to improve this further, please let us know.

The terminology was discussed and agreed on by the research team prior to conducting the survey. *Obstacles* was the term used in the survey, so we would prefer to keep this term in the paper for consistency.

#### Introduction

4. There is a reasonable introduction that could be further supported with actual figures. For example, how common are the physical disabilities being referred to? Include an operational definition of physical disabilities. This would normally include motor impairment, so why does the paper refer to physical disabilities and movement impairment. I think this needs clarification supported by the literature.

Response: A reference to the Global Burden of Disease study has been added to the Introduction. A definition and distinction of impairment and disability have also been provided in paragraph 1. According to the International Classification of Functioning, Disability and Health [6], it is possible to have a physical (structural) impairment (eg, mild weakness, tremor, or loss of range/muscle length) that does not necessarily impact on function (disability).

5. It would also strengthen the rationale for the study if slightly more context were provided for key studies cited in this section [7-12].

Response: Further detail on the referenced studies has been given in the Introduction.

#### Methods

6. Design and development: the first sentence should read “findings from the scoping review...” The authors refer to “experts,” please indicate which experts these were.

Response: The first sentence has been reworded as per the suggestion. The *experts* were specialists in rehabilitation and physical disabilities, as stated in the same paragraph (this has now been clarified).

7. Second paragraph: this sentence does not read well or make sense on its own: “To maximise accuracy and completeness of data, formatting and compulsory items [13] were used in the questionnaire design.” Suggest rewriting or providing a little more explanation.

Response: The term *formatting* has been replaced with *validation*. Further explanation of compulsory items has been added.

8. Third paragraph: re: questionnaire: How long was the estimated time of completion? Could the same respondent complete it a second/multiple times? Were any measures in place to prevent this from happening? Make it clear that the questionnaire was anonymous but with an option for contact details if the respondent chose to include these.

Response: The time of completion was around 15 minutes; this has now been added. As stated in the Data Analysis section, the data set was checked for duplicate entries prior to analysis (there were none). The contact details section was optional; this is stated in the Design and Development section with more information given in the Recruitment and Data Collection section.

9. Recruitment and data collection: as a general comment, the selection criteria are not clearly explained. For example, who was classified as a rehabilitation practitioner and therefore could participate in the survey? Were there any measures in place to check that respondents were genuinely professional people (ie, verification of identity)?

Were there any exclusion criteria?

Clarify consent: was this if they returned the completed survey, then it was taken as automatic consent?

Response: Further detail on inclusion criteria has been added to this section: UK-based rehabilitation practitioners involved

in rehabilitation were eligible to participate, regardless of their level of experience with telerehabilitation. This included professionals with direct patient contact, who were working in the NHS, social services, independent private, or charitable organization sectors.

We did not ask for verification of identity; as in all self-completed questionnaires, respondents can give false information about their demographics, qualifications, or any aspect of what is being asked. However, we have no reason to believe that respondents had any motivation to provide false information.

Regarding consent, an online consent form was used at the beginning of the survey (stated in this section).

10. Data analysis: Delete this sentence: “No statistical correction (such as weighting of items or use of propensity scores) was used; this was not felt to be appropriate as this was not a probabilistic sample.” It is redundant.

Response: Sentence deleted.

### Results

11. The authors write “Of the 247 respondents, 207 (84%) reported having used video-based consultations.” The reviewer is wondering why did the other 40 not use video consultations. Was this not an inclusion criterion? Please explain.

Response: We wanted to capture the views of practitioners regardless of their level of experience with telerehabilitation (as specified in the inclusion criteria). The reasons for not using video consultations are summarized in paragraph 4 of the Perceived Benefits and Obstacles section.

12. Further down, the authors write “In free text responses, reduced travel and improved flexibility were deemed particularly beneficial for those with physical disabilities and fatigue.” Consider referring to open ended questions instead of free text. Additionally, clarify who benefited from reduced travel and improved flexibility—does this refer to professional, client, or both?

Response: *Free text responses* has been changed to *open responses*. Reduced travel and improved flexibility are potential benefits for both the patient and practitioner, but here we are referring to the most frequently selected benefits, which included reduced patient travel and convenience and flexibility of the appointment for patients.

13. The next sentence refers to multidisciplinary working. Please explain which aspects pertain to being multidisciplinary (eg, communication or decision-making).

Response: As this was not specified by the respondents who reported this as a benefit, we are unable to comment on which aspects they were referring to.

14. Figure 2: The title refers to perceived benefits, please clarify for whom? Is this written from a professional perspective, as only professionals completed this survey? It is important to make this distinction.

Response: Figure 2 refers to the benefits and obstacles of video-based consultations as perceived by practitioners. The title has been amended to clarify this.

15. Consider replacing “obstacles” with challenges, difficulties, or barriers encountered.

Response: As in comment 3, *obstacles* was the term used in the questionnaire and is unchanged for reasons of consistency.

16. Usability: Do you mean compatibility issues and unstable internet connections? If so, change in text.

Response: Examples of usability issues have been added (performance, responsiveness, and incompatibility of hardware and software).

17. It would be helpful to provide contextual examples of clients where one needs to rely on family for physical assessments. It could be that, for the client profile in question, the preferred method recommended is face-to-face—a point to comment on in the Discussion section.

Response: The following paragraph has been added to Perceived Benefits and Obstacles:

“It was recognised that telerehabilitation may not be the best option for every person or case. Examples given where practitioners felt remote consultations were less appropriate were consultations with very elderly people, people with severe cognitive, sensory or physical impairments, and cases where manual therapy such as adjustment of prostheses is required.”

This has also been referred to in the Discussion (paragraph 1).

18. Table 3: It would be helpful to include mapping of the answers to the relevant survey questions, so the reader can link the two and has a point of reference.

Response: The relevant survey questions are given in the footnote of Table 3.

19. With reference to sensory function (comment e below the table), I am finding it difficult to understand how one assesses sensory function using telerehabilitation methods accurately? Surely there must be validity and reliability issues with this method, please comment in the Discussion section.

Response: The authors feel that this is beyond the scope of the Discussion and would be more relevant in a paper that focuses solely on validity and reliability. Table 3 refers to patient-reported measures of sensory function (specifically the Dunn Adult/Adolescent Sensory Profile and the Reisman and Hanschu Sensory Integration Inventory).

20. Similarly, further down it refers to “clinician rated physical assessments.” Was there any concern for patient-reported outcomes? Especially patients who may have cognitive impairments or want to say what they think the professional wants to hear. Authors could comment on this point in the discussion.

Response: The majority of respondents commented on the validity and reliability of clinician-rated physical assessments. However, there were a small number of comments on patient-reported outcomes used remotely; a statement has been

added to the Physical Outcomes Assessed Remotely section and paragraph 4 of the Discussion.

### Discussion

21. There is a reasonable discussion in light of the findings. Further to the comments marked for the Discussion previously, the authors could also discuss/elaborate on the following.

Paragraph 5: Comment on the potential implications of avoidance in some cases as in when carrying out assessments via video or telephone

Response: The following statement has been added to paragraph 5 of the Discussion:

“Although most patients will be seen by alternative means (particularly as COVID restrictions are easing), there is a possibility that for some, this will lead to delays in diagnosis or treatment.”

22. Next, the authors make a very valid point about “Understanding the actual versus perceived safety risks” but do not elaborate. I think that this is worth further elaboration.

Response: This point has been elaborated on in paragraph 5.

23. Paragraph 6: The first line refers to “Technical and practical support from family members and carers...” What happened in

cases where family/carer support was unavailable? How did professionals get around this challenge and any implications for the practice as a result?

Response: This was briefly covered in the Results section and has now been added to paragraph 6 of the Discussion.

24. Paragraph 7: Line 6 refers to training. Can the authors specify the kind of training required and which areas?

Response: This has now been elaborated on in paragraph 8 of the Discussion.

25. Last paragraph: The authors write “future surveys and qualitative studies should explore how experiences, attitudes and training needs evolve during and after the COVID pandemic.” What about duration/competence of clinical experience of the professional? Did this impact confidence? Is this a question that should be included in future surveys? Please comment.

Response: We agree that this is an important point to consider but did not include a survey question to specifically assess clinical experience/competence. This should be explored in future surveys and qualitative studies; this has been added to the end of the Limitations section.

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of United Kingdom Practitioners"*

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Authors' Response to Peer Reviews

# Authors' Response to Peer Reviews of "Continuous User Experience Monitoring of a Patient-Completed Preoperative Assessment System in the United Kingdom: Cross-sectional Study"

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Companion article: <https://med.jmirx.org/2022/1/e31679/>

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*This is the authors' response to peer-review reports for the paper "Continuous User Experience Monitoring of a Patient-Completed Preoperative Assessment System in the United Kingdom: Cross-sectional Study."*

## Round 1 Review

**Reviewer BG****General Comments**

Thank you for your comment [1]. We also feel that user experience evaluation and feedback is important in the development of eHealth applications.

**Specific Comments****Minor Comments**

1. Thank you for your comment. We sought to introduce this innovation [2] to prevent "questionnaire fatigue."
2. Thank you for your comment. We have included that in the Conclusions and Recommendations section.

**Reviewer CZ****General Comments**

Thank you for your very insightful and helpful comments. Our main points were summarized properly. We have followed your recommendations regarding the title, the Abstract, and the Methods and Discussion sections. The specific changes we have made are outlined below.

**Specific Comments**

Thank you for your comments [3]. We have implemented the recommendations as specified in the responses to the comments below.

**Major Comments**

1. Thank you for your comment. We have changed the title to the one suggested.
2. Thank you for your comment. We have followed your suggestions and revised the abstract accordingly.
3. Thank you for your comment. We have followed your suggestions and revised the abstract accordingly.
4. Thank you for your comment. We have structured the introduction as recommended.

5. Thank you for your comment. We have moved the last paragraph to the *Rationale* section.
6. Thank you for your comment. We have restructured the *Methods* section as outlined.
7. Thank you for your comment. We have added text justifying the use of the statistical tests.
8. Thank you for your comment. We have organized the data analysis subsection as suggested.
9. Thank you for your comment. We have included the suggested guideline and included the checklist as a Multimedia Appendix.
10. Thank you for your comments. We have organized the *Results* section as suggested.
11. Thank you for your comments. We have organized the *Results* section as suggested.
12. Thank you for your comment. For the continuous variables, we tested the differences between groups using both parametric (*t* test, analysis of variance) and nonparametric tests (Wilcoxon rank sum, Kruskal-Wallis). The Shapiro-Wilk test for both age and completion times showed that the data were not normally distributed. We have revised the table to report the median ages and completion times.
13. Thank you for your comment. We have revised the tables to report the medians.
14. Thank you for your comment. We have corrected the terms as suggested.
15. Thank you for your comment. We will report the median completion times, as the data were not normally distributed according to the Shapiro-Wilk test.
16. Thank you for your comment. We have merged the tables as suggested.
17. Thank you for your comment. We have added that paragraph to the *Results* section.
18. Thank you for your comment. We have organized the Discussion as suggested above.
19. Thank you for your comment. We have moved the ethical considerations to the *Methods* section.
20. Thank you for your comment. We listed the appendices before the references and moved the abbreviation list to the end of the paper.

#### Minor Comments

1. Thank you for your comment. We have done so.
2. Thank you for your comment. We have amended the Abstract accordingly.
3. Thank you for your comment. We have modified the statement as suggested.
4. Thank you for your comment. We have formatted the tables according to the guidelines.
5. Thank you for your comment. We have merged some of the tables and so decreased the number of tables to 5.
6. Thank you for your comment. We have reformatted the *P* values to follow the guidelines.
7. Thank you for your comment. We have restructured the *Conclusion* as suggested.
8. Thank you for your comment. We have followed the suggestion given.
9. Thank you for your comment. We have reformatted the references in AMA citation style and included PMIDs and DOIs where available.
10. Thank you for your comment. We have traced the pdfs of all the articles.

### Round 2 Review

#### Reviewer CZ

RESPONSE: Thank you for your comment. We have followed your suggestion and used the text in the Results section of the Abstract as the “Principal findings” and moved the rest of the text in the discussion to under “Comparisons with prior studies.” We have also added some more information about how our results compare favorably with prior studies.

We would like to thank the reviewers for their very insightful and helpful comments that greatly aided in improving this paper.

#### References

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Authors' Response to Peer Reviews

# Authors' Response to Peer Reviews of "COVID-19 Infection and Symptoms Among Emergency Medicine Residents and Fellows in an Urban Academic Hospital Setting: Cross-sectional Questionnaire Study"

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## Abstract

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(*JMIRx Med* 2022;3(1):e36198) doi:[10.2196/36198](https://doi.org/10.2196/36198)

**KEYWORDS**

COVID-19; emergency medicine; housestaff wellness; medical education; training; frontline health care workers; frontline; personal protective equipment; pandemic; infectious disease; emergency

*This is the authors' response to peer-review reports for "COVID-19 Infection and Symptoms Among Emergency Medicine Residents and Fellows in an Urban Academic Hospital Setting: Cross-sectional Questionnaire Study."*

The authors of the manuscript [1] are grateful to the editor and reviewers [2,3] for their invaluable input and feedback.

## Round 1

---

**Reviewer S [2]****Major Comments**

1. We have added to the Data Analysis section of our paper in response to this reviewer's comments. We chose the Fisher exact test instead of the Monte Carlo Simulation because we thought the readers would be more familiar with the Fisher exact test.

### Minor Comments

2. We chose these variables based on our predetermined survey questions.
3. We investigated other statistical analyses by combining other variables but still found the sample size too small to make for a sound analysis.
4. This was a rounding error and should read .049. It has now been corrected. Thank you for pointing this out.

Data analysis: Survey responses were tabulated and compiled into a table format with ranges. Frequency data were reported as percentages with 95% CI. Group comparisons were analyzed by either by chi-square or the Fisher exact test if the sample size requirements for chi-square were violated (the value of the cell expected should be 5 or more in at least 80% of the cells, and no cell should have an expected value of less than 1; Berwick et al [4]). Alpha set as .05 and all tests were 2-tailed. SPSS Statistics for Windows (version 23.0, IBM Corp) was used.

### Reviewer BZ [3]

- 1,2. We have changed our wording to document an acceptable rate of survey completion. We also added the number of survey question items to the Methods section, as this is a known factor for survey noncompletion.
- 3,4. We have defined COVID-19 and SARS-CoV-2 the first time they are mentioned in the introduction of the paper. We have reread and edited our paper for punctuation and grammatical errors, and we used Grammarly software to assist with this process as well.
5. Please see our above comments on data analysis.
6. As the subjects of the study were physicians in training, the governing body dictating protocol was the Accreditation Council for Graduate Medical Education, which at the time and currently deferred to local institutional protocols apart from maintaining the need for supervision and providing adequate protective equipment. At the time this study was conducted, institutional

protocol changed often so there was no uniform process for testing or quarantine. We have added this point to our discussion and feel discussing other countries' protocols would not be appropriate for this publication.

7. We have corrected the use of SARS-CoV-2 and COVID-19 throughout our manuscript.
8. We listed the polymerase chain reaction (PCR) and antibody testing methods in our Methods section under study protocol, with references for each. We also cited the suggested article with a comment on clinical versus laboratory diagnosis in our Discussion section.
9. We have reviewed these articles and cited them in our Discussion section, along with commentary on their prevalence and presentation of COVID-19 compared to ours.

### Round 2 Review

Thank you for your comments.

1. We have changed this to include data up to October 2021 and labeled them as such.
2. We have added a second table (the new Table 2) with this data and added a paragraph to the manuscript with a summary of the data and table.
3. Since we found no trend in the univariate analysis of postgraduate year, clinical hours, or number of patients with COVID-19 treated, we decided that a receiver operator characteristic curve analysis or logistic regression was not appropriate to predict antibody positivity among our respondents.

### Round 3 Review

Thanks for your review. We have added the letter from the SUNY Downstate Institutional Review Board (IRB) confirming that this study is exempt from IRB approval to the Multimedia Appendices section.

### References

1. Frisch S, Jones S, Willis J, Sinert R. COVID-19 Infection and Symptoms Among Emergency Medicine Residents and Fellows in an Urban Academic Hospital Setting: Cross-sectional Questionnaire Study. *JMIRx Med* 2022;3(1):e29539 [[FREE Full text](#)] [doi: [10.2196/29539](https://doi.org/10.2196/29539)]
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### Abbreviations

- IRB:** institutional review board  
**PCR:** polymerase chain reaction

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Authors' Response to Peer Reviews

# Authors' Response to Peer Reviews of “Measuring Integrated Novel Dimensions in Neurodevelopmental and Stress-Related Mental Disorders (MIND-SET): Protocol for a Cross-sectional Comorbidity Study From a Research Domain Criteria Perspective”

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**KEYWORDS**

psychiatry; mental health; psychiatric disorders; neuropsychology; stress; comorbidity

*This is the authors' response to peer-review reports for “Measuring Integrated Novel Dimensions in Neurodevelopmental and Stress-Related Mental Disorders (MIND-SET): Protocol for a Cross-sectional Comorbidity Study From a Research Domain Criteria Perspective.”*

## Round 1 Review

**Reviewer B [1]**

Building on the Research Domain Criteria (RDoC; Cuthbert and Insel [2]), the manuscript [3] presents the study protocol of a transdiagnostic study program to determine mechanisms that either differentiate between neurodevelopmental and stress-related psychiatric disorders or show commonalities. The authors formulate a compelling argument that the



pathophysiological pathway of psychiatric disorder needs to be considered taking a developmental perspective, with an emphasis on the role of comorbidities. To address such a high level of complexity, the authors present a cross-sectional study focused on stress-related (mood, anxiety, and substance abuse) and neurodevelopmental (autism, attention-deficit/hyperactivity disorder) disorders, with four points of measurements (distance unclear), and with each point of measurement including several observational levels: genetics, physiology, neuropsychology, system-level neuroimaging, behavior, self-report, and experimental neurocognitive paradigms.

Reaction: We have now added the time period (1 month) to the procedure section.

Overall, I find this to be an extremely ambitious project. The study protocol as it is provides some good direction, and the approaches taken are state of the art, but the details of the proposal are inaccessible because of its complexity. What worries me most about the ambition of the plan is that the sample size and the requirements of the sample size are not discussed, which leads to issues with the interpretability of the collected data. An issue in a project that puts so much strain on the participants should be carefully considered.

Reaction: We thank the reviewer for the compliments. We must stress that this protocol should be considered as an umbrella for several separate studies and therefore does not permit going into every detail of all envisioned studies. Instead, we have tried to express the general lines of our transdiagnostic approach along the RDoC framework and moreover give enough details about the exact data collection as a reference for other researchers and so that we can refer to this protocol in later papers. Below, we specifically address the sample size issue.

I found the submission to be a mismatch to JMIRx Med; this is clearly a research protocol and might be better suited for JMIR Research Protocols.

Reaction: We would like publish our protocol where it is best suited and will conform to the editor decision here.

Looking at the work solely from a research protocol perspective, I would like to read more details about how the authors intend to combine data or a detailed description of how they intend to pursue their analysis. The complexity prevents them from doing so, but as a result, the quality of the research protocol is difficult to judge—it is too high level to judge all aspects of the protocol responsibly. Defining the most relevant end points would be one approach that would help here.

Either way, I think the work is relevant to address, but journal fit and my mentioned points about sample and approach should be addressed, and the overall work would benefit from formatting and editing (some sections, for example, on the methods used, are redundant).

Reaction: We have restructured the entire manuscript, edited sections, removed redundancy, and moved a section to the discussion. We focus more on statistical analyses that can combine multiple modalities and different levels of observation, such as canonical covariate analysis, linked independent component analysis, and normative modelling.

## Strengths

- Very important topic
- The authors pose a number of highly relevant questions
- Engaging summary of effects of individual disorders on pathophysiological and shared effect between disorders
- Considering the complexity of this project, the details are well thought through and the approaches described are reasonable. To assess the quality of each approach taken in detail, a range of expertise is required
- The authors pose a number of highly relevant questions
- The authors pose a number of highly relevant questions

## Major Issues

- The sample size required is huge and one of the bottlenecks of the suggested approach; while the authors seem to have one unit to recruit participants, it is unclear how many participants would take part. The issue I foresee is that, with that many levels of observation, the complexity of comorbidities, and individual differences, the analysis will remain inconclusive. I would like to hear the authors' thoughts on the sample size and interpretability of the collected data.

Reaction: We thank the reviewer for the important remark and have now included a full paragraph on this issue:

“This research protocol will comprise multiple studies to be conducted across multiple years. The majority of studies will estimate effects at the population level by means of parametric t, F or X2 tests where empirical evidence from our and other centers suggests that typical study sizes of ~20-30 subjects per group can be sufficient to detect relevant between group differences, given typical effect sizes across a variety of data modalities. After consulting a biostatistician, we decided that an overall sample size calculation will be of little value. Also power calculations for studies with MRI are difficult and not used routinely, but here is also consensus that groups of  $\geq 20$  usually yield sufficient power in MRI-studies to detect moderate differences in regions of interest. Based on these considerations and to have at least 20 subjects per group in the broadly defined comorbid conditions, we aim to include a total of 650 patients and 150 healthy control participants in the time period between 2016 and 2022. In October 2021 we are at 95% of our target. Many research studies that will be conducted under this proposal will be exploratory in nature, where not much prior reference work is available. In these cases we will use expected effect size estimates and ranges thereof generated from testing small samples in pilot studies in order to inform sample size calculations. In these sample size calculations, we expect that for cross-sectional analyses, a power of 80% and an alpha of 0.05 we will be able to detect small differences with respect to clinical variables and questionnaires.”

- The instruments used for data collection (questionnaires, biodata, etc) are all vaguely described (eg, which questionnaires will be used and, if biosamples are collected, what exactly will they be processed for). The data is provided in a later step—it is unclear to me why the same aspect is described twice with different levels of detail.

- Engaging summary of effects of individual disorders on pathophysiological and shared effect between disorders
- Considering the complexity of this project, the details are well thought through and the approaches described are reasonable. To assess the quality of each approach taken in detail, a range of expertise is required.
- Reaction: We have included a supplemental text with a full description of all the data that is collected and how it will be processed. Throughout the manuscript, we only mention the instruments briefly to avoid redundancy.
- Throughout the paper, it is not clear if the work has been performed, will be performed, or is still in the process of development and approval. This might be partially due to changes in time but also due to the overall presentation of the protocol—being more upfront about the goals of the manuscript would have helped.  
Response: We have ethical approval and aim to include a total of 650 patients and 150 healthy control participants in the time period between 2016 and 2022. In October 2021, we are at 95% of our target. We explicitly state this in the Methods section now.

#### Minor Issues

- The formatting in the Word document and the PDF makes the document difficult to read. The Word document shows incorrect breaks and paragraphs, while the font in the PDF is pixelized.  
Reaction: The formatting of the manuscript was unwantedly changed somewhere during the submission process, and we hope that it is now fixed.
- The citation format is not in line with JMIR standards.  
Reaction: We have adapted the citation format to be in line with JMIR standards.
- Acronyms like RDoC or MIND are not introduced at their first occurrence, which makes the interpretation difficult.  
Reaction: We have gone through the whole manuscript to make sure that all acronyms or abbreviations are properly introduced.
- Classifying autism as a disorder misses a neurodivergent perspective, which the autism community perceives, see [4].  
Reaction: We acknowledge that classifying autism as a disorder misses a neurodivergent perspective, which is of course well in line with our transdiagnostic approach. We now mention this issue in the discussion, using this reference. We also refer to the control group now as neurotypical, which is also in line with comments of the second reviewer, to better accommodate nuances in classifying autism.  
Although autism spectrum disorder (ASD) is primarily characterized by alterations in sensory sensitivity, inflexible routines, restricted interests, and deficits in social functioning or rather neurodivergent social functioning, about 50% of high-functioning adults diagnosed with ASD who were referred to a psychiatry department had comorbid major depressive disorder.

## Reviewer AS [5]

### General Comments

This paper is interesting and sets the stage for a pretty comprehensive study.

### Specific Comments

#### Major Comments

1. The background is very long, and some spaces are redundant, talking about the overlap of symptoms in comorbidities. Some of this may be better in a discussion—there is a lot of information here. Reaction: We thank the reviewer for the feedback and agree that the background is too information dense. We have shortened the background, have removed redundant parts, and have moved some parts to the discussion when these parts mainly concern considerations based on the content overlapping and distinctions in mechanisms between neurodevelopmental and stress-related disorders.
2. There are a lot of definitive/overly positive statements (eg, “...the RDoC frameworks fits ideally...” “...we can disentangle.” Consider rewording as this is a fairly small sample size in a singular area of the world. Reaction: We have reworded too definitive or overly positive statements throughout the manuscript.
3. Adjust the title so it is clear that this is a description of methods. Reaction: We have adjusted the title to indicate that this paper contains a rationale and description of methods: “Measuring Integrated Novel Dimensions in Neurodevelopmental and Stress-related Mental Disorders (MIND-Set): protocol for a cross-sectional comorbidity study from an RDoC perspective”
4. Anticipated limitations should be included (eg, single-center, nondiverse population, or the number of data points making differentiation challenging). Reaction: We have added a limitations section in the discussion that reads as follows: Limitations: This study has to be understood in the light of some limitations. Although we aim for a fairly large sample size (we aim to include a total of 650 patients and 150 neurotypical control participants), specific cells of comorbidity between disorders may be low for group comparisons. Moreover, the participants are all recruited at one psychiatric center, i.e. the psychiatric department of the Radboud university medical center, which specializes in the diagnosis and treatment of neurodevelopmental disorders and stress-related disorders in adults and their comorbidity, and this constitutes a form of selection bias and decrease generalizability of the study results to other populations.

#### Minor Comments

1. Change addiction disorder to substance use disorder. Reaction: We have changed addiction to substance use throughout the manuscript.
2. Provide a citation for the first line about the acceptance of psychiatric comorbidities as common. Reaction: We have provided a reference for the common comorbidity of psychiatric disorders.

3. Define abbreviations upon first use (eg, DSM-5 [Diagnostic and Statistical Manual of Mental Disorders (Fifth Edition)]). Reaction: We have gone through the whole manuscript to make sure that all acronyms or abbreviations are properly introduced.
4. Consider changing “healthy” to “neurotypical.” Personality traits were examined too, but there is not a lot of rationale here regarding overlap. I agree it is important to review this too, but this needs to be discussed. Reaction: We agree that neurotypical is better to describe our control group and have changed this throughout the manuscript. This also fits with the point raised by the other reviewer pointing to neurodiversity when considering autism. The inclusion of both personality traits provides the opportunity to analyze distinct and shared variance with, for example, autistic traits, but also with negative effects. For example, factor analyses may reveal overlapping dimensions here. We have explicitly mentioned this in the Methods section under measure and statistical analysis.
5. Is microbiome included at the very end as a data point? Reaction: We have moved the paragraph on the microbiome to the appropriate section in the manuscript.

## Review Round 2

### Reviewer B

I want to thank the authors for such an in-depth, detailed, and carefully presented protocol. This is such a challenging study, but the presented implementation connects the different levels of inquiry and the patient groups very well. I found the decision made to be well motivated and am satisfied with the improvements.

I have one point that requires clarification:

– The authors aim to work with people diagnosed with ASD but also included the command of language as an exclusion criterion (ie, “inadequate command of the Dutch language”). How will the authors make sure that not only vocal patients with ASD are included? From my understanding, selective mutism is quite common in people with ASD.

Reaction: Indeed, the reviewer is right that the nature of our approach, with several questionnaires, behavioral assessments, and neuropsychological assessments, requires normal intellectual abilities and excludes mutism in people with autism, and it is therefore right to mention this, as we only include patients with high-functioning autism.

We have mentioned this in the Methods section as follows:

“With regard to autism spectrum disorders, our exclusion criteria implicate that we only investigate patients with high functioning autism, without intellectual disability and without mutism.”

Several minor comments: overall, the manuscript requires proofreading and finishing touches.

### Abstract

“on the basis of” to “based on”

### Introduction

“the exception (1) .” to “(1).”

“on the basis of” to “based on”

### Current Approaches

“especially in light of” to “considering”

“Are depressive symptoms in someone with an autism spectrum disorder comparable to depressive symptoms in someone without an autism spectrum disorder?”; I assume that this should be “attention-deficit/hyperactivity disorder” in one of the cases.

“How well is someone with an autism spectrum disorder actually able to recognize and verbalize their mood symptoms, and how does this impact the diagnostic procedure, and the treatment choice and course?”; I suggest removing “actually”—it is unclear what the “actually” emphasizes, that there is little knowledge from a medical standpoint or if it emphasizes the assumption that people with autism are not aware of their own mood. I lack specialization in working with people with autism, but I would suggest to carefully frame neurotypical assumptions about neuroatypical processes.

### Comorbidity Within the RDoC Framework

“from a genetic, molecular or cellular level” to “from a genetic, molecular, or cellular level”

I stop commenting on this, but the use of the Oxford comma would help with readability when lists are used.

### Data-Driven Approaches

“has to be understood as step in” to “as a step towards”

### Study Aims and Outline

“mood, anxiety and substance abuse” to “mood, anxiety, and substance abuse”

### Methods

“are as well paid a small fee” — is there a reason the exact amount is omitted?

### Session 2: Behavioral Assessment

“faeces” to “feces”

“the Autism Spectrum Quotient ( AQ-50)” to “(AQ-50)”; “(NIDA)” to “(NIDA)”

“of the negative valence system”; unclear why underlined, maybe a subheading would differentiate the different systems discussed here better

### General Issues

Use of Oxford comma in lists

eg and ie should be followed by a comma. See [6].

Check the document for double spaces.

Reaction: We thank the reviewer for the careful reading of the manuscript and the suggestions. We have gone through the manuscript and have adapted all the mentioned issues by the reviewer.

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## Abbreviations

**ASD:** autism spectrum disorder

**DSM-5:** Diagnostic and Statistical Manual of Mental Disorders (Fifth Edition)

**RDoC:** Research Domain Criteria

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Original Paper

# Continuous User Experience Monitoring of a Patient-Completed Preoperative Assessment System in the United Kingdom: Cross-sectional Study

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## Abstract

**Background:** Anesthetic preoperative assessment (POA) is now a common part of the surgical care pathway, and guidelines support its routine use. MyPreOp (Ultramed Ltd) is a web-based POA system that enables remote assessments. Usability is a key factor in the success of digital health solutions.

**Objective:** This study aims to assess the usability of the MyPreOp system through patient feedback, investigate the amount of time it took for patients to complete the POA questionnaire and the factors that influenced completion time, and explore the effect on completion times of implementing a validated eHealth usability scale, as compared to using a simple but unvalidated usability evaluation scale, and to test the feasibility of administering a more detailed usability evaluation scale in a staggered manner so as not to unduly increase completion times.

**Methods:** In this cross-sectional study, anonymized data sets were extracted from the MyPreOp system. The participants were adults (aged  $\geq 18$  years), scheduled for nonurgent surgical procedures performed in hospitals in the United Kingdom, who gave consent for their anonymized data to be analyzed. Data collected included age, gender, American Society of Anesthesiology (ASA) physical classification status, and completion time. Two user experience evaluations were used: in Phase 1, 2 questions asking about overall experience and ease of use, and in Phase 2, a previously validated usability questionnaire, with its 20 questions equally distributed among 5 succeeding patient cohorts. There were 2593 respondents in total (Phase 1:  $n=1193$ ; Phase 2:  $n=1400$ ). The median age of the participants was 46 years, and 1520 (58.62%) of the 2593 respondents were female. End points measured were the median completion times in Phase I and Phase II. The data were collected by extracting a subset of records from the database and exported to a spreadsheet for analysis (Excel, Microsoft Corporation). The data were analyzed for differences in completion times between Phase I and Phase II, as well as for differences between age groups, genders, and ASA classifications.

**Results:** MyPreOp scored well in usability in both phases. In Phase 1, 81.64% (974/1193) of respondents had a good or better experience, and 93.8% (1119/1193) found it easy to use. The usability rating in Phase 2 was 4.13 out of a maximum of 5, indicating high usability. The median completion time was 40.4 minutes. The implementation of the longer usability evaluation scale in

Phase 2 did not negatively impact the completion times. Age and ASA physical status were found to be moderately associated with increased completion times.

**Conclusions:** MyPreOp rates high in both user experience and usability. The method of dividing the questionnaire into 5 blocks is valid and does not negatively affect completion times. Further research into the factors affecting completion time is recommended.

(*JMIRx Med* 2022;3(1):e31679) doi:[10.2196/31679](https://doi.org/10.2196/31679)

## KEYWORDS

preoperative assessment; self-completed patient questionnaires; digital health; usability; user experience; web-based

## Introduction

### Background

Anesthetic preoperative assessment (POA) is now a common part of the surgical care pathway, and guidelines support its routine use worldwide [1]. POA reduces the risk of poor perioperative outcome and reduces cost of a specific group of perioperative candidates [2]. The American Society of Anesthesiologists (ASA) physical status classification score is used worldwide as a comprehensible and practical tool for classifying a patient's clinical preoperative state, and it correlates well with postoperative mortality [3]. Studies have shown that if age and ASA physical status are known before the preoperative assessment consultation, appointment times can be allocated more accurately [4]. According to the Royal College of Anaesthetists, electronic systems should be considered to enable the capture and sharing of information, support risk identification, and allow data to be collected and made available for audit and research purposes [5]. The implementation of a preoperative digital tool may help to improve guideline adherence [6].

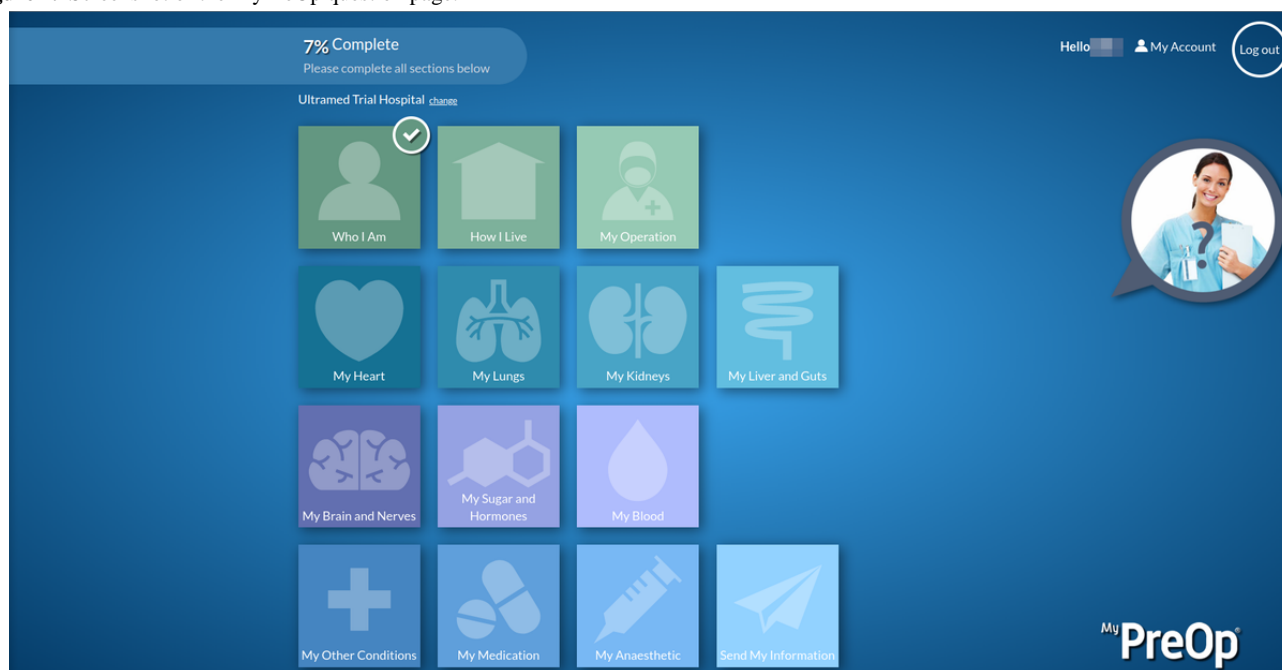
To realize the benefits previously enumerated, a few computerized preoperative assessment systems have recently been developed [2,3,7,8]. One such system that is gaining adoption is MyPreOp.

MyPreOp (Ultram Ltd) is a web-based patient facing app using a secure encrypted connection, designed to replace paper-based preoperative assessments. Patients requiring an

operation can create an account and complete a comprehensive assessment of their general health and medical history. The output includes a clinical summary providing an ASA risk grade of 1 to 5 and recommends additional tests the patient may need. This information is then submitted via email to a nurse from the preoperative team in the form of a PDF file; the nurse reviews the summary and acts on any information provided. The PDF file can be uploaded to the clinical system. The cloud-hosted service can be accessed using a smartphone, tablet, or home computer. As of January 2020, more than 20,000 patients had used the system across 8 UK hospitals, and this number is increasing as more hospitals adopt the system. Incremental improvements have been made to the system based upon feedback from patients and clinicians. Feedback from patients is sought using a short questionnaire after preoperative details are completed. The data from the MyPreOp system is stored in an SQL relational database hosted on a Microsoft Azure server [9]. A screenshot of one of the question pages of MyPreOp is shown in [Figure 1](#).

Usability has been identified as a key component of good practice in the development of digital applications and is a key criterion for the assessment of digital applications in health. Evaluation of usability in eHealth applications has enormous value for patient benefit, as well as greater acceptance by patients and clinicians alike. It is also necessary to ensure that health technologies are appropriately designed and targeted to the end users' needs before they are used as health interventions [10-12]. A recent World Health Organization report stressed that development of digital solutions should be focused on user experience [13].

**Figure 1.** Screenshot of the MyPreOp question page.



## Study Rationale

We conceived this study to address the need to evaluate a POA system using a validated digital health usability measure. We reviewed the literature to find similar studies that evaluated the usability of a POA system.

In the literature, we found only two computerized preoperative assessment systems that reported the results of the usability testing methods used in their development and evaluation. The developers of one system used the System Usability Scale (SUS) questionnaire as well as a heuristic evaluation to evaluate usability [7]. The SUS is a commonly used usability evaluation scale, but it is not specific to digital health applications.

User experience and acceptability of another system were measured using the Questionnaire's Questionnaire, 10-item version (QQ-10) [1]. The QQ-10 was developed and validated to evaluate specific aspects of value and burden of a questionnaire. However, it was originally intended for paper questionnaires, and it was not specifically designed to evaluate the usability of digital health applications.

Current evidence is limited on the factors influencing the amount of time it takes for patients to self-complete a computerized preoperative assessment. A previous study has shown that age and ASA physical status have the largest effect sizes in influencing the amount of time spent in a face-to-face preoperative assessment with a clinician [4]. We decided to investigate the patient-reported usability of the MyPreOp preoperative assessment system with a validated digital health usability measure, assess the factors that influence the completion times, and devise a method of continuously assessing usability without unduly increasing completion time.

## Study Aims and Objectives

The aim of our study was to evaluate the usability of the MyPreOp preoperative assessment system. The objectives of

the study were to assess the usability of the system through patient feedback, investigate the amount of time it took for patients to complete the preoperative assessment questionnaire and the factors that influence completion time, and explore the effect on the completion times of implementing a validated eHealth usability scale as compared to using a simple but unvalidated usability evaluation scale, and test the feasibility of administering a more detailed usability evaluation scale in a staggered manner so as not to unduly increase completion times.

## Methods

### Study Design, Setting, and Recruitment

The research was designed as a cross-sectional study, with all participants selected based on the inclusion and exclusion criteria for the study. The inclusion criteria were patients aged 18 years and older who entered data in the MyPreOp system for preoperative assessment for nonurgent surgical procedures in hospitals across the United Kingdom and successfully completed the POA.

### Intervention and Data Collection (Phase 1 and Phase 2)

The study was performed in two phases. An initial analysis of retrospectively extracted data was performed for Phase 1 of the study. In Phase 2, data were prospectively collected, and a longer, previously validated usability questionnaire was used to evaluate the usability of the system.

### Phase 1

For the first phase of the study, an anonymized subset of the data was extracted from records entered by patients into the MyPreOp database from January to March 2019 and exported to a spreadsheet (Excel 2013, Microsoft Corporation). The variables in the subset included age, gender, ASA grade, and amount of time required to complete the questionnaire (completion time). Completion time was measured by measuring

the time from when the patient logged on to the system to when the patient clicked on the submission button. Data from the responses to two feedback questions about their overall experience and ease of use of the system were also extracted. The two questions were:

- Question 1: “Overall, how did you find your experience of using MyPreOp?” Respondents were asked to choose between Excellent, Good, Satisfactory, and Poor.
- Question 2: “How easy did you find it to follow the instructions and enter your information?” The choices were Very easy, Easy enough, A bit difficult, and Very difficult.

A free text comment box was also included for patients to enter any comments or suggestions.

### Phase 2

In Phase 2, data were extracted from patient entries made in the period from the start of May 2019 to mid-June 2019. Age, gender, ASA grade, and the amount of time needed to complete the MyPreOp questionnaire were among the variables collected.

The patients evaluated the usability of the system by filling in the Health Information Technology Usability Evaluation Scale (Health-ITUES). The Health-ITUES is a validated instrument that explicitly considers each task by addressing various levels of expectation of support for the task by the health information technology. The Health-ITUES also has the added benefit of being customizable; it can address the study needs and concepts measured without item addition, deletion, or modification. The Health-ITUES has been validated in both web and mobile health technologies. The Health-ITUES consists of 20 items rated on a 5-point Likert scale from strongly disagree (1) to strongly agree (5). A higher scale value indicates higher perceived usability of the technology [14,15].

### End Points Measured

The main outcome of interest was the time taken to complete the preoperative assessment. Explanatory variables were age, gender, and ASA physical classification, as previous studies had identified these as variables that were correlated with differences in completion times in face-to-face preoperative assessments [4].

### Study of the Intervention

To lessen the effect from “questionnaire fatigue,” the 20 questions of the Health-ITUES were divided into 5 blocks of 4 questions each. Each block of questions was presented to the users of MyPreOp for approximately 1 week before switching to the next block of questions.

It was hypothesized that if the patients had a clearer idea of how long it would take to complete the assessment, they would be able to manage their expectations better and this would increase their perception of the system’s usability. During Phase 2, patients using the system in the first 2 weeks of the month used the usual system, and in the latter 2 weeks, this message was included at the start of the assessment:

*Most people take between 30 and 60 minutes to complete MyPreOp. This is because your hospital needs a lot of background information about you. I*

*understand that it is likely to take me between 30 and 60 minutes to complete MyPreOp.*

The completion times and ratings of patients who did not see the message and patients who saw the message were compared.

### Data Analysis

The data analysis was organized as follows:

- Assessment of usability: the usability of MyPreOp was assessed through ease-of-use questions and by the Health-ITUES score.
- Questionnaire completion times and the factors affecting this (age, gender, ASA classification): we analyzed the effects of these factors on average completion times, as well as the correlation between completion times and age.
- Effect of using a more detailed usability scale (Health-ITUES): we also looked at the correlation between completion times and usability as measured by the Health-ITUES.

Analysis of the data consisted of computation of descriptive statistics and tests of the differences between completion times and ages. Preliminary analyses were conducted to ensure that there was no violation of the assumptions of each statistical test. Depending on the nature of the data, an appropriate statistical test was used to test the differences between the continuous variables under investigation. If the data were normally distributed, then a *t* test (for 2 groups) or analysis of variance (for more than 2 groups) was used. In cases where the data were not normally distributed, the Wilcoxon rank sum test (2 groups) or Kruskal-Wallis test (more than 2 groups) was used where appropriate. A *P* value <.05 was considered statistically significant. For categorical variables, the chi-square test was used to test the differences in proportions. All statistical analyses were performed using the R statistical package (R Foundation for Statistical Computing).

### Ethical Considerations

Anonymized data sets were provided to the investigators by the service provider (Ultramed). The study was classified as a service evaluation, which, together with the use of anonymized data that had been collected by a second party with informed consent, meant that formal ethical approval was not necessary.

We also accomplished the mHealth Evidence Reporting and Assessment (mERA) checklist, which is included as [Multimedia Appendix 1](#).

## Results

### Participant Characteristics

In Phase 1, data from 1236 patient entries into the MyPreOp system were collected, with complete data available for 1193 patients. In Phase 2, data from 1496 patient entries were collected, with complete data available for 1400 patients. Complete data were available for 2593 patients in total. The baseline characteristics, including age, gender, time to complete MyPreOp, and responses to the feedback questions on overall experience and ease of use are shown in [Table 1](#). In terms of age, participants in Phase 1 were younger than participants in



Phase 2, and the difference was statistically significant (Wilcoxon rank sum test,  $P < .001$ ). Likewise, the completion times for patients in Phase 1 were shorter than the completion times for patients in Phase 2, and the difference was statistically significant (Wilcoxon rank sum test,  $P < .001$ ). On average, Phase 1 patients completed the MyPreOp assessment 6.97 (95% CI 7.53-4.66) minutes faster than Phase 2 patients.

The median completion times of the different age groups and ASA physical status groups varied significantly from one another (Table 2). Overall, there was no difference in median completion times between male and female participants (Wilcoxon rank sum test,  $P = .28$ ). The median completion times

for each ASA physical status group were statistically different from those of each of the other ASA physical status groups ( $P < .001$ ). This was true for both phases.

There was a statistically significant difference in the median ages of each of the ASA physical status groups (Kruskal-Wallis test,  $P < .001$ ). A pairwise comparison showed that this difference is statistically significant between the ASA physical status groups, except for between ASA grades 3 and 4. The table below shows the median ages for the ASA physical status groups.

This indicates that age and ASA grade are not independent of each other and that as age increases, the ASA grade likewise increases.

**Table 1.** Summary of demographics, ASA status, and time to complete MyPreOp.

Characteristic	Overall (N=2593) <sup>a</sup>		Phase 1 (n=1193) <sup>b</sup>		Phase 2 (n=1400) <sup>c</sup>	
	n (%)	Median time to complete MyPreOp (minutes)	n (%)	Median time to complete MyPreOp (minutes)	n (%)	Median time to complete MyPreOp (minutes)
<b>Age (years)</b>						
≤45	1290 (49.75)	32.16	706 (59.18)	30.79	584 (41.72)	33.84
46-65	799 (30.81)	43.28	334 (27.30)	40.78	465 (33.21)	44.48
≥66	504 (19.44)	61.17	153 (12.82)	59.68	351 (25.07)	61.85
<b>Gender</b>						
Female	1520 (58.62)	40.7	698 (58.51)	38.32	822 (58.71)	43.32
Male	1073 (41.38)	40.12	495 (41.49)	34.5	578 (41.29)	44.57
<b>American Society of Anesthesiology physical status</b>						
1	953 (36.75)	32.48	499 (41.83)	31.23	454 (32.43)	34.54
2	1021 (39.38)	42.6	434 (36.38)	39.36	587 (41.93)	45.15
3	526 (20.29)	51.35	220 (18.44)	45.14	306 (21.86)	55.04
4	93 (3.58)	60.55	40 (3.35)	54.62	53 (3.78)	63.57

<sup>a</sup>Median age 46 years; median time to complete MyPreOp 40.47 minutes.

<sup>b</sup>Median age 40.88 years; median time to complete MyPreOp 36.75 minutes.

<sup>c</sup>Median age 50.96 years; median time to complete MyPreOp 43.92 minutes.

**Table 2.** Median ages of the American Society of Anesthesiology (ASA) groups.

ASA physical status group	Age (years), median
1	35
2	49
3	59
4	63

### Assessment of Usability: Phase 1

In Phase 1, complete results were obtained from 1193 patients. For the evaluation, patients were asked two multiple choice questions about overall experience and ease of use, as stated in

the *Methods* section of this paper. The frequency of the responses to the two evaluation questions, median time, and ASA physical status for each type of response are shown in Table 3.

**Table 3.** Patient satisfaction ratings, completion times, ASA physical status, and overall experience in Phase 1.

Phase 1 (n=1193)	Overall experience				Ease of use			
	Excellent	Good	Satisfactory	Poor	Very easy	Easy enough	A bit difficult	Very difficult
Participants, n (%)	417 (34.95)	557 (46.69)	194 (16.26)	25 (2.10)	697 (58.43)	422 (35.37)	63 (5.28)	11 (0.92)
Median time to complete MyPreOp (minutes)	32.67	38.33	44.17	42.33	33.18	41.94	53.13	35.05
<b>American Society of Anesthesiology physical status</b>								
1	200 (16.76)	222 (18.60)	69 (5.78)	8 (0.67)	331 (27.75)	149 (12.49)	17 (1.42)	2 (0.17)
2	149 (12.49)	206 (17.27)	74 (6.20)	5 (0.42)	244 (20.45)	157 (13.16)	28 (2.35)	5 (0.42)
3	59 (4.95)	110 (9.22)	41 (3.44)	10 (0.84)	107 (8.97)	98 (8.21)	11 (0.92)	4 (0.34)
4	9 (0.75)	19 (1.59)	10 (0.84)	2 (0.17)	15 (1.26)	18 (1.50)	7 (0.59)	0 (0.00)

Median completion times differed statistically depending on the response given in the overall experience question ( $P < .001$ ). Those who answered that they had an “excellent” overall experience had a quicker median completion time (32.67) than those who answered “poor” to the overall experience question (42.33). Those who answered that they found MyPreOp “very easy” to use had a quicker media completion time of 33.18 minutes; this was slightly faster than those who found the system “very difficult” to use, with a median completion time of 35.05 minutes.

The responses to the feedback questions were related to the ASA physical status scores computed by the MyPreOp system.

A chi-square test revealed that there was a significant association between ASA physical status and the response to the overall experience feedback question ( $\chi^2_9=25.793$ ;  $P < .05$ ).

Likewise, the responses to the ease-of-use question were also significantly associated with ASA physical status. The

chi-square test showed that the association between ASA physical status and the response to the ease-of-use question was significant ( $\chi^2_9=42.75$ ;  $P < .001$ ).

### Assessment of Usability in Phase 2: Health Information Technology Usability Evaluation Scores

In Phase 2, complete entries were collected from 1400 patients. As in Phase 1, data on age, gender, computed ASA physical status classification, and number of minutes needed to complete the assessment were collected. In addition to this, the simple evaluation questions in Phase 1 were replaced with more detailed questions from the Health-ITUES. As described previously, the 20 questions in the Health-ITUES were divided into 5 blocks of 4 questions each and were presented sequentially over the data collection period. Each patient answered 4 of the 20 questions. The questions are divided into the following domains: impact, perceived usefulness, perceived ease of use, and user control. The median score for each question, as well as the median combined and overall scores, are shown in [Table 4](#).

**Table 4.** Descriptive statistics for the question scores.

Question	Median score	Median combined score
<b>Impact</b>		4.09
I think MyPreOp would be a positive option for persons needing to fill out a preoperative assessment.	4.11	
I think MyPreOp would improve the quality of care of persons needing to complete a preoperative assessment.	4.03	
MyPreOp is an important part of meeting my needs related to preoperative assessment and my upcoming operation.	4.11	
<b>Perceived usefulness</b>		4.19
I am able to self-complete my preoperative assessment in a timely manner because of MyPreOp.	4.12	
Using MyPreOp is useful for self-completion of my preoperative assessment.	4.13	
I think MyPreOp presents a modern approach for the self-completion of preoperative assessment.	4.43	
Using MyPreOp makes it easier to self-complete my preoperative assessment.	4.38	
Using MyPreOp enables me to self-complete my preoperative assessment more quickly.	4.1	
I am able to make changes to my medical history myself whenever I use MyPreOp.	4.05	
Using MyPreOp increases my ability to self-complete my preoperative assessment.	4.2	
I am satisfied with MyPreOp for self-completion of my preoperative assessment.	4.16	
Using MyPreOp makes it more likely that I can self-complete my preoperative assessment.	4.11	
<b>Perceived ease of use</b>		4.26
I can always remember how to log on and use MyPreOp.	4.21	
I find MyPreOp easy to use.	4.19	
Learning to operate MyPreOp is easy for me.	4.37	
I am comfortable with my ability to use MyPreOp.	4.38	
It is easy for me to become skillful at using MyPreOp.	4.16	
<b>User control</b>		4.24
MyPreOp gives error messages that clearly tell me how to fix problems.	4.4	
Whenever I make a mistake using MyPreOp, I can amend answers easily and quickly.	4.23	
The information (such as online help, on-screen messages, and other documentation) provided with MyPreOp is clear.	4.05	
Overall score	N/A <sup>a</sup>	4.2

<sup>a</sup>N/A: not applicable.

To determine if the scores could be combined into scales, the median scores for each question block were calculated and compared using the Kruskal-Wallis test. This nonparametric test was chosen because the data were not normally distributed, as demonstrated by a Shapiro-Wilk test. The Kruskal-Wallis test showed that the differences between the median scores of the blocks were statistically significant ( $P < .001$ ). The effect size was calculated to determine the extent of the differences of the scores between blocks using the  $\epsilon^2$  statistic. The calculated  $\epsilon^2$  value was 0.011, which is interpreted as indicating a small effect size [16]. Furthermore, the effect size of the differences in the scores of each question was calculated. The calculated  $\epsilon^2$  value was 0.02, which also corresponds to a small effect size. We therefore determined that combining the scores was a valid

approach because the effect size of dividing the questionnaire into blocks was minimal.

MyPreOp scored well in all the subscales and had a median overall score of 4.2 out of a maximum score of 5 in usability as measured by the Health-ITUES. The subscale where MyPreOp scored highest was perceived ease of use (4.26/5), and the subscale with the lowest score was impact (4.09/5).

We investigated if the ratings differed between age categories. The results are shown in Table 5.

The youngest age category gave the highest median scores (4.37), while the oldest age category gave the lowest median ratings (3.94). The differences in ratings were quite small (0.43), and calculating for effect size showed that the age category had only a small effect size on the ratings (effect size 0.04).

**Table 5.** Median overall ratings by age category.

Age category (years)	Median overall score (out of 5)
≤45	4.37
46-65	4.22
≥66	3.94

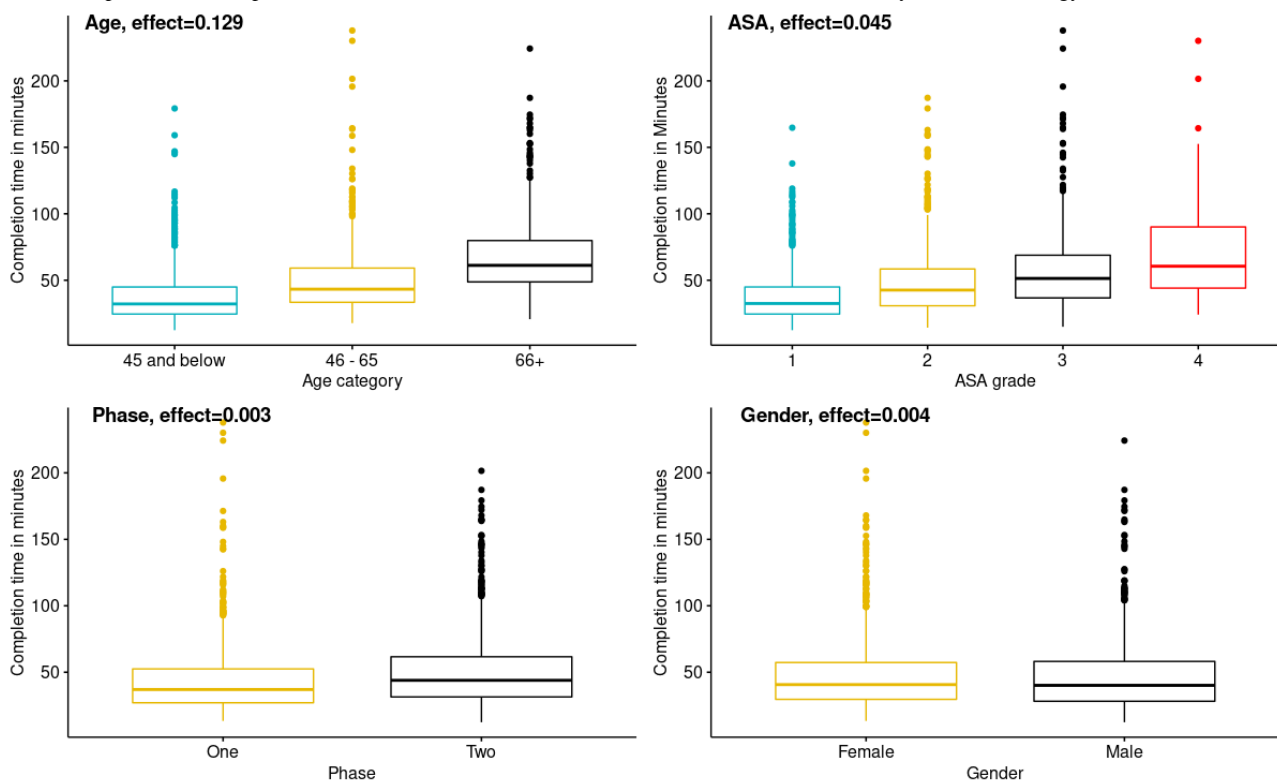
### Factors Affecting Completion Times

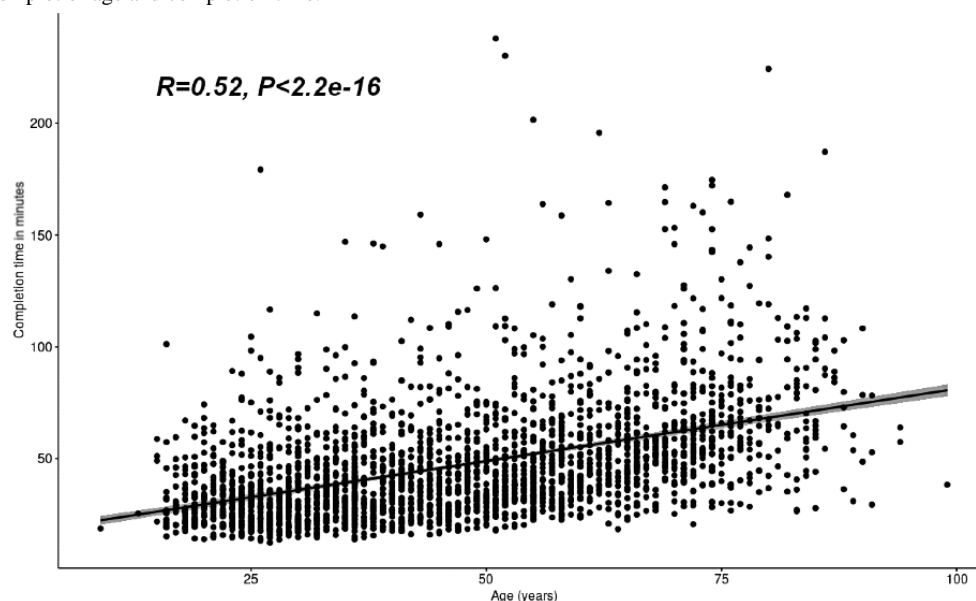
Using the combined data from both phases, the research team investigated which factors influenced the amount of time required for patients to complete the preoperative evaluation. The factors examined included age category, ASA grade, gender, and use of the Health-ITUES (this scale was not used in Phase 1, whereas it was used in Phase 2).

The box plots in [Figure 2](#) illustrate the completion times for each category of the factors, as well as the effect size for each factor. Comparing the median completion times for the various factors under investigation, we found that the completion time increases with age and that the age category has the largest effect size. Patients aged ≤45 years had a median completion time of 32.16 minutes, compared with 61.17 minutes for patients aged ≥66 years, a difference of 29.01 minutes. Completion time also increased with ASA physical status grade; the median completion time of patients with ASA grade 1 was 28.07

minutes shorter than that of patients with ASA grade 4. Incorporating the Health-ITUES scale in Phase 2 (in 5 blocks of 4 questions each) had only a small effect on completion time, with an increase of 7.17 minutes for the cohort using the Health-ITUES. The computed effect size of including the Health-ITUES was likewise very small, accounting for only 0.3% of the variance. Gender also had a negligible effect on completion time, with a <1 minute difference in completion times between female and male participants.

Although age had the largest effect size on completion time, it only accounted for approximately 12% of the variance in completion times, as indicated by the partial  $\epsilon^2$  value. We further investigated the correlation between age and completion time by plotting the times on a graph and calculating the correlation. The results are shown in [Figure 3](#). The calculated correlation coefficient was 0.52 ( $P<.001$ ), indicating a moderate positive correlation of age with completion time.

**Figure 2.** Box plots of the completion times and effect sizes of various factors. ASA: American Society of Anesthesiology.

**Figure 3.** Correlation plot of age and completion time.

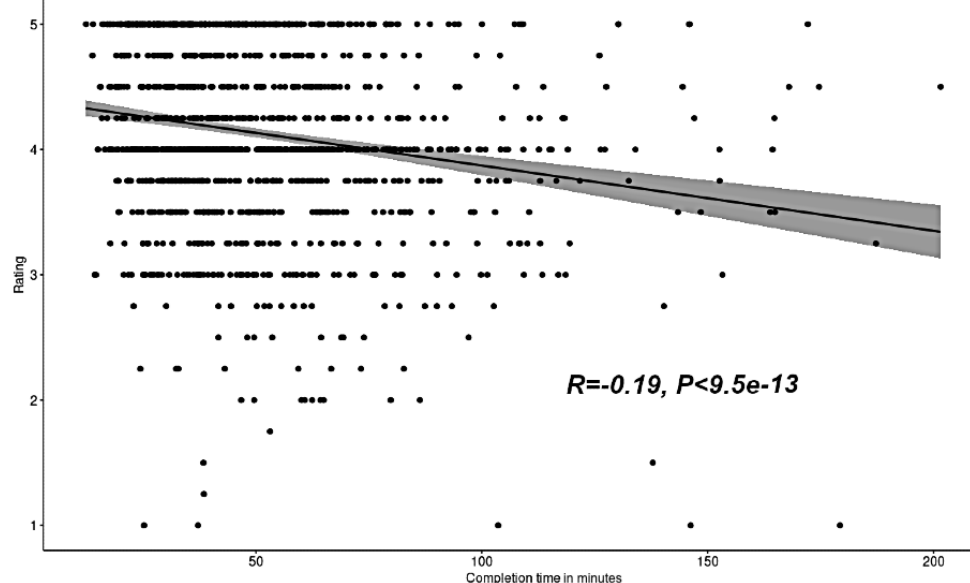
### Effect of Completion Times on Health-ITUES Ratings

We also examined the relationship between completion times and the overall Health ITUES ratings. The ratings in the four questions asked for every patient were averaged to obtain an overall rating for every patient. We then plotted the overall ratings with their corresponding completion times and calculated the correlation coefficient to determine the strength of the association. The results are shown in Figure 4. The calculated correlation was  $-0.19$  ( $P<.001$ ), which is evaluated as a weak negative correlation between the rating and completion time. This can be interpreted as a very slight decrease in the usability rating as the completion time increases.

Finally, the ratings and completion times of patients who received the information message about the time needed to complete the assessment were compared. The median overall ratings by patients who did not receive the message and patients who received the message were both 4. There was no significant difference between the ratings ( $P=.41$ ). The median completion times for the groups who did not receive the message and who

received it were 43.6 minutes and 44.3 minutes, respectively. There was no statistical difference between completion times for the 2 groups (Wilcoxon rank sum test,  $P=.50$ ). We interpret this as the appearance of the information message having no effect on either the rating or completion time.

In summary, the outcomes of interest, as in, the completion times and usability ratings, were influenced by contextual factors. Age and ASA physical status had the most effect on completion times, while gender, the use of the Health-ITUES questionnaire, and the presence of a message about the length of time needed to complete the evaluation had little effect on completion times. The presence of the message also had no effect on the usability ratings. Completion time had a weak negative effect on usability ratings. We cannot discount the possibility of other factors influencing the completion time, such as speed and quality of the internet connection, whether the patient took a break while completing the assessment, and whether it was the patient or a carer who completed the assessment. We explore this further in the *Discussion* section.

**Figure 4.** Correlation plot of the completion times and ratings in Phase 2.

## Discussion

### Principal Results

The results of both Phase 1 and Phase 2 indicate that MyPreOp scores very high in overall experience, ease of use, and usability as measured by the Health-ITUES evaluation scale. Approximately 81% of the users in Phase 1 rated their overall experience of MyPreOp as excellent or good, and 94% rated the system's ease of use as very easy or easy enough. Older people and people with more morbidities (as indicated by age category and ASA physical status score) tended to give lower ratings for overall experience and ease of use.

The Health-ITUES ratings collected in Phase 2 show that the participants rated MyPreOp high in usability, with an overall rating of 4.13 out of 5. Age only had a small effect on the ratings, indicating that both younger and older patients perceived the system as highly usable. Completion time also had little effect on the ratings, as the correlation between the ratings and the time taken to complete the assessment was weak. This finding demonstrated that the high perceived usability of MyPreOp was due primarily to the user interface design and was not affected by other factors.

Dividing the 20 questions of the Health-ITUES in 5 blocks of 4 questions had little effect on the variance of the ratings and on the completion times. This shows that it is feasible to administer the Health ITUES in this fashion, provided that the block sizes are large enough. Our study had block sizes ranging from 252 to 311 patients per block, which would provide adequate power.

We interpret the smaller effects that age and other factors such as ASA physical status had on the ratings as being due to the more specific nature of the questions being asked in the Health-ITUES. The benefit of the Health-ITUES is that it is able to provide ratings for specific subscales; this will be useful in designing the next iteration of MyPreOp, with the aim of providing a better user experience. The simple questions about overall experience and perceived ease of use only provide a

general idea about what can be improved upon in the user experience. The fact that completion time had little effect on the ratings but a significant effect on overall experience can be attributed to user experience encompassing factors other than usability, such as usefulness, desirability, accessibility, credibility, findability, and value [17].

The results indicate that increased completion times are associated with increasing age and ASA physical status, as in, older patients with more disease conditions take longer to complete the self-assessment. A characteristic of the system is that because of the branching algorithms, those with more morbidities will be asked more questions, thereby increasing completion times. This corresponds to the findings from a study that measured the time of in-clinic POA with health professionals, where age and ASA physical status were also associated with increased length of assessment [4].

Aside from the increased number of morbidities that accompany advancing age, other factors associated with age may be present that increase completion time. It is acknowledged that at present there is a digital divide, where older people are less familiar with digital technology. This may also contribute to the increase in completion times for a web-based self-administered questionnaire in older people with less digital health literacy. Training programs, possibly delivered by digital health champions, may be able to raise digital health literacy in older populations [18-20].

It is important to note that while age had the greatest effect size on completion time among the factors being compared, the actual measured effect size was small, accounting for only 12% of the variance in completion times. This indicates that other factors that were not measured in the data set could be responsible for increasing completion times. These factors could include the nature of the internet connection being used (eg, mobile phone network vs superfast broadband), the device being used (smartphone, tablet, or PC), whether a patient or a carer is answering the assessment. Another factor to be taken into consideration is whether the patient answered the question in



one sitting or took breaks or “multitasked” while accomplishing the assessment. The fact that the user can save their data, perform other tasks, and return to the assessment could be one factor that accounts for the high overall experience and usability scores despite the completion times ranging from 12 to 237 minutes. The convenience of being able to complete the assessment when and where the patient chooses, coupled with the ability to save the data and resume the assessment, is one of the desirable features of the system. The system also gives informational links relevant to the disease conditions being reported by the patient. Time spent browsing these links also gets included in the completion time if the patient decides to read the information before completing the assessment.

### Comparison With Prior Studies

Our findings are similar to the study performed by Hawes et al [4], who also found that age and ASA physical status influenced the length of face-to-face preoperative assessment. Some of the other factors that they found to influence assessment time were which nurse practitioner saw the patient and the type of surgery the patients were being screened for. The former factor is not applicable in our study, as all the participants in our study performed self-assessments. Data on the type of surgery were not collected in our study. However, the effect size of the type of surgery was very small, only 0.006, meaning that it accounted for only 0.6% of the variability.

### Study Limitations

The lack of data on the other factors that affect completion time is one of the limitations of the study. Data on the speed of the respondent’s internet connection, the type of device they used to complete the assessment, whether the patient and/or a carer answered the questionnaire, and the digital health literacy of the respondent are not routinely collected by the MyPreOp system. Further studies are needed to collect data on these factors and determine the extent of their influence on completion times. Data on the type of surgery being screened for were also not collected.

The strength of the study lies in the large sample size from which we were able to collect data. To our knowledge, this is the first study of a POA system that used a usability evaluation scale designed specifically for health information technology.

### Conclusion

The objectives of the study were to (1) evaluate the usability of MyPreOp, (2) investigate the factors that influence the time it takes to complete MyPreOp, and (3) explore how a validated usability measure can be implemented without unduly lengthening completion times.

We found that for the majority of the 2593 patients whose data were included in the study, MyPreOp provides a good overall experience, good perceived ease of use, and high usability as measured by both simple usability questions and the Health-ITUES. The factors that influenced completion time were age and ASA physical status. The method of administering the Health-ITUES by administering it 4 questions at a time in 5 blocks did not have a deleterious effect on completion times or induce a large variation in the ratings, as shown by the small effect size.

One lesson we learned was that for digital health applications with a large installed base, dividing the usability questionnaire items into more manageable blocks is a valid way of evaluating user experience without negatively impacting completion times. This prevents “questionnaire fatigue” on the part of the respondents.

More research is needed on the factors that influence completion times, setting aside the inherent nature of the system where more questions are asked when the patient has multiple disease conditions. It would also be helpful to further explore the impact of a message addressing length of assessment completion at the start of the assessment. Additional qualitative research is also needed on what factors specifically impact on user experience. The association between digital health literacy and the speed of completion of electronic health questionnaires needs to be investigated further.

We recommend that training programs aimed at increasing the digital health literacy of the older population be instituted, as this can contribute to faster completion times for computerized preoperative self-assessment as well as other self-completed computerized assessments. We also recommend that digital health champions be deployed to assist in delivering programs to increase digital health literacy in the older population.

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### Authors' Contributions

AC and IDM conceived the study. IDM was involved in obtaining the data sets, data analysis, and writing the first draft of the manuscript. Both authors reviewed and edited the manuscript and approved the final version of the manuscript.

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### Conflicts of Interest

None declared.

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## Multimedia Appendix 1

mHealth evidence reporting and assessment (mERA) checklist.

[\[PDF File \(Adobe PDF File\), 124 KB - xmed\\_v3i1e31679\\_app1.pdf \]](#)**References**

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**Abbreviations****ASA:** American Society of Anesthesiology

**Health-ITUES:** Health Information Technology Usability Evaluation Scale

**POA:** preoperative assessment

**QQ-10:** Questionnaire's Questionnaire 10-item version

**SUS:** System Usability Scale

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Original Paper

# COVID-19 Infection and Symptoms Among Emergency Medicine Residents and Fellows in an Urban Academic Hospital Setting: Cross-sectional Questionnaire Study

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## Abstract

**Background:** COVID-19, an illness caused by the novel coronavirus SARS-CoV-2, affected many aspects of health care worldwide in 2020. From March to May 2020, New York City experienced a large surge of cases.

**Objective:** The aim of this study is to characterize the prevalence of illness and symptoms experienced by residents and fellows in 2 New York City hospitals during the period of March to May 2020.

**Methods:** An institutional review board–exempt survey was distributed to emergency medicine housestaff in May 2020, and submissions were accepted through August 2020.

**Results:** Out of 104 residents and fellows, 64 responded to our survey (a 61.5% response rate). Out of 64 responders, 27 (42%) tested positive for SARS-CoV-2 antibodies. Most residents experienced symptoms that are consistent with COVID-19; however, few received polymerase chain reaction testing. Out of 27 housestaff with SARS-CoV-2 antibodies, 18 (67%) experienced fever and chills, compared with 8 out of 34 housestaff (24%) without SARS-CoV-2 antibodies. Of the 27 housestaff with SARS-CoV-2 antibodies, 19 (70%) experienced loss of taste and smell, compared with 2 out of 34 housestaff (6%) without SARS-CoV-2 antibodies. Both fever and chills and loss of taste and smell were significantly more commonly experienced by antibody-positive compared to antibody-negative housestaff ( $P=.002$  and  $<.001$ , respectively). All 13 housestaff who reported no symptoms during the study period tested negative for SARS-CoV-2 antibodies.

**Conclusions:** Our study demonstrated that in our hospitals, the rate of COVID-19 illness among emergency department housestaff was much higher than previously reported. Further studies are needed to characterize illness among medical staff in emergency departments across the nation. The high infection rate among emergency medicine trainees stresses the importance of supplying adequate personal protective equipment for health care professionals.

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## KEYWORDS

COVID-19; emergency medicine; housestaff wellness; medical education; training; frontline health care workers; frontline; personal protective equipment; pandemic; infectious disease; emergency

## Introduction

COVID-19 is a viral respiratory illness caused by SARS-CoV-2; it has created problems worldwide since 2020. By March 2020, COVID-19, also known as “novel coronavirus,” had reached the epidemiological criteria for a global pandemic [1]. After its initial identification in Wuhan, China, COVID-19 quickly spread across the world [2]. Since COVID-19 was first identified in the United States on January 15, 2020, in Seattle, Washington, the United States has reported the largest number of confirmed cases. To date, the United States has had over 13.8 million COVID-19 cases, with over 320,000 of those in New York City alone [3]. New York City experienced a massive surge of cases between March and May 2020.

At the time of the writing of this article, the county of Kings, New York, also known as the city of Brooklyn, had seen the highest number of COVID-19–related deaths in the United States, at over 24,000 [2]. The State University of New York (SUNY) Downstate Medical Center and Kings County Hospital are state and public city hospitals located in central Brooklyn. The emergency departments in both hospitals are staffed primarily by board-certified emergency medicine (EM) attending physicians and EM residents. As of November 18, 2020, Kings County Hospital had cared for 2701 patients with COVID-19 and reported 348 COVID-19–related deaths. As of November 18, 2020, SUNY Downstate Medical Center, which was designated a COVID-19–only facility by the state governor’s mandate [4], had admitted 864 patients with COVID-19 and reported 298 deaths.

Resident physicians in teaching hospitals act as the front lines of the emergency department, intensive care units, and clinics. Given the large volumes of patients they see over long and frequent shifts, their exposure rates are perceived to be great. Furthermore, in this study, we include SARS-CoV-2 exposure early in the first wave of COVID-19, when personal protective equipment (PPE) was limited and before stockpiles were mandated in New York City.

This study aims to evaluate the SARS-CoV-2 exposure of emergency medicine resident physicians and fellows working at the abovementioned urban academic medical centers. After quantifying the exposure, their symptoms, the number of patients with COVID-19 treated and intubated, and perceived adequacy of PPE was correlated with residents’ and fellows’ antibody test results.

## Methods

### Study Design, Setting, and Population

A cross-sectional survey study was conducted at SUNY Downstate Medical Center and Kings County Hospital Center in Brooklyn, New York, among individual emergency medicine residents and pediatric emergency medicine fellows. This material has not been previously presented.

### Study Protocol

The open 20-question electronic survey questionnaire was generated using the Qualtrics Survey platform, August 2020 version (Qualtrics), and the technical functionality of the survey on the Qualtrics platform was tested prior to distribution. The survey was self-administered in May 2020 via email listserv to the residents and fellows of the SUNY Downstate Emergency Medicine Department. The survey and investigation received institutional review board (IRB) exemption status from the SUNY Downstate IRB with participant consent waived. Participation in the study was voluntary, and no compensation was given for participation. No personal information was stored. Completeness checks were not performed automatically, but participants were able to review their responses prior to submitting. Results were automatically captured in the Qualtrics system, and they were kept anonymous and confidential. IP addresses were used to ensure unique responses and identify potential duplicate entries. During the study period, residents were offered three laboratory options for SARS-CoV-2 IgG antibody testing:

1. Wadsworth Center microsphere immunoassay [5], performed at the public health laboratory of the New York State Department of Health
2. Abbott Laboratories Inc chemiluminescent microparticle immunoassay [6], performed at Quest Diagnostics
3. Abbott ARCHITECT [6] nucleocapsid immunoassay analyzer, performed at the University Hospital of Brooklyn Laboratory

Residents who had reverse transcriptase–polymerase chain reaction (RT-PCR) testing were offered the following tests from our institutions:

1. Hologic Panther Fusion System [7], performed at Lenco Diagnostic Laboratory (March 2020)
2. Cepheid GeneXpert Systems [8], conducted at the University Hospital of Brooklyn Laboratory (April to August 2020)
3. BioFire Respiratory 2.1-EZ Panel [9], conducted at the University Hospital of Brooklyn Laboratory (July to August 2020)

### Key Outcome Measures

The survey questions included a range of options for the total number of patients with COVID-19 that the housestaff were exposed to, the total number of patients with COVID-19 that the housestaff intubated, average clinical weekly hours worked, symptoms of illness, and whether or not the housestaff felt the PPE provided was adequate. The survey questions referenced the period between February 2020 and survey completion. Results were collected through August 2020.

### Data Analysis

Survey responses were tabulated and compiled in table format with ranges. Frequency data were reported as percentages with



95% confidence intervals. The Fisher exact test was used to analyze group comparisons. The  $\alpha$  value was set as .05; all tests were 2-tailed (SPSS, version 23.0; IBM Corporation).

## Results

The demographic characteristics of the survey participants are presented in [Table 1](#).

**Table 1.** Demographics of survey participants (N=64).

Characteristics	Value, n (%)
<b>Age (years)</b>	
26-30	39 (61)
31-35	21 (33)
36-40	4 (6)
<b>Postgraduate year</b>	
1	13 (20)
2	20 (31)
3	14 (22)
4	12 (19)
5+	5 (8)
<b>Gender</b>	
Female	33 (52)
Male	31 (48)
<b>Clinical hours (average/week)</b>	
11-20	1 (2)
21-30	4 (6)
31-40	11 (17)
41-50	17 (27)
51-60	23 (36)
61-70	6 (9)
71-80	2 (3)
<b>COVID-19 PCR<sup>a</sup> test result</b>	
Positive	9 (14)
Negative	8 (12)
Indeterminate	1 (16)
Did not take PCR test	46 (72)
<b>Antibody test result</b>	
Positive	27 (42)
Negative	34 (53)
Indeterminate	1 (16)
Did not take antibody test	2 (3)

<sup>a</sup>PCR: polymerase chain reaction.

Of 104 residents and fellows, 64 responded to the survey, yielding a 61.5% response rate. There were no duplicate entries, and all surveys were filled out completely. Of the 64 housestaff, 27 (42%) tested positive for SARS-CoV-2 IgG antibodies, 2 residents did not undergo antibody testing, and 1 resident had indeterminate results. Most of the respondents were female (33/64, 52%) and between 26 and 30 years of age (39/64, 61%).

The most common postgraduate year (PGY) was PGY2, with PGY3 and PGY1 the second and third most common, respectively. Most of the housestaff (23/64, 36%) worked 51 to 60 hours per week. The majority of study participants (46/64, 72%) did not take a SARS-CoV-2 PCR test, but 62 of 64 (97%) of respondents had taken a SARS-CoV-2 antibody test. All



residents with a positive PCR test (n=9) also had a positive antibody test.

**Table 2** compares COVID-19 exposure between residents who tested antibody-positive and antibody-negative for SARS-CoV-2. There was no significant difference in the risk of a positive antibody test based on the number of patients with COVID-19 the respondents treated during the study period. Most respondents (46/61, 75%) intubated fewer than 5 patients with COVID-19 at the time of the survey; this number of events is too small to accurately compare the number of intubations to the risks of becoming antibody-positive. A significant difference in symptoms was noted between antibody-positive and antibody-negative residents. Although none of the antibody-positive residents had no symptoms, 21 of 34 (62%)

of the antibody-negative residents had a symptom commonly associated with COVID-19 infection.

Out of 27 housestaff with SARS-CoV-2 antibodies, 18 (67%) experienced fever and chills, compared with only 8 out of 34 housestaff (24%) without SARS-CoV-2 antibodies. A total of 19 out of 27 (70%) housestaff with SARS-CoV-2 antibodies experienced loss of taste and smell, compared with only 2 out of 34 (6%) housestaff without SARS-CoV-2 antibodies. Both fever and chills and loss of taste and smell were significantly more commonly experienced by antibody-positive compared to antibody-negative housestaff (*P* values .002 and <.001, respectively). Gastrointestinal and upper respiratory symptoms and headache did not appear to correlate to antibody status. The perception of the adequacy of PPE was similar regardless of antibody status.

**Table 2.** Comparison of the characteristics of COVID-19 IgG antibody-negative and antibody-positive residents.

Category	Antibody-negative (n=34), n (%)	Antibody-positive (n=27), n (%)	<i>P</i> value
<b>Patients treated, n</b>			
<10	1 (3)	1 (4)	>.99
10-20	0 (0)	1 (4)	>.99
20-40	8 (24)	4 (15)	.52
40-60	8 (24)	7 (26)	>.99
60-80	6 (18)	5 (19)	>.99
80-100	2 (6)	1 (4)	>.99
>100	9 (26)	8 (30)	>.99
<b>Patients intubated, n</b>			
<5	26 (76)	20 (74)	>.99
5-10	2 (6)	6 (22)	.049 <sup>a</sup>
10-15	3 (9)	1 (4)	.02
15-20	3 (9)	0 (0)	.25
<b>Resident symptoms of illness</b>			
Fever and chills	8 (24)	18 (67)	.002
Gastrointestinal symptoms	8 (24)	8 (30)	.77
Upper respiratory symptoms	13 (38)	15 (56)	.21
Loss of taste/smell	2 (6)	19 (70)	<.001
Headache	11 (32)	11 (41)	.40
None	13 (38)	0 (0)	<.001
<b>Adequate personal protective equipment</b>			
Yes	18 (52)	11 (41)	.44
Maybe	10 (29)	9 (33)	.79
No	6 (18)	7 (26)	.25

<sup>a</sup>Italic text indicates *P*<.05.

## Discussion

### Principal Findings

Our survey had an adequate response rate of 61.5% (64/104). Overall, 27 of 64 (42%) of our residents and fellows tested

positive for SARS-CoV-2 antibodies, indicating a high exposure rate within the first few months of the pandemic. No residents or fellows were hospitalized. In residents who had SARS-CoV-2 antibodies, the most common symptoms experienced during the study period were loss of smell and taste (19/27, 70%), fever

and chills (18/27, 67%), and upper respiratory symptoms (15 out of 27, 56%).

Sabetian et al [10] found a SARS-CoV-2 infection rate of 5.62% among 4854 health care workers in Southwest Iran between March and May 2020. They found that the highest infection rate was in emergency room workers (30.6%), which is comparable to our 42% infection rate for housestaff. Breazzano et al [11] surveyed cross-specialty program directors in New York City in April 2020, accounting for 382 emergency medicine residents; they found 6.5% confirmed, 8.4% presumed, and 3.1% suspected COVID-19 infections. These rates are much lower than the 42% infection rate of housestaff in our study because our study period extended through a longer time period, which allowed for more exposure and the availability of more testing in New York City. A more recent study in the US state of California, conducted from September to October 2020, found that only 2.9% of their emergency department staff (n=139) had antibodies for SARS-CoV-2 [12]. This study reported a much lower infection rate than ours, possibly because it was conducted before the largest surge of COVID-19 in California. Additionally, the New York City COVID-19 surge was the first large surge in our country, and the hospitals under study were unprepared, with insufficient PPE. By the time the California study was conducted, hospital workers were wearing N-95 masks universally. Lumley et al [13] investigated health care workers in the United Kingdom, and they found that 1265 out of 12,541 health care workers (10%) had SARS-CoV-2 antibodies by November 30, 2020. Their antibody prevalence was much lower than our 42% antibody prevalence, possibly because their study included health care workers who may have had fewer patient contact hours, such as administrative staff and laboratory staff; moreover, their study period concluded before the United Kingdom's largest COVID-19 spike.

The percentage of physicians in training in our emergency departments who developed SARS-CoV-2 antibodies was greater than those previously reported. This is likely multifaceted and could be due to the high-risk nature of the EM specialty, the use of antibody testing in addition to PCR testing to determine exposure, location regulations, and our hospital and regional setting. Antibody testing captures the incidence of infections over a longer time frame (both active and past infections) compared to PCR testing, which usually only affords a positive result for an active infection. Additionally, our practice area of Flatbush, Brooklyn, was a COVID-19 hotspot, and the University Hospital of Brooklyn was identified as a COVID-19-only facility by governor mandate [4], which may have increased housestaff exposure.

Shahriarirad et al [14] investigated symptoms experienced by patients in Iran with COVID-19 and found that the most common symptoms at the onset of disease were fatigue (66.4%), cough (64.6%), and fever (59.3%). In our study, residents with SARS-CoV-2 antibodies had comparable rates of fever and chills (67%) and upper respiratory symptoms (56%). Additionally, the most common symptom experienced in our study was the loss of smell and taste (70%).

Alasia et al [15] found that advanced age and presence of fever, dry cough, dyspnea, fatigue, productive cough, diarrhea, and

vomiting were more associated with severe COVID-19 disease among Nigerians in Rivers State. Our cohort did not have any cases of severe COVID-19 illness requiring hospitalization during the study period, and this may be because our cohort is composed of individuals aged 40 years and under.

Our study was not powered to detect a relationship between the number of patients seen and/or intubated and antibody status. A larger study is needed to evaluate this further. Another component that could be included in a further study is controlling for outside sick contacts, ensuring that the risk assessed for infection was work-related. Identification of exposure can be difficult, especially if the antibody test is used as a proxy for infection due to the longer time frame for positivity. Additionally, future studies should include vaccination status as a confounding variable for infection.

Lack of PPE at the onset of the pandemic was an issue nationally. More than half of our polled housestaff who developed SARS-CoV-2 antibodies stated that they felt the PPE provided to them may have been inadequate.

Only 18 of 64 housestaff (28%) had taken a SARS-CoV-2 PCR test when they answered the survey, although most of them reported symptoms. In comparison, 62 of 64 respondents (97%) reported having an antibody test within the same time frame. PCR testing identifies individuals with acute infection and active viral shedding and is also used to determine isolation needs. Our low reported PCR testing rate is likely due to the poor availability of PCR testing at the onset of the pandemic and could have contributed to asymptomatic spread of infection. PCR testing was limited to critically ill and hospitalized patients despite the presence of COVID-19-like symptoms.

The majority of housestaff, both those with and without antibodies, had symptoms consistent with COVID-19 during the study period. Fever and chills could be considered good symptoms for use in screening, but interestingly, only 66% of those who developed antibodies experienced fever or chills. Therefore, symptoms alone are not sufficient as a screening test. Loss of smell and taste was very specific in identifying individuals with SARS-CoV-2 antibodies. More data are needed to determine if other symptoms are sensitive and specific to identify COVID-19 illness in housestaff. These data are in line with multiple studies showing high false negative rates of SARS-CoV-2 PCR testing and stressing the use of a clinically based COVID-19 diagnosis [16-18]. The results of this study reinforce the accuracy of symptom-based diagnosis. Asymptomatic pooled PCR testing is another adjunct that can be used to identify individuals shedding viruses.

Our study is hypothesis-generating, and we would like to expand the survey across other emergency departments to gather more data. Because our study demonstrated a much larger percentage of residents experiencing COVID-19 illness compared to prior studies, we believe a larger study across multiple institutions and cities would be the next step in documenting housestaff illness and identifying causative factors, some of which may be possible to address during future waves of COVID-19 or other diseases with a similar spread.

Our study allows for both selection bias and recall bias. The 62% of housestaff who responded to the survey voluntarily may have been more skewed towards individuals who underwent antibody testing and had a particular result. Additionally, the survey retrospectively asked about the adequacy of PPE, and residents who tested positive for antibodies may have felt that due to their illness, they lacked PPE compared to their counterparts. Similarly, when asked retrospectively about symptoms of disease, our housestaff may have over- or underreported their symptoms.

Another limitation of our study was the relatively small sample size. Our study only included residents and fellows in 2 emergency departments in Brooklyn and therefore was

underpowered to identify a significant trend in comparing patient encounters and intubations with COVID-19 illness in housestaff.

### Conclusion

The rate of COVID-19 infection in EM residents and fellows at 2 New York City hospitals during the first few months of the 2020 pandemic was 42%, much higher than that in previous reports. Other significant results include the association of fever and chills and loss of smell and taste with COVID-19 infection and the association of absence of any symptoms with SARS-CoV-2 antibody negativity in housestaff. This calls for continued advocacy for sufficient PPE and more routine PCR testing of asymptomatic carriers to identify those who are acutely ill and shedding virus.

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### Conflicts of Interest

None declared.

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## Abbreviations

**EM:** emergency medicine  
**IRB:** institutional review board  
**PGY:** postgraduate year  
**PPE:** personal protective equipment  
**RT-PCR:** reverse transcriptase–polymerase chain reaction  
**SUNY:** State University of New York

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Protocol

# Measuring Integrated Novel Dimensions in Neurodevelopmental and Stress-Related Mental Disorders (MIND-SET): Protocol for a Cross-sectional Comorbidity Study From a Research Domain Criteria Perspective

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## Abstract

**Background:** It is widely acknowledged that comorbidity between psychiatric disorders is common. Shared and diverse underpinnings of psychiatric disorders cannot be systematically understood based on symptom-based categories of mental disorders, which map poorly onto pathophysiological mechanisms. In the Measuring Integrated Novel Dimensions in Neurodevelopmental and Stress-Related Mental Disorders (MIND-SET) study, we make use of current concepts of comorbidity that transcend the current diagnostic categories. We test this approach to psychiatric problems in patients with frequently occurring psychiatric disorders and their comorbidities (excluding psychosis).



**Objective:** The main aim of the MIND-SET project is to determine the shared and specific mechanisms of neurodevelopmental and stress-related psychiatric disorders at different observational levels.

**Methods:** This is an observational cross-sectional study. Data from different observational levels as defined in the Research Domain Criteria (genetics, physiology, neuropsychology, system-level neuroimaging, behavior, self-report, and experimental neurocognitive paradigms) are collected over four time points. Included are adult (aged  $\geq 18$  years), nonpsychotic, psychiatric patients with a clinical diagnosis of a stress-related disorder (mood disorder, anxiety disorder, or substance use disorder) or a neurodevelopmental disorder (autism spectrum disorder or attention-deficit/hyperactivity disorder). Individuals with no current or past psychiatric diagnosis are included as neurotypical controls. Data collection started in June 2016 with the aim to include a total of 650 patients and 150 neurotypical controls by 2021. The data collection procedure includes online questionnaires and three subsequent sessions with (1) standardized clinical examination, physical examination, and blood sampling; (2) psychological constructs, neuropsychological tests, and biological marker sampling; and (3) neuroimaging measures.

**Results:** We aim to include a total of 650 patients and 150 neurotypical control participants in the time period between 2016 and 2022. In October 2021, we are at 95% of our target.

**Conclusions:** The MIND-SET study enables us to investigate the mechanistic underpinnings of nonpsychotic psychiatric disorders transdiagnostically. We will identify both shared and disorder-specific markers at different observational levels that can be used as targets for future diagnostic and treatment approaches.

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## KEYWORDS

psychiatry; mental health; psychiatric disorders; neuropsychology; stress; comorbidity

## Introduction

### Background

It is widely acknowledged that comorbidity between psychiatric disorders is the rule rather than the exception [1]. Shared and diverse underpinnings of psychiatric disorders cannot be systematically understood based on symptom-based categories of mental disorders, which map poorly onto pathophysiological mechanisms. In the Measuring Integrated Novel Dimensions in Neurodevelopmental and Stress-related Mental Disorders (MIND-SET) study, we take advantage of concepts of comorbidity that transcend the current diagnostic categories in a naturalistic cohort of patients with frequently occurring psychiatric disorders and their comorbidities (excluding psychosis). The main objective of the MIND-SET project is to determine the shared and specific mechanisms of neurodevelopmental and stress-related psychiatric disorders at different observational levels. In the Introduction section, we will explain our approach generally and the choice of patients we will include.

### Current Approaches in Diagnosing Psychiatric Comorbidity

Comorbidity is not well covered by categorical, symptom-based diagnostic systems. The use of criteria to classify patients based on verbal report and observable behavior has substantially increased the reliability of psychiatric diagnoses, which serves its ultimate clinical goal of guiding treatment decisions [2,3]. However, the Diagnostic and Statistical Manual of Mental Disorders's (Fifth Edition; DSM-5) descriptive and atheoretical approach encourages multiple diagnoses [4] and has contributed to a conceptualization of psychiatric disorders as distinct entities that should be treated according to clinical guidelines drafted for distinct disorders. Clinical practice shows that patients with the same diagnostic classification may require different treatments, while different disorders are often treated with the

same interventions, indicating that a categorical approach may overlook both heterogeneity and transdiagnostic dimensions of psychopathology. Relatedly, a large body of research indicates that factors of risk and resilience for psychopathology are not unique for distinct disorders that are identified based on symptom criteria but commonly impact across diagnostic borders [5].

Not surprisingly in the light of the aforementioned controversy and the common dimensions, to date, no biological markers have been identified that are uniquely associated with specific disorders [6,7]. Conversely, diagnostic categories seem to link poorly to underlying neurobiological mechanisms, which may better map onto dimensional diagnostic approaches that incorporate the heterogeneity of psychiatric disorders. Searching for discrete etiology underlying categorical disorders is a dead end, considering the common comorbidity between disorders. Psychiatric disorders and their comorbidity should be more properly understood in a multidimensional, empirical framework, paving the way for new ways of understanding pathophysiological mechanisms of psychiatric disorders [8]. It requires a transdiagnostic perspective that regards psychiatric disorders as related disorders with distinct and shared underlying pathophysiological pathways. As is clearly illustrated by the focus of the MIND-SET study on highly prevalent neurodevelopmental and stress-related disorders that are separable diachronically, it also requires a life span and developmental perspective that distinguishes between trait and state characteristics of psychopathology.

### Comorbidity Between Neurodevelopmental and Stress-Related Disorders

In this cohort, we focus on commonly occurring comorbidities that present a challenge in diagnostics and treatment. Comorbidity between neurodevelopmental disorders such as autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) and



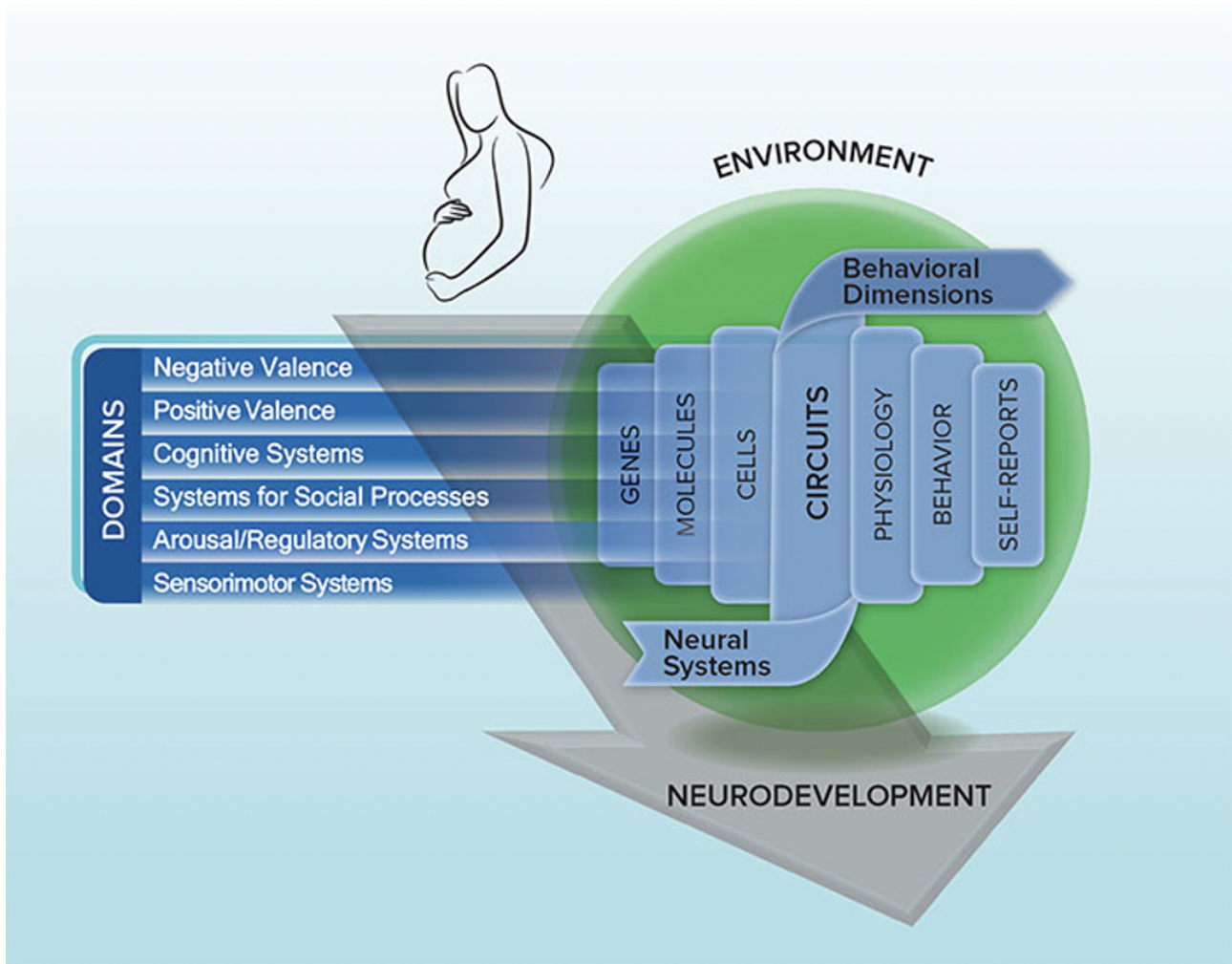
stress-related disorders such as mood, anxiety, and substance use disorders is common in clinical practice [9]. Notably, comorbidity may also occur across the lifespan, suggesting a pleiotropic genetic background of common psychiatric disorders. Comorbidity is more prevalent than would be expected by chance alone, indicating that neurodevelopmental disorders may share pathophysiological mechanisms with stress-related disorders or pose a risk factor for these disorders over time. Comorbidity is associated with a higher level of functional impairment and a poorer mental health outcome [10]. At the clinical level, psychiatric comorbidity raises several questions related to complicated recognition and diagnosis, and poses therapeutic dilemmas about the most optimal treatment strategy for particular comorbidities [11]. Are depressive symptoms in someone with an ASD comparable to depressive symptoms in someone with ADHD or someone without a developmental disorder? Additionally, at the pathophysiological level, are these depressive symptoms related to, for example, biases in information processing, comparable to negative biases in major depressive disorder (MDD) without an ASD, which can be targeted with interventions such as cognitive behavioral therapy, or should treatment for the comorbid condition be modified, and if so, how? How well is someone with ASD able to recognize and verbalize their mood symptoms, and how does this impact the diagnostic procedure and the treatment choice and course? Additionally if the recognition of mood symptoms is compromised, for example, when a patient shows alexithymia, how does this affect their vulnerability to stress? For ADHD, related questions arise, such as how to distinguish core attentional deficits from concentration problems related to depression, or when do symptoms of emotional dysregulation,

which are frequently observed in ADHD but not part of the formal criteria, substantiate a separate diagnosis? If so, what are the therapeutic consequences, if any? Currently, we treat comorbid depression and autism or ADHD mostly as solid entities that receive separate treatments while they may share neurobiological mechanisms that may demand different targets for treatment.

### **Comorbidity Within the Research Domain Criteria Framework**

High comorbidity among supposedly distinct classifications motivated the development of dimensional systems to characterize the complexity of psychiatric illness [12,13]. Trying to overcome the limitations of categorical descriptive classifications, we hence link to the Research Domain Criteria (RDoC) to study the comorbidity of neurodevelopmental and stress-related disorders (see Figure 1). The RDoC offers a research framework for understanding mental disorders in terms of varying degrees of dysfunction along basic dimensions of biological systems that have been elucidated by neuroscience. Its focus on transdiagnostic mechanisms of mental disorders is rooted in a matrix with different functional domains and within domain constructs across multiple units of analysis. Brain circuits have a central place in the units of analysis, as mental disorders are primarily regarded as disorders of the brain, which can be identified with the methods of clinical neuroscience [8]. The ultimate goal of the RDoC is to find biosignatures that on the one hand improve current diagnostic approaches [14] and on the other hand help to understand the working mechanisms of existing therapeutics and serve as targets for new treatments.

**Figure 1.** An overview of the research domain criteria framework.



Six functional systems are identified that serve the basic motivational and adaptive needs of an organism: the negative and positive valence systems, cognitive systems, arousal and regulatory systems, social processes, and sensorimotor systems. The negative valence system directs responses to aversive stimuli or contexts, whereas the positive valence system addresses such responses to positive situations. The cognitive system contains various cognitive processes such as memory and cognitive control, whereas social processes mediate the responses to interpersonal settings. Arousal and regulatory systems include processes that are responsible for the activation of neural systems within certain contexts, as well as homeostatic regulation. Sensorimotor systems are involved in motor behaviors. Each domain contains up to seven constructs such as “acute threat” and “loss” in the negative valence system and “affiliation and attachment” and “perception and understanding of self” in the social processes system. These constructs and domains are to be analyzed with different methods and at different units of analysis: from a genetic, molecular, or cellular level to neural, or brain circuitry, and further to the physiological and behavioral level, onward to the level of self-report and paradigms.

### Data-Driven Approaches

In the light of the different levels within the RDoC framework, we aim to approach psychiatric comorbidity by data-driven

approaches that are not constrained by the clinical categories. Moreover, as working principally from the RDoC perspective means working back and forth through different domains and analysis units (eg, linked independent component analysis [LICA]), we will aim to find cross-domain links with data-driven procedures and, in the end, assess the relation to clinical categories, including the descriptive comorbidities.

MIND-SET, our cross-sectional cohort study, has to be understood as a step toward understanding comorbidity from an RDoC perspective by including patients classified with neurodevelopmental disorders with an early age of onset (ASD: 1-5 years; ADHD: 5-12 years) or stress-related disorders with, on average, an adult age of onset. We include patients with at least one of these broadly used classifications, aiming to study underlying shared and distinct mechanisms. MIND-SET does not involve longitudinal changes directly (eg, improvement of prognosis through interventions) in our patients, which is the step to be taken to leverage these insights to clinical practice and which will be addressed by planned follow-up studies. The advanced understanding of comorbidity will help to progress toward innovative ideas about new therapeutic approaches that in the end will hopefully change clinical practice for patients with a multiplicity of symptoms.

## Study Aims and Outline

The main objective of the MIND-SET study is to determine the shared and specific mechanisms of neurodevelopmental and stress-related psychiatric disorders at different observational levels to gain insight in the comorbidity of the most common nonpsychotic disorders (ie, neurodevelopmental and stress-related disorders).

We will realize this aim by adopting a dimensional approach focusing on dysfunction related to stress-related (mood, anxiety, and substance use disorders) and neurodevelopmental (autism, ADHD) disorders. This will allow us to investigate connections between different units of analysis (connect symptoms with underlying circuits) and derive profiles that improve current understanding of comorbidity and ultimately can lead to better treatment.

## Methods

### Design

The MIND-SET study is an observational, cross-sectional study, in which data from different observational levels according to the RDoC units of analysis (genetics, physiology, neuropsychology, system-level neuroimaging, behavior, self-report, and experimental neurocognitive paradigms) are collected over four time points for patients with neurodevelopmental and stress-related disorders and neurotypical controls.

### Setting

The MIND-SET study is mainly executed at the outpatient unit of the psychiatric department of the Radboud University Medical Center (Radboudumc), Nijmegen, the Netherlands. The department specializes in the diagnosis and treatment of neurodevelopmental disorders and stress-related disorders in adults, with a special attention and expertise for psychiatric comorbidity and combined psychiatric and somatic pathology. Inpatients who are able to be investigated can also participate in the study.

### Population

#### Patients

#### Inclusion Criteria

Included are adult (aged  $\geq 18$  years) psychiatric patients with a clinical diagnosis of a stress-related disorder (mood disorder, anxiety disorder, or substance use disorder) or a neurodevelopmental disorder (ASD or ADHD).

#### Exclusion Criteria

Patients with diseases of the central nervous system resulting in (permanent) sensorimotor or (neuro)cognitive impairments, a current psychosis, a full-scale IQ estimate  $< 70$ , inadequate command of the Dutch language, or who are mentally incompetent to give informed consent are excluded from participation. With regard to ASD, our exclusion criteria implicate that we only investigate patients with high functioning autism, without intellectual disability and without mutism. Additional exclusion criteria for the magnetic resonance imaging (MRI) session are metal objects in the body (excluding dental fillings), ferromagnetic implants or pacemakers, jewelry or piercings that cannot be removed, brain surgery, epilepsy, claustrophobia, pregnancy, and self-declared inability to lie still for more than 1 hour.

#### Neurotypical Control Participants

Individuals with no current or past psychiatric diagnosis are included. Possible eligible individuals are approached via databases of the department's previous studies; advertisement in newspapers, social media, and websites; and via the research participation system of the Radboud University Faculty of Social Sciences (SonaSystem), as well as verbally through the researchers' own networks. The absence of lifetime psychiatric diagnoses is assessed via a telephone screening interview, using the same diagnostic measurement instruments as described in the following section for the patient sample.

#### Procedure

The data collection procedure includes an online assessment and three subsequent sessions that are planned within 1 month:

- Online assessment: Online self-report questionnaires assessing demographics, symptomatology, and functioning
- Session 1: Standardized clinical examination, physical examination, and blood sample
- Session 2: Psychological constructs, behavioral tasks, neuropsychological tests, and biological markers
- Session 3: Neuroimaging measures

The procedure for each part is briefly described in the following sections. An overview is given in [Table 1](#), including the full names of the measurement instruments used. In the last column of [Table 1](#), we categorize the data according to the six units of analyses as proposed by the RDoC (self-report, behavior, physiology, circuits, cells, and molecules).

**Table 1.** Data collection of the MIND-SET study: topics and instruments<sup>a</sup>.

Topic	Assessment	Unit of analysis <sup>b</sup>	Domain
<b>Preassessment</b>			
Demographic factors	• Demographics standard questionnaire	• Self-report	• General
Psychiatric disorders in family	• FIGS <sup>c</sup>	• Self-report	• General
ADHD <sup>d</sup> screening	• ASRS <sup>e</sup>	• Self-report	• Cognitive
ADHD symptom severity	• CAARS <sup>f</sup>	• Self-report	• Cognitive
Autistic traits	• AQ-50 <sup>g</sup>	• Self-report	• Social processes
Depressive symptoms	• IDS-SR <sup>h</sup>	• Self-report	• Negative valence
Anxiety sensitivity	• ASI <sup>i</sup>	• Self-report	• Negative valence
Personality traits	• PID-5-SF <sup>j</sup>	• Self-report	• General
General health	• SF-20 <sup>k</sup>	• Self-report	• General
Disability	• WHO-DAS 2.0 <sup>l</sup>	• Self-report	• General
Quality of life, health related	• OQ-45 <sup>m</sup>	• Self-report	• General • Positive valence
<b>Session 1: clinical examination</b>			
Psychiatric diagnosis: structured clinical interviews	<ul style="list-style-type: none"> <li>• Neurodevelopmental disorders <ul style="list-style-type: none"> <li>• ADHD: DIVA<sup>n,o</sup></li> <li>• Autism: NIDA<sup>o,p</sup></li> </ul> </li> <li>• Stress-related disorders <ul style="list-style-type: none"> <li>• Mood and Anxiety disorders: SCID-I<sup>q</sup></li> <li>• Substance related disorder: MATE-Crimi<sup>r</sup></li> </ul> </li> </ul>	• Self-report/behavior	• General
Somatic diagnosis	• Self-report questionnaire presence of somatic disease (CBS <sup>s</sup> )	• Self-report	• General
Medication use	• Medication verification	• Molecules	• General
Physical examination	<ul style="list-style-type: none"> <li>• Height and weight</li> <li>• Pulse rate and blood pressure (in lying and standing position)</li> <li>• Visual acuity</li> </ul>	• Behavior/physiology	• General
Biological marker (I)	• Blood sample	<ul style="list-style-type: none"> <li>• Molecules</li> <li>• Cells</li> </ul>	• General
<b>Session 2: behavioral session</b>			
Biological markers (II)	<ul style="list-style-type: none"> <li>• Feces microbiome</li> <li>• Cortisol from hair sample</li> <li>• Saliva cortisol</li> <li>• Heart and respiration rate during stress induction in the scanner</li> </ul>	<ul style="list-style-type: none"> <li>• Molecules</li> <li>• Cells</li> </ul>	• Arousal and regulatory
Trauma history	• NEMESIS <sup>t</sup> -childhood trauma questionnaire	• Self-report	• General

Topic	Assessment	Unit of analysis <sup>b</sup>	Domain
Eating behavior	<ul style="list-style-type: none"> <li>• Food intake: TACTICS<sup>u</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Self-report</li> </ul>	<ul style="list-style-type: none"> <li>• General</li> </ul>
Psychological constructs: alexithymia, behavioral regulation, repetitive thoughts	<ul style="list-style-type: none"> <li>• TAS-20<sup>v</sup></li> <li>• BRIEF-A<sup>w</sup></li> <li>• PTQ<sup>x</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Self-report</li> </ul>	<ul style="list-style-type: none"> <li>• Social processes</li> <li>• Cognitive</li> <li>• Negative valence</li> </ul>
Cognitive bias: attention bias, attention focus, memory bias, and self-referent encoding task	<ul style="list-style-type: none"> <li>• Noninvasive computer-mounted beam eye-tracking system</li> <li>• Pictures of faces with different expressions (plus subsequent emotion-recognition task)</li> <li>• Recognition of stimuli presented during the attention bias task</li> <li>• Self-referent encoding task</li> <li>• NB. Mood is assessed between every (sub)task and motivation after the SRET<sup>y</sup> using visual analogue scales</li> </ul>	<ul style="list-style-type: none"> <li>• Behavior</li> </ul>	<ul style="list-style-type: none"> <li>• Cognitive systems</li> <li>• Negative valence systems</li> </ul>
Executive functioning: prepotent response inhibition, interference control, updating, shifting, and reversal learning	<ul style="list-style-type: none"> <li>• Go no-go (from TAP 2.3<sup>z</sup>)</li> <li>• Incompatibility (Simon effect; from TAP 2.3)</li> <li>• Spatial working memory (from CANTAB<sup>aa</sup>)</li> <li>• Intraextra dimensional set shift (from CANTAB)</li> <li>• Reversal learning task</li> </ul>	<ul style="list-style-type: none"> <li>• Behavior</li> </ul>	<ul style="list-style-type: none"> <li>• Cognitive systems</li> <li>• Positive valence</li> </ul>
Intelligence	<ul style="list-style-type: none"> <li>• IQ estimation</li> </ul>	<ul style="list-style-type: none"> <li>• Behavior</li> </ul>	<ul style="list-style-type: none"> <li>• Cognitive</li> </ul>
Underachievement	<ul style="list-style-type: none"> <li>• Alertness (from TAP 2.3)</li> </ul>	<ul style="list-style-type: none"> <li>• Behavior</li> </ul>	<ul style="list-style-type: none"> <li>• Arousal and regulatory</li> </ul>

### Session 3: neuroimaging session

Topic	Assessment	Unit of analysis <sup>b</sup>	Domain
Brain structure and brain function: salience network, default mode network, and central executive, and stress-induced network changes	<ul style="list-style-type: none"> <li>• MRI<sup>ab</sup> <ul style="list-style-type: none"> <li>• T1 scan</li> <li>• DTI<sup>ac</sup></li> <li>• Emotional face matching task</li> <li>• Resting state fMRI<sup>ad</sup></li> <li>• connectivity rs-fMRI<sup>ae</sup> during/after aversive vs neutral movie</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Neural circuits/physiology</li> </ul>	<ul style="list-style-type: none"> <li>• All domains</li> <li>• Social processes</li> <li>• Negative valence</li> </ul>

<sup>a</sup>For a more detailed description of data collection: see [Multimedia Appendix 1](#).

<sup>b</sup>We use the 6 units of analysis of the initiative Research Domain Criteria: genes, molecules, cells, neural circuits, physiology, and behavior.

<sup>c</sup>FIGS: Family Interview for Genetic Studies.

<sup>d</sup>ADHD: attention-deficit/hyperactivity disorder.

<sup>e</sup>ASRS: Adult ADHD Self-Report Scale.

<sup>f</sup>CAARS: Conners' Adult ADHD Rating Scale.

<sup>g</sup>AQ-50: Autism Spectrum Quotient-50.

<sup>h</sup>IDS-SR: Inventory of Depressive Symptomatology–Self Rating.

<sup>i</sup>ASI: Anxiety Sensitivity Index.

<sup>j</sup>PID-5-SF: Personality Inventory for DSM-5–Short Form.

<sup>k</sup>SF-20: Short Form-20.

<sup>l</sup>WHO-DAS 2.0: World Health Organization Disability Assessment Schedule 2.0.

<sup>m</sup>OQ-45: Outcome Questionnaire.

<sup>n</sup>DIVA: Diagnostic Interview for Adult ADHD.

<sup>o</sup>DIVA and NIDA are only carried out in case of positive screening (ASRS>3 or AQ>25) or clinical judgement.

<sup>p</sup>NIDA: Dutch Interview for Autism Spectrum Disorders in Adults.

<sup>q</sup>SCID-I: Structured Clinical Interview for DSM-IV Axis I Disorders; section A,B,C,D,F.

<sup>r</sup>MATE-Crimi: Measurements in the Addictions for Triage and Evaluation and Criminality.

<sup>s</sup>CBS: Central Bureau voor Statistiek.

<sup>t</sup>NEMESIS: Netherlands Mental Health Survey and Incidence Study.

<sup>u</sup>TACTICS: Translational Adolescent and Childhood Therapeutic Interventions in Compulsive Syndromes.

<sup>v</sup>TAS-20: Toronto Alexithymia Scale-20.

<sup>w</sup>BRIEF-A: Behavior Rating Inventory Executive Function–Adult.

<sup>x</sup>PTQ: Perseverative Thinking Questionnaire.

<sup>y</sup>SRET: self-referent encoding task.

<sup>z</sup>TAP 2.3: Testbatterie zur Aufmerksamkeitsprüfung Version 2.3.

<sup>aa</sup>CANTAB: Cambridge Neuropsychological Test Automated B.

<sup>ab</sup>MRI: magnetic resonance imaging.

<sup>ac</sup>DTI: diffusion tensor imaging.

<sup>ad</sup>fMRI: functional MRI.

<sup>ae</sup>rs-fMRI: resting station fMRI.

## Online Assessment

### Questionnaires

All patients referred to the outpatient psychiatric department receive log-in details for an online questionnaire batch at home. They are asked to fill out the questionnaires within 21 days before their first appointment. If preferred, a paper copy is sent to their home address. The questionnaires assess demographics; psychiatric disorders in the family; symptoms of ADHD, depression, and anxiety; and autistic and personality traits. Two questionnaires are also used as screening instruments for autism and ADHD. Finally, questionnaires on general health, disability or functional limitations, and quality of life are included. Summary and subscale scores derived from these questionnaires

are made available before the clinical examination session to inform the clinician about the possible involvement of neurodevelopmental and stress-related disorders, personality problems, and functional status.

### Session 1: Clinical Examination

#### Diagnostics

During a 3-hour clinical examination at the psychiatric department, patients undergo a psychiatric, biographical, and somatic anamnesis; medication verification; review of treatment history; structured clinical interviews; a physical examination; and a questionnaire assessment of the presence of somatic diseases. Examinations are conducted by well-trained clinicians: psychiatrists, psychologists, supervised psychiatric residents,



supervised nurse practitioners, and supervised psychology interns. At the end of the examination, the senior clinician assesses eligibility based on the DSM-5 classification (see Measures section) and completes the written informed consent procedure. The patient consents to the use of their questionnaire data for research, the use of their diagnostic data for research, and participation in the next sessions of the study. After giving informed consent, blood sampling is executed and appointments for sessions 2 and 3 are scheduled to take place as soon as possible and ultimately within 90 days.

## **Session 2: Behavioral Assessment**

### **Biomarkers**

First, patients receive a package and instructions for the collection of a feces sample at home. They are instructed on how to return this package by mail. Next, hair samples are taken for cortisol measurement.

### **Questionnaires and Neuropsychology**

First, patients undergo a neuropsychological assessment (~120 minutes), including a pen and paper task and several computer tasks including an eye-tracking task. The test battery is administered by a trained research assistant. Participants are then required to fill out questionnaires (~20 minutes) assessing trauma history, food intake, and three psychological constructs (alexithymia, repetitive thoughts, and behavioral regulation). A research assistant is available for assistance.

## **Session 3: Neuroimaging**

This final session (180 minutes) is scheduled in the afternoon to account for the diurnal changes in cortisol levels at the Centre for Cognitive Neuroimaging of the Donders Institute for Brain, Cognition and Behavior in Nijmegen. It starts with an acclimatization period during which participants fill in questionnaires about current mood state and recent medication changes, and watch a relaxing nature documentary. Hereafter, they are prepared for the MRI scanner and undergo different imaging paradigms, including a T1 structural MRI, diffusion tensor imaging, functional MRI (fMRI) during an emotion-recognition task, and a baseline resting state fMRI. It continues with resting state fMRI after a neutral and a highly aversive movie clip, meant as a brief stress induction procedure. During the whole imaging session, physiological data are collected, such as heart and respiration rate, and saliva for cortisol and alpha-amylase measurement is collected at different time points in addition to assessments of mood, stress level, and other emotions. The neuroimaging session ends with a short debriefing procedure.

## **Ethics Approval and Consent to Participate**

### **Regulation Statements**

The MIND-SET study has been approved by the local medical ethical committee (Commissie Mensgebonden Onderzoek Arnhem-Nijmegen). After verbal and written information about the study that they receive at home, eligible participants are approached by their care provider for participation in the study. If interested, they sign an informed consent form. Written informed consent is provided for clinical data use and data

collection. In the course of the study, a yearly data monitoring is conducted with a local monitor of the Radboudumc Nijmegen.

All diagnostic interviews, neuropsychological measures, physiological measures, and neuroimaging measures are conducted by extensively trained clinicians and research assistants. All clinicians received diagnostic interview training from certified and experienced trainers. All research professionals conducting the neuropsychological tests received extensive training by neuropsychological testing experts.

### **Compensation**

Participants are compensated with travel costs for the data collection sessions, and the controls are as well paid a small fee for their participation according to the guidelines of the medical ethical committee: €10 (US \$11) per hour and €66 (US \$73) in total.

### **Measures**

[Multimedia Appendix 1](#) offers a complete description of the specific instruments and measures. Here, we focus on the levels of psychopathology, neuropsychology, and brain circuits.

### **Descriptive Psychopathology Level**

Psychopathology is addressed along a continuum ranging from the syndrome or disorder level (Diagnostic and Statistical Manual of Mental Disorders [Fourth Edition; DSM-IV] and DSM-5) to the disorder-related symptomatic level and to the transdiagnostic dimensional level.

Neurodevelopmental disorders are assessed in case of either positive screening or based on clinical judgment by diagnostic interviews. For screening on ASD traits, we use the Autism Spectrum Quotient (AQ-50) [15]. When a patient scores positive on this instrument (50 items, cutoff >25), we next use the Dutch Interview for the Diagnosis of ASD in Adults (NIDA) [16] to diagnose ASD according to the DSM-5. Regarding ADHD, we use the World Health Organization Adult ADHD Self-report Scale short version for screening [17]. In case of positive screening (6 items, cutoff >3), we subsequently conduct the Diagnostic Interview for ADHD in Adults (DIVA) [18] to diagnose ADHD according to the DSM-IV. Both the DIVA and NIDA are completed in the presence of a partner or family member of the patient (if available) to ascertain information retrospectively and collaterally on a broad range of symptoms in childhood and adulthood. The Structured Clinical Interview for DSM-IV Axis I Disorders [19] is used to diagnose mood (depression and anxiety) disorders and to exclude psychotic disorders. To diagnose substance-related disorders according to the DSM-5, we use an adapted version of the Measurements in the Addictions for Triage and Evaluation and Criminality [20].

A set of questionnaires provide measures of depression (Inventory of Depressive Symptomatology), anxiety (Anxiety Sensitivity Index), and ADHD symptoms (Conners' Adult ADHD Rating Scale) not only to provide dimensional measures that fit with the syndromes that are our primary diagnoses but also to assess comorbidity at the symptomatic level in the context of other diagnostic categories. We use the Personality Inventory for DSM-5 to assess personality trait domains

including negative affect, detachment, antagonism, disinhibition, and psychoticism, and the AQ-50 to measure traits that are related to autism in adults with normal intelligence. The personality traits and autistic traits may measure overlapping domains. We have included three questionnaires that address psychological constructs that cut across syndromes and reveal transdiagnostic mechanisms important for understanding comorbidity. We include the Perseverative Thinking Questionnaire and alexithymia (Toronto Alexithymia Scale-20) and behavioral regulation (Behavior Rating Inventory Executive Function–Adult) questionnaires. In addition, a structured inventory developed for the NEMESIS (Netherlands Mental Health Survey and Incidence Study) epidemiological study assesses an individual's trauma history before the age of 16 years, including emotional neglect or psychological, physical, and sexual abuse [21,22].

### ***Neuropsychological Level***

The RDoC unit behavior is operationalized by neuropsychological assessments within the domains of the negative valence systems (constructs: sustained threat, loss), positive valence systems (construct: reward learning), and cognitive systems (constructs: attention, declarative memory, cognitive control).

### ***Negative Valence System***

Affective neuropsychological tests assess emotional processing, and in the context of the negative valence system, we focus on several cognitive biases. We assess attentional bias for both social and nonsocial negative and positive pictures by means of a free-viewing eye-tracker task (with a noninvasive computer-mounted *beam* eye-tracking system) and a subsequent recognition task to assess memory bias during eye-tracking. Measuring eye movements during a task using an eye-tracker is regarded as a reliable measure for attentional focus [23]. As patients with autism generally show decreased attention to social information [24], we have chosen to incorporate both social and nonsocial pictures with either negative or positive valence to be able to dissociate the differential contribution of these factors on attentional processes. In addition, memory bias is tested by a computerized self-referent encoding task [25] in which participants have to indicate how characteristic different positive and negative adjectives are to them and are subsequently tested for correct recall of these adjectives after a distraction task. Visual analogue scales are used to assess mood at four different time points throughout the assessment to account for the influence of mood on performance, as well as self-reported effort on the tests afterward.

### ***Positive Valence System***

Within this domain, we measure the construct of reward learning. Learning can be influenced by the valence of the feedback given on the performance during the task. For example, previous studies have found reduced learning from reward in

mood disorders [26–29]. We use a probabilistic reversal learning task [30–32] to examine reward and punishment sensitivity in a changing context. First, participants learn a stimulus-response relationship by trial and error, after which the stimulus-response relationship is reversed without explicit warning, and they have to change their response. Reversal learning is an important aspect of cognitive flexibility, which supports someone to adapt to changing environmental conditions including rewards [33].

### ***Cognitive Systems***

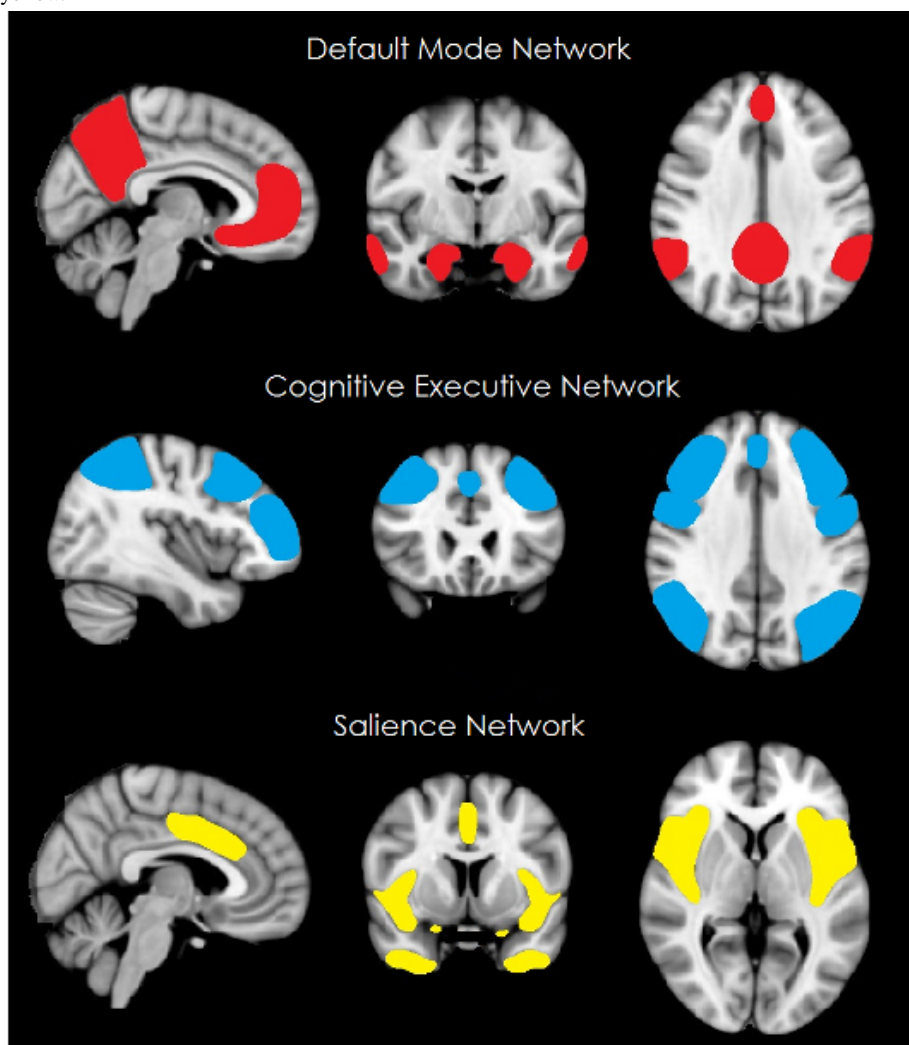
Impairments in emotional regulation are common in both stress-related and neurodevelopment disorders. Our aim here is to study the nature of these alterations in executive functioning by studying prepotent response inhibition, interference control, updating and shifting across stress-related and neurodevelopmental disorders to better understand the underlying mechanisms of shared symptoms such as impaired emotion regulation, rigidity, and impulsivity.

### ***Brain Circuits Level***

The brain circuits level is at the core of our research design, as it bears on the hypothesis that the phenotypic, behavioral differences among psychiatric disorders can be explained by differences in the underlying neural circuitry, while downstream causal mechanisms such as genetic and epigenetic effects or environmental factors will lead to psychiatric symptoms and disorders via their disruptive effects on neural circuits. The brain is dynamically organized into functional networks of interconnected areas, which interact to perform unique brain functions. These networks can be consistently identified with functional MRI scans during the “resting-state” by calculating functional connectivity between voxels. The most relevant networks with regard to psychiatric disorders are the default mode network (DMN), involved in emotion regulation, self-reference, and obsessive ruminations [34]; the salience network, which plays a central role in emotional control [35]; and the central executive network, which is most active during cognitive tasks and is relevant for attention and working memory (see Figure 2).

Together these networks cover the most important functional domains such as top-down cognitive control, conflict signaling, salience detection, and self-referential processing that are affected in both stress-related and neurodevelopmental disorders. Small pilot studies with this approach have already demonstrated that hyperconnectivity in components of the DMN is associated with depressive symptoms such as ruminations and self-absorption, while hypoconnectivity in components of the DMN is associated with anxiety symptoms [36]. Studying the dynamics of network connectivity, in conditions of both rest and stress, allows us to disentangle fundamental pathophysiological mechanisms underlying these disorders and their shared mechanisms that are relevant for understanding comorbidity.

**Figure 2.** Representation of relevant resting-state networks with the default mode network depicted in red, the central executive network in blue, and the salience network in yellow.



### *Negative Valence System*

We will investigate functional networks both during resting state and during a brief stress induction procedure (acute threat paradigm). Previous research has shown that acute stress shifts the brain into a state that fosters rapid defense mechanisms [36]. Stress-related neuromodulators are thought to trigger this change by altering properties of large-scale neural populations throughout the brain. In neurotypical participants, we have shown that noradrenergic activation during acute stress results in prolonged coupling within a distributed network that integrates information exchange between regions involved in autonomic-neuroendocrine control and vigilant attentional reorienting. It remains unclear to what extent these mechanisms are altered by psychiatric diseases, thereby reflecting an acute measurement of vulnerability and disease load. Functional measures will be complemented by diffusion-weighted imaging to provide measures of structural connectivity between the networks. Further, we want to explore if dynamic functional connectivity data along the baseline-stress-recovery axis for the three distinct networks will serve to identify differences in the dynamic balance in these networks at the individual participant level and can be related to behavioral and symptom profiles.

### *Social Processes*

An emotional face matching task addresses the subconstruct reception of facial communication within this domain. This paradigm engages the amygdala and an amygdala-centered network by contrasting the BOLD response during blocks of angry and fearful face stimuli with blocks with geometric shapes that consist of scrambles of the same face stimuli [37,38]. This task is commonly used as a paradigm to probe amygdala reactivity, and aberrant amygdala reactivity has been implicated in both stress-related and neurodevelopmental disorders.

### *Data Analysis*

#### *Sample Size*

This research protocol will comprise multiple studies to be conducted across multiple years. The majority of studies will estimate effects at the population level by means of parametric  $t$ ,  $F$ , or chi-square tests, where empirical evidence from our and other centers suggests that typical study sizes of ~20 to 30 participants per group can be sufficient to detect relevance between group differences, given typical effect sizes across a variety of data modalities. After consulting a biostatistician, we decided that an overall sample size calculation will be of little value. Additionally, power calculations for studies with MRI



are difficult and not used routinely, but here, there is also consensus that groups of  $\geq 20$  usually yield sufficient power in MRI studies to detect moderate differences in regions of interest. Based on these considerations and to have at least 20 participants per group in the broadly defined comorbid conditions, we aim to include a total of 650 patients and 150 neurotypical control participants in the time period between 2016 and 2022. In October 2021, we are at 95% of our target. Many research studies that will be conducted under this proposal will be exploratory in nature, where not much prior reference work is available. In these cases, we will use expected effect size estimates and ranges thereof generated from testing small samples in pilot studies to inform sample size calculations. In these sample size calculations, we expect that for cross-sectional analyses, with a power of 80% and an alpha of .05, we will be able to detect small differences with respect to clinical variables and questionnaires.

### **Data Handling**

We will store raw and cleaned data in a digital research environment. Data is also shared with researchers via the digital research environment. A variety of analysis software and statistical programs will be used to analyze the data. Statistical analysis will be performed within, for example, SPSS (version 25; IBM Corp) and R (R Foundation for Statistical Computing; version 3.6.1). Analysis of neuroimaging data will be performed with, for example, FSL (FMRIB Software Library version 5.0) for connectivity analyses before and after stress induction, SPM12 (Statistical Parametric Mapping version 12) for the emotional face matching task, and Freesurfer (version 6.0.0) for analysis of the structural MRI and diffusion data. Data will be analyzed according to the state-of-art analyses insights and using relevant new techniques and approaches where applicable.

Digitalized diagnostic interviews are used to facilitate completeness of the diagnostic data. A data manager coordinates the data entry in the digital research environment while also checking data quality. Data archiving and creating variables and scales is part of data management. Yearly study monitoring is carried out by an independent monitor to assess adherence to the procedures and to ensure patient safety and privacy.

### **Statistical Analyses**

Detailed processing and statistical methods applying to the different measures and levels are presented in [Multimedia Appendix 1](#). We will use exploratory factor analysis within SPSS to uncover domains of functioning that transcend conventional diagnostic (DSM) boundaries and investigate shared and distinct variance that is measured by the different questionnaire and instruments at the descriptive psychopathological level. We will use parallel analysis and skree-plots to find optimal factor solution (maximum likelihood estimation, oblique rotation).

We will apply univariate statistics within the framework of the general linear models or linear mixed models to investigate differences in specific measures between different disorders and investigate relations between different measures. As an example, we will use analyses of covariance to compare different diagnostic groups on negative memory bias scores and

investigate associations between negative memory bias and depression symptom severity with linear regression models. As we collect a large set of measures and perform a large number of comparisons, which carries the risk of false positives, we will only perform analyses according to a priori-specified analysis plans that are approved by the steering board of MIND-SET, and we will apply appropriate corrections for multiple comparisons. In addition, multivariate analyses can further reduce the risk of false positives.

The ultimate goal is to relate features of the different units of analysis across the different domains with multivariate methods. To exploit the multimodal, multilevel dimensions of our data, we will apply advanced statistical methods to identify relevant multivariate patterns, including machine learning, factor, and network analyses. Extracted components from the self-report, behavior, and physiological data are used as inputs in regularized canonical correlation analyses to detect connections among the different units of analysis and identify transdiagnostic patterns in the data.

LICA is a new analysis technique, which integrates different imaging modalities and link shared patterns, or so-called independent components, to interindividual differences in behavior and psychopathology (Llera et al [39]). LICA combines imaging modalities at an early stage in the analysis pipeline, rather than a post hoc combination of unimodal results at the stage of final interpretation (Groves et al [40]). LICA has not yet been used within a transdiagnostic research context.

Finally, we will adopt a normative modeling approach for mapping associations between brain function, biological and clinical measures, and behavior to estimate deviation from the normative model on a participant level. Normative modeling provides a framework to characterize patients individually in relation to normal functioning, which may be far more informative than categorical labels. This approach may help to parse the heterogeneity that is common in clinical cohorts and point to more biologically valid subtypes [41].

### **Dissemination**

The study results will be published in peer-reviewed journals and distributed via media outlets. We will post our preprints at bioRxiv or medRxiv, free online archives, and distribution services for unpublished preprints in the life and medical sciences. It is operated by Cold Spring Harbor Laboratory, a not-for-profit research and educational institution. By posting preprints on bioRxiv and medRxiv, MIND-SET authors are able to make their findings immediately available to the scientific community and receive feedback on draft manuscripts before they are submitted to journals. Results will further be presented at national and international congresses and meetings. Participants are notified of study progress and outcome by means of newsletters.

### **Availability of Data and Materials**

The data sets generated or analyzed during this study are not publicly available due to privacy reasons but are made available for researchers within the digital research environment upon reasonable request to the corresponding author and approval of the steering board of the MIND-SET study group.

## Results

We aim to include a total of 650 patients and 150 neurotypical control participants in the time period between 2016 and 2022. In October 2021, we are at 95% of our target.

## Discussion

### Transdiagnostic Approach

Psychiatric disorders and their comorbidity could be more properly understood in a multidimensional, empirical framework, adopting a transdiagnostic perspective that regards psychiatric disorders as related disorders with distinct and shared underlying pathophysiological pathways. The MIND-SET study is setup to investigate the mechanistic underpinnings of stress-related and neurodevelopmental disorders to identify both shared and disorder-specific markers at different observational levels that are based on RDoC domains. Here, we will specifically focus on the importance of studying cognitive systems and negative valence system together and at different observational levels.

Negative affect such as depressed mood and anxiety, both on a symptomatic and syndromic level, is frequently comorbid in neurodevelopmental disorders. We know for example that later in life, individuals with ASD have a four times higher lifetime prevalence of depression. Although ASD is primarily characterized by alterations in sensory sensitivity, inflexible routines, restricted interests, and deficits in social functioning or rather neurodivergent social functioning [42], about 50% of high-functioning adults diagnosed with ASD who were referred to a psychiatry department had comorbid MDD [43]. Because of the overlap of symptoms and personality characteristics (eg, rigidity), depression is often difficult to recognize in ASD and remains frequently undetected [44]. Individuals with ASD have difficulties reading their own inner states, and clinicians lack diagnostic tools and treatment options. Recognition and treatment are needed, as individuals with MDD and ASD have lower global functioning compared to individuals with ASD only.

Our understanding of MDD in neurodevelopmental disorders remains limited today, as well as our treatment options. One possibility is that negative affect results from increased levels of stress sensitivity that are related to the primary deficits, for example, increased levels of stress caused by sensory overstimulation or problems in relationships related to deficits in social cognition and flexibility [45]. ASD and ADHD are both associated with impairments in executive function, and each disorder is thought to have its specific deficits, with impairment in shifting most prominent in ASD [46], while ADHD is typically characterized by problems with behavioral inhibition [47]. Evidence suggests that impairment of executive function is an important predictor of comorbid anxiety and depression, and that specific deficits of ASD and ADHD may reveal pathways to comorbidities in these disorders [48].

Performance of executive function in ASD is thought to be related to poor regional coordination and integration of prefrontal executive processes that integrate with emotion and

social circuits, reflected by aberrant patterns of connectivity with both changes of within- and between-network functional connectivity scale networks [49]. A recent data-driven approach identified three transdiagnostic subtypes of executive functioning in a large sample of children with ASD, ADHD, and neurotypical children that spanned the normal to impaired spectrum but also cut across ADHD and ASD samples. Moreover, these subtypes of executive functioning better accounted for variance in the neuroimaging data than DSM diagnoses did, highlighting the point that transdiagnostic subtypes may indeed refine current diagnostic classifications [50].

Individuals with ASD and ADHD may also be more vulnerable to depression and anxiety because they share information processing styles that are related to the susceptibility for depression and anxiety, such as biases in information processing [51]. Biases in information processing have traditionally been studied within the boundaries of diagnostic categories and have mainly been studied in affective disorders. Patients with depression show more attention toward negative information, which probably points to a difficulty to disengage from negative information [52], but in comparison with neurotypical individuals, they also show less attention to positive stimuli [53]. Negative memory bias seems to be associated with a higher level of comorbidity among psychiatric disorders [54]. Biased information processing may therefore constitute a transdiagnostic mechanism for psychopathological symptoms, which seems crucial for understanding comorbidity. This biased information processing constitutes a cognitive vulnerability that, according to Beck's [55,56] model, is linked to the experience of adverse events during childhood, which may lead to dysfunctional cognitive schemas.

In our mechanistic approach to investigate underlying cross-domain processes to explain patterns of comorbidity across a range of neurodevelopmental and stress-related disorders, both executive functioning and emotional information processing are key mechanistic elements that may interact in specific ways across different levels of analysis. Recent neurocognitive findings suggest that problems in emotion regulation result from preferential processing of (negative) emotional information in subcortical structures, including overactivation of an amygdala-centered network and reduced prefrontal executive control to inhibit inappropriate emotions and emotion expression (eg, [57-59]). Habituation of the amygdala response may also play a role here, as it has been shown to correlate negatively with anxiety [60] and is decreased in ASD [61-63]. Both amygdala activation and habituation have been frequently used in genetic imaging studies to investigate the neural effects of genetic variants that are linked to depression, anxiety, and personality traits like neuroticism [63,64]. For example, the short allele of the serotonin transporter gen has been associated with increased risk for depression after exposure to stress, which is thought to be mediated by increased amygdala reactivity to threat [64].

Moreover, the function of covert cognitive mechanisms in several cross-disorder symptoms such as impulsivity, apathy, or alexithymia are yet unknown. Characterizing these mechanisms may allow us to identify different underlying

profiles that combine executive dysfunction and emotional process biases, and could serve as targets for new treatments such as neuromodulation. A specific example, which may illustrate partly overlapping mechanisms, is a deficit in mental shifting that may be implied in preoccupied and rigid thinking that is characteristic for ASD but which is also implied in the ruminative thinking that characterizes depression. In individuals with ASD, there is some evidence that poorer executive functioning (and greater behavioral inflexibility) predicts greater anxiety and depression [48,65]. Similarly, executive deficits have been related to rumination [66] and the susceptibility to depression [57]. In addition, early life adversity may have caused enhanced corticolimbic reactivity that, in turn, leads to rumination, which is known to be a vulnerability factor for internalizing psychiatric disorders [67].

## Limitations

This study has to be understood in the light of some limitations. Although we aim for a fairly large sample size (we aim to include a total of 650 patients and 150 neurotypical control participants), specific cells of comorbidity between disorders may be low for group comparisons. Moreover, the participants are all recruited at one psychiatric center (ie, the Psychiatric Department of the Radboud University Medical Center), which specializes in the diagnosis and treatment of neurodevelopmental disorders and stress-related disorders in adults and their comorbidity, and this constitutes a form of selection bias and decreases generalizability of the study results to other populations.

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## Authors' Contributions

PvE, RC, JV, AAV, IT, and A Schene conceived the design of the study and the study protocol. PvE, RC, DEG, JV, IT, and A Schene wrote the first draft of the manuscript. PvE, RC, JV, AAV, EvdM, SB, FD, AB, JvO, IT, and A Schellekens revised the manuscript. All authors approved the final manuscript

## Conflicts of Interest

None declared.

Multimedia Appendix 1  
Supplemental material.

[[DOCX File, 101 KB](#) - [xmed\\_v3i1e31269\\_appl.docx](#)]

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## Abbreviations

**ADHD:** attention-deficit/hyperactivity disorder

**AQ-50:** Autism Spectrum Quotient

**ASD:** autism spectrum disorder

**DIVA:** Diagnostic Interview for Attention-Deficit/Hyperactivity Disorder in Adults

**DMN:** default mode network

**DSM-IV:** Diagnostic and Statistical Manual of Mental Disorders (Fourth Edition)

**DSM-5:** Diagnostic and Statistical Manual of Mental Disorders (Fifth Edition)

**fMRI:** functional magnetic resonance imaging

**LICA:** linked independent component analysis

**MDD:** major depressive disorder

**MIND-SET:** Measuring Integrated Novel Dimensions in Neurodevelopmental and Stress-Related Mental Disorders

**MRI:** magnetic resonance imaging

**NEMESIS:** Netherlands Mental Health Survey and Incidence Study

**NIDA:** Dutch Interview for the Diagnosis of Autism Spectrum Disorder in Adults

**RDoC:** Research Domain Criteria

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Original Paper

# Telerehabilitation for People With Physical Disabilities and Movement Impairment: A Survey of United Kingdom Practitioners

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## Abstract

**Background:** Telerehabilitation is a feasible and potentially effective alternative to face-to-face rehabilitation. However, specific guidance, training, and support for practitioners who undertake remote assessments in people with physical disabilities and movement impairment are limited.

**Objective:** The aims of this survey of United Kingdom-based health and social care practitioners were to explore experiences, assess training needs, and collate ideas on best practices in telerehabilitation for physical disabilities and movement impairment. The aim will be to use the findings to inform a practical tool kit and training package for telerehabilitation use.

**Methods:** UK rehabilitation practitioners were invited to complete an online questionnaire from November to December 2020. Opportunity and snowball sampling were used to recruit participants from professional and educational networks, special interest



groups, and via social media. Closed questionnaire items were analyzed using descriptive statistics. Qualitative inductive analysis using NVivo was used for open responses.

**Results:** There were 247 respondents, of which 177 (72%) were physiotherapists and occupational therapists. Most (n=207, 84%) had used video-based consultations (typically supported by telephone and email), and the use of this method had increased in frequency since the COVID-19 pandemic. Practitioners perceived telerehabilitation positively overall and recognized benefits for patients including a reduced infection risk, convenience and flexibility, and reduced travel and fatigue. Common obstacles were technology related (eg, internet connection), practical (eg, difficulty positioning the camera), patient related (eg, health status), practitioner related (eg, lack of technical skills), and organizational (eg, lack of access to technology). Support from family members or carers was a major facilitator for successful remote consultations. Of the 207 respondents who had used video-based consultations, 103 (50%) had assessed physical impairments using this method, 107 (52%) had assessed physical function, and 121 (59%) had used patient-reported outcome measures. Although practitioners generally felt confident in delivering video-based consultations, they felt less proficient in undertaking remote physical assessments, expressing concerns about validity, reliability, and safety. Only 46 of the 247 (19%) respondents had received any training in telerehabilitation or video consultations, and some felt they were “feeling their way in the dark.” Practitioners desired training and guidance on physical assessment tools suitable for remote use, when to use video-based consultations or alternative methods, governance issues, digital platforms, and signposting to digital skills training for themselves and their patients.

**Conclusions:** In response to the COVID-19 pandemic, practitioners rapidly adopted telerehabilitation for people with physical disabilities and movement impairment. However, there are technical, practical, and organizational obstacles to overcome, and a clear need for improved guidance and training in remote physical assessments. The findings of this survey will inform the development of a tool kit of resources and a training package for the current and future workforce in telerehabilitation.

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## KEYWORDS

telerehabilitation; physical disabilities; movement impairment; remote assessments; telehealth; rehabilitation; training; health care practitioners; physiotherapy; occupational therapy

## Introduction

Physical disabilities and impairments are common; globally, one in three people will experience an illness, injury, or impairment that will benefit from rehabilitation at some point in their life [1]. According to the International Classification of Functioning, Disability and Health, impairment is a problem in body function or structure (eg, weakness, tremor, loss of range, or muscle length), which may result in disability (ie, impact on function at an individual or societal level) [2].

Usually, hands-on detailed movement assessment is carried out by practitioners such as physiotherapists, occupational therapists, speech and language therapists, and podiatrists. During the COVID-19 pandemic, disruption of health care services and shielding of the most vulnerable meant that many people did not receive any face-to-face rehabilitation [3,4].

In response, practitioners adapted their practices to incorporate new ways of working, including telerehabilitation—the delivery of rehabilitation services via information and communication technologies [5]. The pandemic generated a rapid increase in the use of telephone and video-based consultations for rehabilitation assessments and interventions, in the United Kingdom and worldwide [4,6,7]. Although efficacy is not yet established, systematic review evidence suggests that services delivered using these methods may be as effective as face-to-face interventions for improving patient outcomes [8,9]. In one review, physiotherapy delivered via video or telephone for a range of musculoskeletal conditions was associated with similar or superior improvements in physical function and pain outcomes when compared to usual (face-to-face) care [8].

Another review reported comparable improvements in health-related quality of life of patients with stroke (and their caregivers) in telerehabilitation and control groups [9].

Telerehabilitation is perceived as acceptable by many patients with physical disabilities, including those with chronic musculoskeletal conditions [10], stroke [11], and severe expressive communication disorders [12]. Patient surveys have found that services delivered remotely may be preferred due to advantages such as reduced travel time and convenience [10,13,14]. In addition, there are potential cost savings for health and social care providers when rehabilitation services are delivered remotely; this includes reduced costs associated with practitioners' time and patients' and practitioners' travel [15] in addition to lower outpatient resource use [16].

Our recent global scoping review found that specific published guidance, training, and support on how to undertake remote assessments in people with physical disabilities is limited [17]. Professional bodies and clinical networks highlight large variations in the approaches taken, expressing concerns about potential inequity and inefficiency [4,18,19]. There is a clear need for standardized guidance, support, and training in telerehabilitation for physical disabilities and movement impairment.

To produce guidance that is useful, relevant, and applicable to real-world practice, the experiences and needs of health and social care practitioners must first be understood. As part of a National Health Service (NHS) UK Research and Innovation–Medical Research Council–funded project that aims to develop a tool kit of resources and a training package to support practitioners in carrying out remote physical



assessments, we conducted a survey of rehabilitation practitioners.

The objectives of the survey were to:

- Understand UK practitioners' experiences of telerehabilitation for people with physical disabilities and movement impairment (including use, perceived benefits and obstacles, and outcomes assessed)
- Explore practitioners' self-perceived confidence and competence in carrying out remote physical assessments
- Identify knowledge gaps and training needs
- Collate examples of best practice and recommendations

## Methods

### Overview of Survey

A cross-sectional online survey was conducted in November and December 2020 using the Jisc platform [20]. Ethical approval was obtained from the University of Plymouth Faculty of Health Staff Research Ethics and Integrity Committee (ref 2392). CHERRIES (Checklist for Reporting Results of Internet E-Surveys) [21] was used to guide the design, conduct, and reporting of the survey.

### Design and Development

Findings from our scoping review [17] and consultation with experts informed the survey questions. The expert consultation process involved informal discussions (email and verbal) with specialists in rehabilitation and physical disabilities, including health and social care practitioners and academics within, and external to, the project team. This enabled the identification of key issues and relevant questions, with a focus on what would practically inform the tool kit and training package.

The questionnaire included a combination of closed response (tick box, multiple choice, and Likert rating scales) and open response (free text) questions. To maximize accuracy and completeness of data, validation and compulsory items [20] were used in the questionnaire design. Only the closed response questions were compulsory and included *prefer not to say*, *other*, and *none of the above* options where appropriate. Adaptive questioning (ie, routing) was also used to ensure that only questions relevant to each respondent were answered [20,21]. Respondents were unable to submit responses until all relevant sections had been worked through and were able to amend their answers during completion. Prior to dissemination, the questionnaire was piloted with members of the research team for usability and technical functionality, with minor changes made to the structure, wording, and order as a result.

The questionnaire consisted of five sections: demographics, experience of telerehabilitation, perceived competence, knowledge and training, and final comments and (optional) contact details. There were 37 questions in total, with additional subquestions. The questionnaire took approximately 15 minutes to complete. A copy of the questionnaire is included in [Multimedia Appendix 1](#).

### Recruitment and Data Collection

Health and social care practitioners involved in rehabilitation throughout the United Kingdom were invited to take part in the survey. A combination of opportunity and snowball sampling were used; potential participants were identified from contacts and networks of the research team, and these participants were in turn asked to forward the survey to other potential participants. Invitations were sent via email to national networks (eg, Therapists in Multiple Sclerosis National Network), professional bodies (eg, Royal College of Occupational Therapists), regional education networks (eg, First Contact Practitioners), and special interest groups (eg, South West Physiotherapy Respiratory Interest Group). The survey was also advertised via social media (Twitter and Facebook). Inclusion criteria were broad; UK-based practitioners involved in rehabilitation were eligible to participate, regardless of their level of experience with telerehabilitation. This included professionals with direct patient contact, who were working in the NHS, social services, independent private, or charitable organization sectors.

The survey was open to anyone with the web link meeting the inclusion criteria. Potential respondents were provided with information on participation, ethical considerations, and use of their data at the beginning of the questionnaire. This was followed by an online consent form. Respondents were informed that their responses would be anonymized for reporting and analysis but were given the option to leave their name and contact details for clarification or discussion of their answers with the research team or to receive future study updates. No incentives were offered for participation.

### Data Analysis

Data cleaning was performed prior to analysis. This included checking the overall data set for duplicate entries and checking individual responses for eligibility. Based on these checks, one respondent based outside of the United Kingdom was excluded.

Quantitative analysis was performed using Excel (Microsoft Corporation) and SPSS Statistics 25 (IBM Corp) [22]. Descriptive statistics (eg, frequencies, percentages, and mean) were calculated for the closed questionnaire responses.

Qualitative thematic analysis was used to analyze the open responses, following the guidance of Braun and Clarke [23] and Braun et al [24]. Qualitative responses were coded and organized using NVivo 12 (QSR International) [25]. Following familiarization with the data, two researchers (authors SAB and KA) independently coded the responses before meeting to compare and discuss the identified themes. Common themes within the data were identified inductively (ie, generated from the data as opposed to guided by theory). Responses to the following questions were analyzed thematically: reasons for not using video-based consultations, concerns regarding validity and reliability of remote physical assessments, ways of overcoming challenges, recommendations for carrying out telerehabilitation with people with physical disabilities and movement impairment, recommendations for video-based consultations with people recovering from COVID-19, open

responses on information and training needs, and further comments on telerehabilitation.

## Results

### Demographics of Respondents

In total, 247 health and social care practitioners participated in the survey. Respondents had a mean age of 44.1 (SD 9.8) years,

with an age range of 23-70 years. The majority (n=202, 82%) were female. The respondents' occupational characteristics are shown in [Table 1](#). Almost half (n=114, 46%) of the respondents were physiotherapists, but a large range of allied health and social care professionals were represented. Respondents were from a range of specialties (most frequently neurological and musculoskeletal) and worked in various settings, with the highest proportions working in community health or social care and secondary care.

**Table 1.** Occupational characteristics of survey respondents.

Variable	Respondents (N=247), n (%) <sup>a</sup>
<b>Profession</b>	
Physiotherapist	114 (46)
Occupational therapist	63 (26)
Prosthetist or orthotist	17 (7)
Medic	15 (6)
Speech and language therapist	12 (5)
Podiatrist	8 (3)
Nurse	4 (2)
Social worker	3 (1)
Dietician	2 (1)
Other	9 (4)
<b>Setting of service</b>	
Community health or social care	91 (37)
Secondary care (eg, hospital outpatients)	81 (33)
Tertiary care (eg, specialist hospitals)	33 (13)
Private practice	14 (6)
Primary care (eg, GP <sup>b</sup> surgeries)	11 (5)
Charity or social enterprise	10 (4)
Academic institution	4 (2)
Residential social care	2 (1)
Other	1 (0.4)
<b>Clinical specialty</b>	
Neurological (including stroke)	103 (42)
Musculoskeletal/heumatology	28 (11)
Pediatrics	23 (9)
Community rehabilitation	20 (8)
Care of older people	11 (5)
Trauma/orthopedics	12 (5)
Developmental/learning	9 (4)
Disabilities	8 (3)
Amputees	7 (3)
Generic	3 (1)
Hand therapy	2 (1)
Mental health	2 (1)
Sports and exercise	2 (1)
Vocational services	17 (7)
Other or multiple specialties	1 (0.4)
<b>Work mainly with...</b>	
Adults	186 (75)
Children/adolescents	61 (25)
<b>Location</b>	

Variable	Respondents (N=247), n (%) <sup>a</sup>
England	205 (83)
Scotland	22 (9)
Wales	16 (7)
Northern Ireland	3 (1)
Other British isles	1 (0.4)
<b>Deliver service predominately to patients/service users in...</b>	
Urban setting	106 (43)
Rural setting	41 (17)
Both	100 (41)

<sup>a</sup>Percentages may not total 100 due to rounding.

<sup>b</sup>GP: general practitioner.

## Experiences of Telerehabilitation

### Use of Telerehabilitation

Of the 247 respondents, 207 (84%) reported having used video-based consultations. Respondents recalled their use of video-based consultations before, during, and after the first COVID-19 lockdown in the United Kingdom; the government restrictions imposed between March and June 2020 included 2-meter social distancing rules, restrictions on travel (only essential travel was permitted), and closure of nonessential retail and public venues. The frequency of use had increased substantially during this time; before March 2020, only 27 of 207 (13%) respondents were using video-based consultations, compared with 195 of 207 (94%) respondents after the first COVID-19 lockdown. Video-based methods were typically supported by telephone and email. Practitioners used video-based consultations for a range of purposes including screening and triage, assessments, and intervention delivery (Table 2). The follow-up assessment was the most commonly cited reason for using telerehabilitation, reported by 177 of 207

(86%) respondents. Only 29 of 207 (14%) respondents had delivered virtual group interventions (eg, exercise or educational classes), compared with 129 of 207 (62%) respondents who had delivered individual interventions.

The most frequently used platforms for video-based consultations were Attend Anywhere (Chris Ryan) [26] (used by 124/207, 60% of respondents), Teams (Microsoft Corporation) [27] (used by 79/207, 38%), and Zoom (Zoom Video Communications) [28] (used by 58/207, 28%). More than half of the respondents (112/207, 54%) reported using more than one platform. Organizational requirements were the largest influencing factor in selecting a particular platform, with 178 of 207 (86%) respondents providing this as a reason for their choice. Some practitioners noted a disparity between organizational requirements and which platforms might be preferred by patients:

*I am limited by what our organisation considers to be secure which is not what patients are more familiar with. [Occupational Therapist, Neurology]*

**Table 2.** Purposes of video-based consultations (n=207).<sup>a</sup>

Purpose of consultation	Respondents, n (%) <sup>b</sup>
Screening and triage	80 (39)
Initial assessment	154 (74)
Follow-up assessments	177 (86)
Assess or review use of equipment	77 (37)
Intervention delivery on an individual basis (eg, goal-setting, exercise, or education)	129 (62)
Intervention delivery on a group basis (eg, exercise class or educational class)	29 (14)

<sup>a</sup>Respondents were asked "For which of the following purposes have you used video-based consultations?"

<sup>b</sup>Some respondents used video consultations for multiple purposes; therefore, the percentages do not total 100.

### Perceived Benefits and Obstacles

Overall, respondents perceived telerehabilitation in a positive light and saw it as a valuable tool and a useful adjunct to, rather than a replacement for, face-to-face care:

*We've been talking about telerehabilitation for so long and COVID has made us step up to the plate. Although it is useful, it can never replace face-to-face consultations. [Physiotherapist, Stroke Rehabilitation]*  
*[Telerehabilitation is] a useful tool, but in my practice the gold standard is still face-to-face consultation, and is liable to remain so for the foreseeable future.*

*Much of my work involves having to touch, manipulate or adjust prostheses and this cannot be done remotely.* [Prosthetist, Amputees]

It was recognized that telerehabilitation may not be the best option for every person or case. Examples given where practitioners felt remote consultations were less appropriate were consultations with older people; people with severe cognitive, sensory, or physical impairments; and cases where manual therapy such as adjustment of prostheses is required.

Respondents were asked to select the three most important benefits of undertaking video-based consultations (Figure 1). The three most frequently selected benefits were patient-related, including reduced risk of infection (161/207, 78%), reduced patient travel (120/207, 58%), and convenience and flexibility of the appointment for patients (79/207, 38%). In open responses, reduced travel and improved flexibility were deemed particularly beneficial for those with physical disabilities and fatigue. A range of additional benefits were perceived for practitioners and organizations, including efficiency, facilitating multidisciplinary working, and cost savings (Figure 1).

Obstacles encountered by practitioners in relation to video-based consultations were grouped into five categories: technology related, practical, patient related, practitioner related, and organizational (Figure 1). Technology-related issues had been experienced by 180 of 207 (87%) respondents. These included poor internet connections and usability issues (eg, performance, responsiveness, and incompatibility of hardware and software). Practical issues, including difficulty positioning the camera for physical assessments, had been experienced by approximately 71% (146/207) of respondents. Patient-related issues included lack of skills or confidence in using technology (experienced

by 149/207, 72% of respondents) and lack of access to technology (reported by 151/207, 73%). The patient's health status was also a frequently encountered obstacle. Around 56% (116/207) of respondents perceived telerehabilitation as less suitable for people with visual, sensory, or cognitive impairments, and 46% (95/207) reported severe physical impairment as an obstacle to a successful remote consultation. Practitioner-related obstacles included a perceived lack of skills or confidence in using technology (reported by 15/207, 15%), concerns surrounding the validity and reliability of video-based assessments (71/207, 34%), and safety concerns or difficulties conducting a risk assessment remotely (49/207, 24%). Organizational and governance obstacles were encountered by 21 of 207 (10%) respondents (eg, organizations recommending face-to-face consultations or prohibiting the use of certain technologies).

For the respondents who had not used video-based consultations (40/247, 16%), the reasons given were closely related to the obstacles experienced by the practitioners already using telerehabilitation. However, more emphasis was placed on organizational factors. These included unavailability of the required hardware or software within the organization and telerehabilitation services and protocols not having been set up yet.

Practitioners reported that technical and practical obstacles were most overcome by support from family members or carers. This support included helping to use the technology, holding and positioning the camera during physical assessments, ensuring the environment is safe and free of obstacles, providing physical support (eg, when assessing balance), and clarifying the practitioner's instructions.

**Figure 1.** Benefits and obstacles of video-based consultations (as perceived by practitioners).

PERCEIVED BENEFITS	OBSTACLES ENCOUNTERED
<p><b><u>PATIENT</u></b></p> <p>Reduced risk of infection (eg, COVID-19)</p> <p>Reduced travel</p> <p>Convenience and flexibility</p> <p>Better access for remotely located patients</p> <p>Reduced stress / patient may be more comfortable in home environment</p> <p>Easier for family to join consultations</p>	<p><b><u>PATIENT</u></b></p> <p>Lack of skills and/or confidence in using technology</p> <p>Lack of access to technology</p> <p>Health status – less suitable for patients with visual, sensory, cognitive, or severe physical impairments</p>
<p><b><u>PRACTITIONER</u></b></p> <p>Reduced travel</p> <p>More efficient / time saving</p> <p>Opportunity to see the patient (and carers) functioning in their home environment</p> <p>Facilitates multi-disciplinary working and supporting junior staff</p> <p>Easier screening and triage</p> <p>Useful when not possible to see patient face-to-face</p>	<p><b><u>PRACTITIONER</u></b></p> <p>Lack of skills and/or confidence in using technology</p> <p>Validity and reliability concerns</p> <p>Safety concerns / difficulty with risk assessment</p>
<p><b><u>ORGANIZATION</u></b></p> <p>More efficient use of services (eg, treatment space and parking reserved for those who need it)</p> <p>Potential cost savings</p>	<p><b><u>TECHNOLOGY</u></b></p> <p>Variable internet connection</p> <p>Usability issues (hardware and software)</p>
	<p><b><u>PRACTICAL</u></b></p> <p>Difficulty positioning the camera for physical assessments</p> <p>Need to rely on family / carer support for some physical assessments</p>
	<p><b><u>ORGANIZATION</u></b></p> <p>Lack of facilities / access to technology</p> <p>Telerehabilitation service not set up in organization</p> <p>Information governance or consent procedures unclear / not established</p>

### Physical Outcomes Assessed Remotely

Half (103/207, 50%) of the respondents had used video-based consultations to assess physical impairments (aspects such as strength and joint range as distinct from physical function). The categories of physical impairments most frequently assessed remotely were generalized (gross) and specific (individual joints) range of movement, posture, and balance (Table 3). Physical function had been assessed remotely by 107 of 207 (52%) practitioners, including standardized tests such as the Five Times Sit-To-Stand [29] and Timed Up and Go [30] tests, and nonstandardized assessments such as observing gait. Patient-reported measures had been used remotely by 121 of 207 (59%) practitioners, with activities of daily living and pain assessed most frequently (Table 3).

Practitioners reported a number of specific concerns in relation to the validity, reliability, and safety of clinician-rated physical

assessments carried out remotely. These were grouped into five key themes (Table 4). The most frequently reported concern was a lack of confidence in applying physical measures remotely when they had not been designed for remote use:

*I am concerned that we are all using assessment techniques which lack known reliability and validity if conducted in a context different to that in which they are supposed to be used (i.e. using them remotely rather than face-to-face). [Physiotherapist, Musculoskeletal]*

Additional concerns included physical examination restrictions preventing a hands-on approach (assessing muscle tone, strength, sensation, etc), communication difficulties, technology issues, and concerns about patient safety. Safety was a particular concern in cases where the patient was alone. Although only 10 of 207 (5%) respondents had experienced a safety incident



(eg, a fall or near miss) while conducting remote physical assessments, practitioners reported being more risk averse compared with face-to-face consultations. This led to a reduction in the number of assessments carried out, and some avoided these assessments altogether:

*Among some colleagues I noticed a perceived fear regarding the safety of remote interventions and this dominated so they were reluctant to consider any remote interventions or even reviews.*  
[Physiotherapist, Neurology]

Most practitioners accepted the validity and reliability of patient-reported outcomes, but a small number reported concerns when using these measures remotely. Concerns included accuracy and reliability of self-reported measures and the potential influence of family members:

*I don't have any evidence of reliability of taking patient-reported outcome measures by video or how much pressure the parents are using.* [Physiotherapist, Pediatrics]

**Table 3.** Physical impairments and patient-reported outcomes assessed remotely.

	Respondents, n (%) <sup>a</sup>
<b>Clinician-rated measures of physical impairment (n=103)<sup>b</sup></b>	
Range of motion: generalized (eg, gross lower limb movement)	84 (82)
Posture	66 (64)
Range of motion: specific (individual joints)	63 (61)
Balance	60 (58)
Dexterity	34 (33)
Muscle strength	40 (39)
Speech	12 (12)
Swallowing	5 (5)
Respiratory	5 (5)
Other <sup>c</sup>	19 (18)
<b>Patient-reported outcome (n=121)<sup>d</sup></b>	
Activities of daily living	79 (65)
Pain	78 (65)
Fatigue	59 (49)
Quality of life	55 (46)
Psychosocial	40 (33)
Cognitive	22 (18)
Other <sup>e</sup>	31 (26)

<sup>a</sup>Some respondents reported assessing multiple impairments or outcomes; therefore, the percentages do not total 100.

<sup>b</sup>Respondents were asked "When undertaking video consultations, which of the following physical impairments do you measure remotely?"

<sup>c</sup>Other impairments included muscle tone, tremor, reflexes (including vestibulo-ocular), bradykinesia, facial palsy, skin disorders and scars, oedema, and congenital impairments (eg, arthrogryposis, radial longitudinal deficiency, and syndactyly).

<sup>d</sup>Respondents were asked "Which of the following do you assess remotely using self-report?"

<sup>e</sup>Other patient-reported outcomes assessed remotely included movement, general health status, and sensory function.

**Table 4.** Concerns of practitioners regarding the validity and reliability of remote physical assessments.

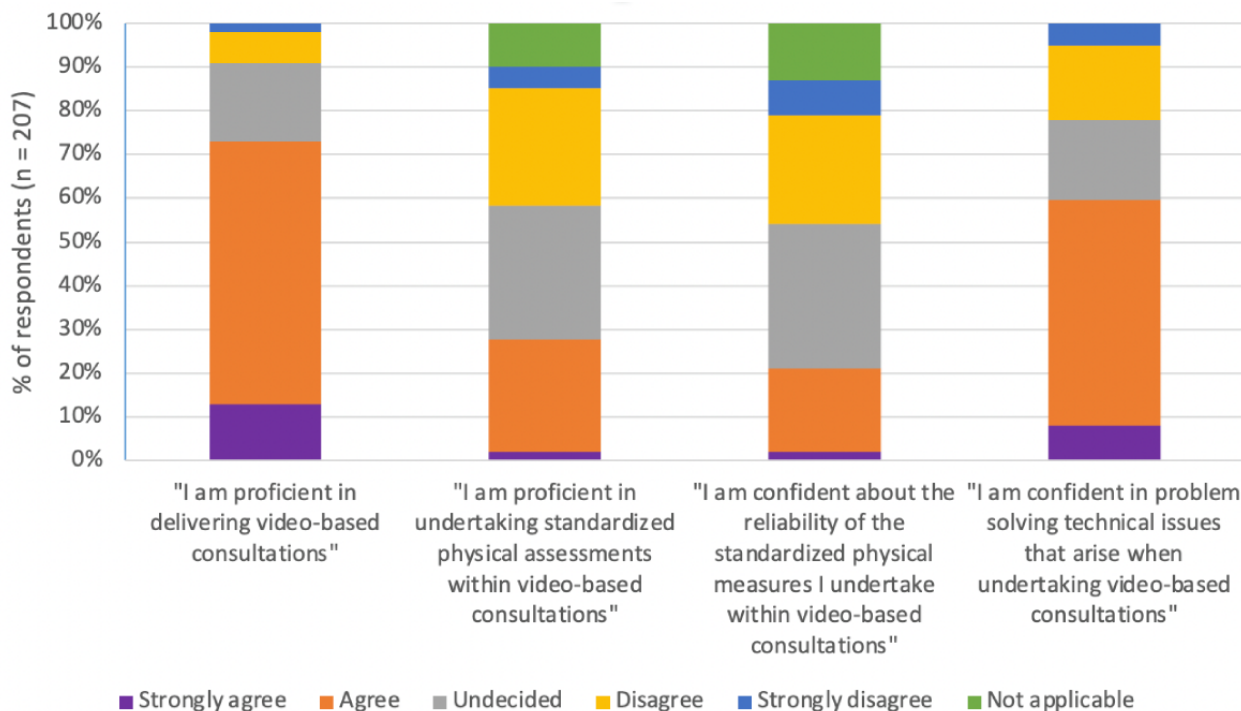
Theme	Description	Exemplar quote
Lack of confidence in measures used remotely	Practitioners expressed distrust and skepticism in the accuracy and reliability of the measures they used, as they felt they were not designed to be used remotely. This led to uncertainty about the effectiveness of interventions. Practitioners described taking outcome measures with a “spoonful of salt” and used them as a general indication of health, rather than to evaluate change. This theme was the most frequent concern out of all responses.	“We are having to use observations which have unknown reliability and validity when used remotely.” (Physiotherapist, Musculoskeletal)
Physical examination restrictions	Physical examinations were reported as being considerably restricted when working remotely. Examples of problems were a limited view of the patient due to the camera angle, not feeling the movements of the patient, and difficulty gaining a valid assessment of mobility. This theme was the second most frequent concern.	“It’s easy to miss things over video. You can’t always see all the movement.” (Occupational Therapist, Generic)
Patient safety concerns	Practitioners were concerned for the patient’s safety when engaging in physical assessments. As they were not physically present, they felt that they were not in control of the patient’s environment, and therefore unable to minimize the risk of falls or other safety incidents.	“Safety can be a real concern. If the person is at risk of falls then you need a carer by them or otherwise I don't undertake the test.” (Physiotherapist, Neurology)
Communication issues	Communication issues between the patient and practitioner related to information clarity and ensuring the patient understood instructions during assessments. Practitioners expressed that the lack of nonverbal cues and body language could hinder rapport building. Some concerns also revolved around distractions in the patient’s home environment.	“There is less rapport [online] so I feel that the client is less likely to reliably report how they are managing [their condition].” (Occupational Therapist, Neurology)
Technology issues	Practitioners reported that technical issues including hardware and internet connections impacted on their ability to carry out physical assessments. Poor quality of video and time lags reduced visual acuity and ability to discern subtle changes in movement.	“It is sometimes difficult to visually pick up all aspects due to poor internet connection.” (Physiotherapist, Pediatrics)

**Self-Perceived Confidence and Competence**

Practitioners who had carried out video-based consultations were asked to rate their self-perceived confidence and competence (Figure 2). Although most (150/207, 72%) respondents reported that they felt they were proficient in delivering video-based consultations, fewer felt proficient in

undertaking physical assessments using this method. Of the 187 practitioners who had used standardized clinician-rated physical assessments within video-based consultations, 57 (30%) reported feeling proficient in conducting these assessments. Of the 207 practitioners, 123 (59%) felt confident in dealing with technical issues.

**Figure 2.** Self-perceived competence and confidence in carrying out video-based consultations (n=207).



## Knowledge and Training Needs

Sources of information used by respondents regarding the use of telerehabilitation are shown in [Table 5](#). The most frequent source of knowledge was informal sharing of information with colleagues (reported by 190/247, 77% of respondents). Almost half of the respondents (118/247, 48%) had referred to their organization's standard operating procedure or guidance. Practitioners had accessed a range of online sources including webinars, social media, and blogs.

Only 46 (19%) practitioners had received formal training in telerehabilitation or video consultations; this was most frequently delivered in a virtual classroom. Many respondents reported having learned quickly through experience and recognized the need for improved guidance and training:

*We are expected to provide telerehabilitation without guidance or training – we are feeling our way in the dark.* [Physiotherapist, Neurology]

*We need explicit guidance about what should and what should not be expected from a video consultation.* [Consultant, Neurology]

*It would be good to have guidance for an approach that works that can be adopted by a whole team. Everyone is making it up as they go along, so even within a service there is no consistency.* [Physiotherapist, Neurology]

Respondents desired training to be flexible and not too time-consuming to fit it around their work commitments. The

majority stated that they would prefer a virtual classroom or a blended approach with facilitated and self-directed learning. Regardless of the preferred training format, respondents wanted opportunities for interaction and discussion with peers; this was seen as important to enable sharing of experiences and ways to overcome challenges.

There was a perception that training in telerehabilitation should be available for staff at all levels but may be particularly important for students and junior staff with less clinical experience. For example:

*Most experienced clinicians have fully adapted to remote consultation and we depend on our experience, whereas students or new clinicians have no experience so remote appointments for them will be a little different to a simulation or text, they will lack the essential full sensory experience of a real patient.* [Physiotherapist, Musculoskeletal]

Respondents desired guidance on the following subjects:

- Physical measures and assessment tools that are suitable for remote use
- Governance including confidentiality and consent
- Guidance and support on different digital platforms (eg, Microsoft Teams)
- Examples of when to use video-based consultations or other methods (ie, telephone and face-to-face)
- Signposting to digital skills training for patients/service users and practitioners

**Table 5.** Sources of information used by practitioners in relation to video assessments or consultations (N=247).<sup>a</sup>

Source of information	Respondents, n (%)
Informally sharing information with colleagues	190 (77)
Own organization's standard operating procedure/guidance	118 (48)
Published guidelines (eg, NHS <sup>b</sup> Digital or professional guidelines)	76 (31)
Virtual working groups (eg, professional forums or special interest groups)	56 (23)
Social media (eg, Facebook or Twitter)	51 (21)
Journal articles (including Cochrane reviews)	42 (17)
YouTube videos	39 (16)
Webinars	8 (3)
Other online sources (eg, web searches, blogs, or help guides for video consultation platforms)	36 (15)

<sup>a</sup>Respondents were asked "Have you used any of the following sources of information relating to conducting video assessments or consultations? Please choose all that apply."

<sup>b</sup>NHS: National Health Service.

## Best Practice and Recommendations

Survey respondents shared examples of successful practice, how they had overcome obstacles, and recommendations for telerehabilitation with people with physical disabilities and movement impairment. This included top tips for carrying out

video-based consultations, outcome assessment measures and tools that have been successfully used remotely, and recommendations for working with specific groups (eg, people with cognitive or communication difficulties or patients recovering from COVID-19). The key recommendations are presented in [Textbox 1](#).

**Textbox 1.** Recommendations of survey respondents in carrying out telerehabilitation with people with physical disabilities and movement impairment.

- Support from family members and carers is crucial; they can provide physical assistance during assessments or help with using technology.
- Clear communication between the practitioner and patient is even more important in remote consultations and assessments (eg, give clear instructions, do not rush, and use summaries and repeating back).
- Prepare as much as you can in advance; for example, send the patient resources that can be referred to during the consultation, familiarize yourself with the technology, and plan the structure of the consultation.
- At least the same amount of time should be allocated for remote physical assessments as face-to-face.
- Telephone triage is a valuable tool for assessing background, medical, and medication history, and deciding on the best method for follow-up treatment and management.
- Make use of patient-reported outcome measures as much as possible (eg, questionnaires for pain and quality of life).
- Do not try to do too much; focus on one or two key physical outcomes in a single session.
- For people recovering from COVID-19, try to do the consultation at a time of day when they are less fatigued, and keep the session short.
- Keep safety at the forefront and use your clinical judgement but try not to be too risk averse in physical assessments; remember the patient is already functioning in their own home.

## Discussion

### Principal Results and Comparison With Prior Work

In this survey of UK rehabilitation practitioners in health and social care, we found that the use of telerehabilitation for people with physical disabilities and movement impairment had increased rapidly since the COVID-19 pandemic. Practitioners generally viewed telerehabilitation positively and recognized many advantages for patients, including reduced risk of infection, increased flexibility, and reduced burden of travel for those with physical disabilities and fatigue. Video- and telephone-based consultations were perceived as a useful adjunct to, rather than a replacement for, face-to-face care. They were not felt to be appropriate for every individual or case; for example, remote consultations may be less suitable for manual therapy and people with severe cognitive, sensory, or physical impairments. These findings reflect those of other studies, where telerehabilitation has been reported as both feasible and acceptable to practitioners and health service users as part of the wider package of care [10,31-33].

The majority of existing surveys have focused on the overall experience of video consultations for practitioners and service users, including perceived acceptability, satisfaction, and communication [10,13,14,33-35]. This survey extends the scope of this research by exploring the physical and movement-oriented aspect of remote consultations and assessments. The categories of physical impairments most frequently assessed via video-based consultations were generalized (gross) and specific (individual joints) range of movement, posture, and balance. Practitioners had used patient-reported outcome measures more frequently than standardized clinician-rated tests.

A number of obstacles were identified in relation to carrying out video-based consultations with people with physical disabilities and movement impairment. The obstacles experienced by practitioners who were using video-based consultations were closely related to the reasons stated by those who had never used this method. Obstacles were grouped into five categories: technological (eg, poor internet connection or

usability issues), practical (eg, difficulty positioning the camera), patient related (eg, lack of skills and access to technology), practitioner related (eg, validity and reliability concerns), and organizational (eg, lack of facilities or protocols not established for telerehabilitation). This complements the findings of existing studies; for example, Bower and colleagues [36] classed barriers to clinicians' use of technology in neurorehabilitation into factors related to the technology itself, its users, and the organizational context [36]. Practical issues including difficulties with camera angles and limited fields of view have been recognized by other telehealth researchers [37,38]. The use of novel technologies (eg, wide-angle webcams and robotic movement tracking devices) that can improve the field of view and aid remote assessments of movement offers one potential avenue for exploration in research and practice [39].

Many of the respondents expressed concerns regarding the validity, reliability, and safety of physical assessments completed remotely. The largest concern related to the application of physical measures remotely when they had not been designed for remote use. Although there is some evidence for the validity and reliability of specific physical outcomes assessed remotely, such as a systematic review by Mani and colleagues [40], this knowledge needs to be built on and made available to practitioners and used in practice. A few respondents expressed concerns regarding the remote use of patient-reported outcomes, including lower accuracy and reliability when completed remotely, and the potential influence of family members. This is also worthy of further research.

In our survey, physical examination restrictions and the prevention of hands-on therapy were also a concern of practitioners; this concern has previously been reported by both practitioners and patients undertaking remote physical therapy [37,38,41]. Safety concerns caused practitioners to be more risk averse (and in some cases avoidant) when carrying out assessments via video or telephone. Although most patients will be seen by alternative means (particularly as COVID-19 restrictions are easing), there is a possibility that, for some, this will lead to delays in diagnosis or treatment. Understanding the safety risks associated with remote physical assessments, and how risk averseness may impact on the type and quality of



rehabilitation offered, are important issues for exploration in future research. Practitioners should carry out a thorough risk assessment, in which the risks and benefits of different actions (performing the physical assessment remotely, seeing the patient face-to-face, or taking no action) are carefully considered.

Technical and practical support from family members and carers was reported by respondents as a major facilitator that helped to overcome obstacles and alleviate safety concerns. This reflects the findings of a recent case study, where the success of telerehabilitation for people with dementia during the COVID-19 pandemic was dependent on technical and physical support from caregivers [42]. In our survey, practitioners were less likely to carry out remote physical assessments with patients they deemed vulnerable (eg, at risk of falling) if they lacked the support of a family member or carer. In light of these findings, future research should explore the feasibility, safety, and practicalities of carrying out effective and safe telephone and video-based consultations with people who live alone or do not have a carer present.

A major contribution of this study is the exploration and identification of training needs of practitioners in relation to telerehabilitation. Only around one in five of the practitioners in our survey had completed formal training in telerehabilitation or video consultations; this closely matches the findings of an Australian survey of allied health clinicians delivering telehealth for musculoskeletal conditions, where only 21% had received training [37]. In the Australian survey, there was a general feeling of lacking adequate training and support [37] similar to our survey where practitioners reported “feeling their way in the dark.” We found that practitioners had quickly adapted their ways of working through the COVID-19 pandemic and primarily learned through experience, relying on informal sources of knowledge such as sharing information with colleagues and social media. Although learning through experience is an important part of clinical practice [34,43], there is a need for improved resources, guidance, upskilling, and training to support this [37,44,45]. Our survey confirmed this, identified specific training needs and preferences, and captured recommendations and tips from practitioners working in telerehabilitation.

Regarding specific training needs, most respondents wanted training to take place in a virtual classroom or to involve a blended approach with facilitated and self-directed learning, with opportunities for peer discussion. In particular, a need for training in conducting remote physical assessments was identified. Practitioners felt less confident and competent in delivering this aspect of care remotely compared with subjective assessments and information giving. Practitioners desired specific guidance on physical assessment tools suitable for remote use, when to use video-based consultations or alternative methods, governance issues, digital platforms, and signposting to digital skills training for themselves and their patients.

A strength of the survey is the capture of both quantitative and qualitative information on a range of aspects related to telerehabilitation. This detailed information is currently being triangulated with the findings of our literature review and service evaluation to produce a practical tool kit of resources and a training package to support practitioners in the remote

rehabilitation of people with physical disabilities and movement impairment [46].

## Clinical and Policy Implications

Based on the findings of this survey, there are three key recommendations for clinical practice and policy:

1. Education, training, and upskilling of practitioners: Training should include not only technical skills but also practical and communication skills in remote consultations, and safety, validity, and reliability of remote physical assessments. Supporting staff in health and social care should also be trained in the aspects that are relevant to them (eg, information governance and consent in remote consultations).
2. Provision of access to the necessary equipment, resources, and suitable environments for telerehabilitation: As well as hardware and software, equipment and resources may include the use of novel technologies (eg, robotic movement tracking devices) to help to overcome some of the practical obstacles encountered in movement assessments. Practitioners should have access to private, spacious, quiet rooms with good lighting.
3. Implementation and use of standardized protocols for telerehabilitation: Standardized guidance on aspects of telerehabilitation, such as governance, safety, and consent should be made available. Some tailoring will be necessary based on the needs of organizations and patients, but the adoption of such protocols will improve communication and consistency of care within and between health and social care services.

## Limitations

Some limitations should be considered, including the representativeness of the sample. Recruitment relied on opportunity and snowball sampling rather than random selection. These sampling methods were used for practical reasons, as it was necessary to capture data from practitioners as efficiently as possible to inform the rapid development of the tool kit. The high proportion of female respondents (82%) may be questioned, but this is representative of the health and social care workforce in the United Kingdom, as 77% of NHS staff [47] and 82% of adult social care staff [48] are female. To ensure the views of rehabilitation practitioners across a wide range of sites and work settings were represented, invitations were sent to a variety of national networks. As this was a UK sample, the international relevance of the findings may be questioned. The decision to select UK-based practitioners was a pragmatic one, as the tool kit will include specific guidance on aspects such as information governance and digital platforms used in the United Kingdom. Nevertheless, many of the issues identified are likely to be of relevance to other countries, as suggested by our scoping review [17].

It should be recognized that the online nature of the survey might have biased recruitment toward those who are more comfortable with digital technology and online working. In addition, the survey was cross-sectional, and the views and training needs of practitioners may change over time. Future surveys and qualitative studies should explore how experiences,

attitudes, and training needs evolve during and after the COVID-19 pandemic. Finally, future research should explore the impact of clinical experience on confidence and proficiency in delivering telerehabilitation.

### Conclusions

This survey provided a comprehensive understanding of the experiences and training needs of UK health and social care practitioners regarding the use of telerehabilitation for people with physical disabilities and movement impairment. Although

practitioners have rapidly adopted remote ways of working and viewed telerehabilitation positively overall, there are technical, practical, and organizational obstacles to overcome to maximize the success of this approach. There is a clear need for improved guidance and training, particularly surrounding physical and movement-oriented assessments. The findings will be of interest to practitioners, service providers, researchers, and technology developers, and will have practical relevance through informing the rapid and timely development of a tool kit of resources and a training package for the current and future workforce.

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### Authors' Contributions

JF is the principal investigator and conceived of the study. All authors contributed to the study design. SAB designed the questionnaire in consultation with all the authors. SAB and KA conducted data analysis. SAB wrote the first draft of the manuscript; all authors reviewed and edited subsequent versions, and approved the final version.

### Conflicts of Interest

None declared.

Multimedia Appendix 1

Questionnaire.

[[PDF File \(Adobe PDF File\), 386 KB - xmed\\_v3i1e30516\\_app1.pdf](#)]

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## Abbreviations

**CHERRIES:** Checklist for Reporting Results of Internet E-Surveys

**NHS:** National Health Service

**UKRI-MRC:** UK Research and Innovation–Medical Research Council

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