



Articles

Development of the Reporting Essentials for DELirium bioMarker Studies (REDEEMS) guideline

Ingrid Amgarth-Duff¹ ^a, Annmarie Hosie², Gideon Caplan³, Meera Agar¹

¹ University of Technology Sydney, ² The University of Notre Dame Australia, ³ Prince of Wales Clinical School, University of New South Wales

Keywords: Reporting guidelines, Consensus, Methodology, Delirium, Pathophysiology, Biomarkers

<https://doi.org/10.56392/001c.36531>

Delirium

Background

Delirium is a serious and distressing neurocognitive condition manifesting as an acute change in mental status due to medical illness, injury and/or treatment. The understanding of delirium pathophysiology is limited and largely hypothetical and this evidence gap impedes the development of effective therapies. Delirium biomarker studies have a key role in building knowledge of the pathophysiology of delirium, subject to the robustness of their methods and reporting. Our objective was to describe the multi-method development and finalisation of a new reporting guideline for delirium fluid biomarker studies: REDEEMS.

Methods

A previously published systematic review on delirium and advanced cancer biomarkers informed a three-round modified Delphi study with international experts in delirium research in 2019. We held a follow-up consensus meeting with a newly configured expert panel of 12 delirium researchers in June, 2020 to determine the inclusion or exclusion of 16 items that achieved 70-80% (i.e., borderline) consensus in the Delphi study.

Results

Of the 16 items presented at the consensus meeting, seven were excluded, six remained as discrete items, and three were merged with another item. The final REDEEMS guideline contained nine items specific to reporting delirium biomarker studies.

Conclusion

The REDEEMS guideline was developed through a rigorously conducted Delphi and follow-up consensus meeting with international experts in delirium research. The REDEEMS will support the improved reporting rigour and synthesis of future delirium biomarker research. The next step is dissemination to promote uptake of the guideline and evaluate the influence on improved study methods and capacity to address research hypotheses.

INTRODUCTION

Delirium is a serious, acute and complex neurocognitive condition that precipitated by an acute event such as infection or surgery. Delirium occurs in around one in five hospitalised patients.¹ It is characterised by acute changes in attention, awareness and cognition and affects memory, language, visuospatial ability, orientation and perception.² Delirium is associated with multiple adverse clinical outcomes, including high levels of patient and caregiver dis-

tress, significant morbidity and mortality, impairment of activities of daily living and substantial costs to the health-care system.³⁻⁶

Despite the substantial morbidity and mortality of delirium, knowledge of its pathophysiology is mainly hypothetical, with some underpinning empirical data supporting theories, including involvement of inflammatory systems, neurotransmitter alterations, disruption of circadian rhythm, and glucose metabolism.⁷ Thus, biomarker studies are crucial to accelerate our understanding of delirium biology leading to potential therapies. A biomarker is a biolog-

^a Corresponding author:
Ingrid.Amgarth-Duff@uts.edu.au

ical molecule found in blood, other body fluids, or tissues that is a sign of a normal or abnormal process or a condition or disease.⁸ Although there are an increasing number of pathophysiological studies in delirium, results have been inconsistent. This means it is challenging to elucidate biomarker correlations and further infer pathophysiological pathways associated with delirium hindering the subsequent development of targeted therapies.⁹

Systematic reviews synthesise results from multiple primary studies and are considered the highest level of evidence. Such knowledge synthesis is impeded when primary studies are inadequately reported.^{10,11} Guidelines emerged in the mid-1990s to counteract widespread deficiencies in reporting published research studies. For example, two independent initiatives to improve the quality of reports of randomised controlled trials (RCTs) led to the development of the CONSORT (CONsolidated Standards Of Reporting Trials) statement, first published in 1996 is now one of the most well-established reporting guidelines in health research.¹² The CONSORT statement led the way for developing a multitude of reporting guidelines in multiple journals.¹³ Reporting guidelines help researchers to meet specific standards by providing a checklist of items for best practice reporting.¹⁴

Reporting guidelines with relevance to biomarker studies currently exist. These are: the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) for reporting observational studies¹⁰; reporting guidelines for fluid markers in neurologic disorders¹⁵; the STARD (STAndards for the Reporting of Diagnostic accuracy)¹²; and the REMARK (REporting recommendations for tumour MARKer prognostic studies).¹⁶ However, these reporting guidelines were not explicitly configured for delirium biomarker studies and no previous work has investigated how they may be modified to inform optimal delirium biomarker research. Special configuration for delirium biomarker studies is crucial as delirium often occurs in the context of other illnesses with overlapping pathophysiological processes. Hence the biomarkers of the other diseases may be inaccurately identified as delirium biomarkers, meaning a binary association is insufficient.

In 2020, we published preliminary recommendations for a reporting guideline for delirium biomarker studies.¹⁷ This current paper reports on a follow-up consensus meeting with an expert panel of delirium researchers to finalise the Reporting Essentials for DELirium bioMarker Studies (REDEEMS) guideline.

METHODS

DEVELOPMENT OF REDEEMS

We used a multi-method design to develop the REDEEMS (Figure 1), following methods proposed by Moher et al. (2010).¹³ This included: a systematic review of the literature identifying a gap in rigorous reporting of delirium biomarker studies⁹, a three-round Delphi survey¹⁷ and a follow-up online consensus meeting. This multi-method and staged process is supported by both Delphi researchers and

those experienced in guideline development^{13,18} and endorsed by the Equator Network.¹⁹

The systematic review and Delphi survey have been previously published.^{9,17} This paper now reports the follow-up consensus meeting in detail.

PARTICIPANTS

Those eligible for the consensus meeting were clinical researchers who had studied delirium in humans including, but not restricted to, biomarkers. Basic science and researchers conducting pre-clinical studies in animals focused on delirium were also eligible. Potential participants were required to have delirium research experience in the last ten years (with no minimum number of years pre-specified). We deemed those who met these eligibility criteria were deemed to have adequate knowledge, expertise and opportunity to make a meaningful contribution to the topic area.

RECRUITMENT

Delphi participants were recruited using a combination of purposive sampling and snowballing.^{20,21} Membership lists of international Delirium Societies (Australasian Delirium Association, American Delirium Society and the European Delirium Association); colleagues and professional networks; and researchers identified from biomarker journal articles were invited to participate. Snowball sampling was also employed by asking invitees whether they knew any other relevant persons who may be interested in participation.

Participants for the consensus meeting were identified through the Delphi study participant list, and authorship of recent publications in delirium biomarker studies.

Participants who agreed to take part in the consensus meeting were sent an invitation to attend a Zoom meeting one week before the meeting. Participants were asked to sign a written consent form and answer some basic demographic questions to be sent back to the lead author (IAD) before the meeting.

DATA COLLECTION

We gave meeting attendees the preliminary list of recommendations for reporting of delirium biomarker studies (see Supplementary file 1 and previous publication¹⁷). The focus of discussion was on the 16 items that had achieved only borderline consensus (i.e. 70-80%) in the Delphi survey.

A Poll EverywhereTM (pollev Everywhere.com/) presentation was prepared to provide this information and enable interactive voting with live participant responses and feedback. Group responses were disclosed to participants in real time once all participants had voted, however individual participant votes remained anonymous. Participants were asked to indicate whether or not the item should be included in the guideline (Yes / No) for each item presented. Consensus agreement was determined *a priori*, based on a majority i.e., ≥50% agreement. Any items which did not achieve consensus agreement were discussed until a con-

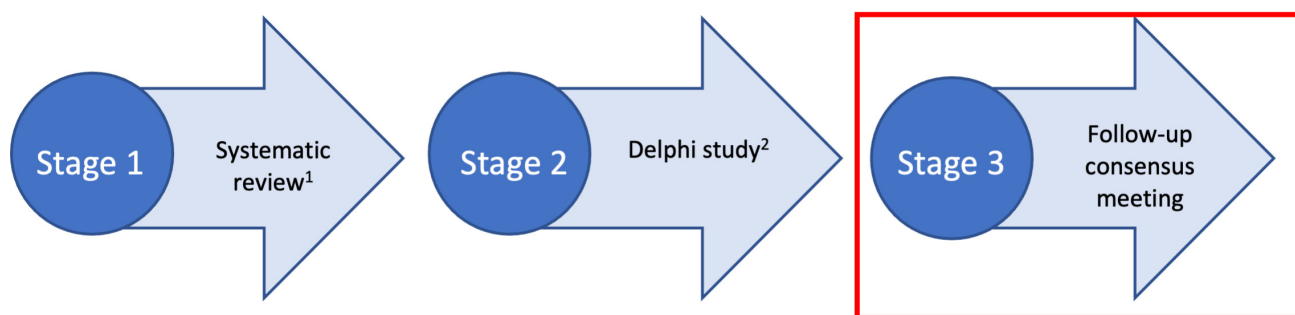


Figure 1. The REDEEMS development process, highlighting the consensus meeting reported in this paper

¹ Amgarth-Duff I, Hosie A, Caplan G, Agar M. A systematic review of the overlap of fluid biomarkers in delirium and advanced cancer-related syndromes. *BMC psychiatry*. 2020;20(1):1-32

² Amgarth-Duff I, Hosie A, Caplan G, Agar M. Toward Best Practice Methods for Delirium Biomarker Studies: An International Modified Delphi Study. *International journal of geriatric psychiatry*. 2020; 35(7):737-748

sensus opinion was reached. Participants were also asked whether each item was clearly worded and, if not, to provide suggestions to improve the wording. IAD facilitated all voting.

ETHICAL CONSIDERATIONS

Ethical approval was obtained from the University of Technology Sydney Human Research Ethics Committee (approval no. ETH18-2673).

We stored data transcripts from the meeting on a password-protected computer and removed all participant names. Participant confidentiality, privacy and anonymity were ensured by allocating participant ID codes in the transcripts. Data were only accessible to the lead author (IAD) and de-identified data were only shared with the other authors (MA, AH and GC) for their input into analysis and interpretation.

RESULTS

The consensus meeting was held on June 30, 2020 and lasted approximately 90 minutes. The demographic details of the consensus meeting participants are presented in [Table 1](#).

Of the 16 sixteen items presented to the panel, seven (44%) items were excluded, six (38%) items remained included, and three (19%) items were merged with another item. Most participants believed three items were clearly worded and four needed rewording ([Table 2](#)).

For items considered to be unclearly worded, we asked participants to suggest alternative wording in open-text form in PollEverywhere™. Minor wording suggestions were added for five items. Although two participants voted for item eight not being clearly worded, no alternative wording was added for this item, and it was later agreed that the item should remain unchanged. Of the 7 included items, two items (7c and 8b) were included without any wording changes, four (1e, 1f, 7b and 12b) underwent minor wording changes and three (5b, 13c and 14d) were merged with another item. (Supplementary file 2).

Following the meeting, items were further revised and reworded through email correspondence with meeting participants to ensure clarity of wording aligned with consensus decisions achieved during the meeting. Participants then provided feedback on all items, resulting in the development of Reporting Essentials for Delirium bioMarker Studies (REDEEMS) guideline ([Table 3](#)).

DISCUSSION

We present the first reporting guideline for delirium fluid biomarker research. Following the consensus meeting, nine items with 22 sub-items were included in the final version of the REDEEMS.

Our prior systematic⁹ highlighted a systemic problem of poor quality of reporting of fluid biomarker studies in delirium. Because systemic reporting deficits so clearly hamper progress in the understanding of delirium pathophysiology, a concerted effort is required to standardise the methodology used in delirium biomarker studies if we are to progress this fundamental field of research.

Guidelines are necessary to promote studies that are standardised and reported in a transparent manner to facilitate reliable and consistent interpretation, application and synthesis of study results. Inadequate reporting of studies is well documented. For example, one review of RCTs conducted in 2006 found that of the 616 trials, only 209 (34%) reported a method of random sequence generation (compared to 21% in 2000) and 156 trials (25%) reported a method of allocation concealment, a slight improvement from 18% in 2000.²² Only 324 trials (53%) defined their primary endpoint, and only 279 (45%) reported a sample size calculation.

Although studies have shown improvements in rigour when using reporting guidelines,^{23,24} a systematic review examining the extent to which journals encourage reporting guidelines found that only 19 (46%) of the online instructions to authors mentioned reporting guidelines.²⁵

Current guidelines that focus on different aspects of biomarker research include the REMARK, STARD and CONSORT statements, which are used when the focus is on prognostic biomarkers, diagnostic testing or when conduct-

Table 1. Participant characteristics

	N=12	(%)
Country of residence		
US	5	(42)
Australia	2	(17)
Ireland	2	(17)
Sweden	1	(8)
Norway	1	(8)
Switzerland	1	(8)
Years in delirium research		
>10 years	9	(75)
5-10 years	3	(25)
Current role		
Clinician/researcher	9	(75)
Researcher	3	(25)
Number of delirium studies conducted		
>10	7	(58)
5-10	4	(33)
<5	1	(8)
Number of biomarker studies conducted		
>10	5	(42)
5-10	3	(25)
<5	3	(25)
0	1	(8)
Conducted a delirium biomarker study		
Yes	10	(83)
No	2	(17)
Delphi participant		
Yes	8	(67)
No	4	(33)

ing randomised controlled trials. However, none of these guidelines are specific to delirium. We therefore utilised the REMARK checklist as a framework to guide the development of these preliminary recommendations for guidelines. The final items illustrate areas where specific guidance was deemed useful by international delirium experts to address methodological issues in delirium.

LIMITATIONS AND STRENGTHS

Firstly, the goal of the REDEEMS guideline is to assist authors by providing specific guidance on reporting delirium biomarker studies, not to replicate 'gold standard' items included in other existing reporting guidelines. In other fields where a need for additional reporting information has been identified, guideline teams have opted to develop an extension to the existing guidelines, adding specific requirements. Rather than create an extension to an existing guideline like the REMARK checklist, REDEEMS was created as a stand-alone guideline to be used in conjunction with another reporting guideline appropriate for study de-

sign. Creating a stand-alone guideline requires an extra layer of effort for authors and reviewers, who must apply a reporting guideline specific to the study design and then use the REDEEMS for reporting the delirium biomarker-specific component. Secondly, the REDEEMS guideline was not piloted before dissemination as proposed by Moher et al (2010).¹³ However, we addressed clarity and usability of the guidelines through extensive discussions and revisions via the consensus meeting.

Strengths included: the systematic approach to develop the REDEEMS guideline using existing recommendations for developing reporting guidelines in health research.¹³ At each stage in the process, care was taken to closely align with the Moher framework¹³ (except piloting) to minimise the potential for investigator bias. Another strength was the breadth of expertise within the international expert group in both the Delphi study and the consensus meeting. However, we acknowledge that we may not have encompassed all possible perspectives.

Table 2. Participant votes for inclusion/exclusion of items from the consensus meeting

Item number	Checklist item	Include n (%)	Exclude n (%)	Reason for exclusion	Item clearly worded (Yes) n (%)	Item clearly worded (No) n (%)
1(e)	The study objective should include: the method of biomarker collection	11 (91)	1 (9)	N/A	4 (36) ^a	7 (65) ^a
1(f)	The study objective should include: A description of which delirium pathophysiological theory the study will address	10 (86)	2 (14)	N/A	1 (9)	11 (91)
3(a)	Delirium biomarker studies should support the person with delirium and their proxy decision maker by: Providing clear procedures to assist staff in interacting and supporting the patient during biomarker collection and other data collection	3 (20)	9 (80)	Not specific to delirium biomarker studies.	N/A	N/A
3(b)	Delirium biomarker studies should support the person with delirium and their proxy decision maker by: Explaining the value of the research in lay terms and how it can contribute to the understanding of delirium	0 (0)	12 (100)	Not specific to delirium biomarker studies.	N/A	N/A
3(c)	Delirium biomarker studies should support the person with delirium and their proxy decision maker by: Clear processes for informed consent	0 (0)	12 (100)	Not specific to delirium biomarker studies.	N/A	N/A
4(a)	When selecting control(s) group: As delirium is a complex clinical condition with many influencing clinical variables, several control groups will strengthen the ability to interpret the findings	5 (40)	7 (60)	Having multiple control groups is not always appropriate and will reduce the power of the study. Recruitment in delirium studies is difficult, therefore this item should be removed.	N/A	N/A
4(b)	The following control groups would be important to consider: Participants with delirium superimposed onto dementia	4 (30)	8 (70)	Do not need a list of examples for control groups in the guideline.	3 (25) ^a	8 (75) ^a
4(c)	In studies which follow participants longitudinally, the following are appropriate additional comparator groups: Participants with delirium of a shorter duration	0 (0)	12 (100)	Do not need a list of examples for control groups in the guideline.	N/A	N/A
5(b)	The biomarker in a delirium study should be: Supported by a biologically plausible rationale	0 (0)	12 (100)	To be merged with item 1.	N/A	N/A
7(b)	Description of the assay procedure should include the following as a minimum: An assay validation for assay repeatability and robustness	12 (100)	0 (0)	N/A	12 (100)	0 (0)
7(c)	Description of the assay procedure should include the following as a minimum: The	12 (100)	0 (0)	N/A	12 (100)	0 (0)

Item number	Checklist item	Include n (%)	Exclude n (%)	Reason for exclusion	Item clearly worded (Yes) n (%)	Item clearly worded (No) n (%)
	inter- and intra- assay coefficients of variation					
8(b)	In biomarker studies, confounding variables need to take into account the population being studied/the clinical condition	12 (100)	0 (0)	N/A	9 (82) ^a	2 (18) ^a
9	The minimum clinical covariates that should be taken into account are: Age, gender, concurrent medication, comorbidities, prior cognitive impairment, illness severity, sepsis, prior neurological conditions, frailty, inflammation, delirium risk and delirium precipitants	4 (30)	8 (70)	Too many items to list as the minimum clinical covariates. These are not always feasible and every study needs to be judged on its own experimental environment.	N/A	N/A
12(b)	The analysis plan should plan for clinical and biomarker missing data due to: Practical challenges of biomarker collection in people with delirium	8 (70)	4 (30)	N/A	4 (38)	7 (63)
13(c)	Univariate analyses of biomarker and clinical endpoints of interest should report the following: How missing data were handled	0 (0)	12 (100)	To be merged with item 12	N/A	N/A
14(d)	Multivariate analyses of biomarker and clinical endpoints of interest should report the following: How missing data were handled	0 (0)	12 (100)	To be merged with item 12	N/A	N/A

^a Only 11 out of 12 participants voted for this item

^b N/A Not applicable

IMPLICATIONS FOR FUTURE RESEARCH AND PRACTICE

This study proposes the first set of reporting guidelines specific to delirium biomarker studies, which may be refined after experience of their utility in practice. The prior systematic review demonstrated several poor-quality studies that were likely affected by a lack of guidelines for delirium fluid biomarker research. Developing reporting guidelines was essential to improving methodological and reporting rigour, which will increase the potential for future studies to be synthesised through meta-analyses. The REDEEMS guideline will support improved reporting practices and consistency for delirium biomarker studies, thereby permitting more accurate replication and synthesis in the field. The REDEEMS will benefit several groups, including authors, researchers, peer-reviewers and journal editors. Authors of future delirium biomarker studies can contribute to transparent and complete reporting by using the REDEEMS guideline and recommending it to others in the field.

The recommended process for developing reporting guidelines includes the development of an accompanying Elaboration and Explanation ('E&E') paper, which the CONSORT group originally undertook to accompany their revised statement.^{6,7} We are developing this in conjunction

with a collaborative team of delirium researchers committed to improving understanding of delirium pathophysiology. The next steps for REDEEMS is dissemination to promote uptake of the guideline and evaluate the influence on improved study rigour and capacity to fully answer study hypotheses.⁶ Further, since the REDEEMS was not piloted before dissemination, we plan to engage in various stakeholders through delirium societies and delirium journals for further refinement of the guidelines. As new evidence emerges and critical feedback is obtained, the REDEEMS will be updated in the future, such as has occurred for other reporting guidelines such as the CONSORT

This paper presents the first reporting guideline for delirium fluid biomarker studies, developed through a systematic review, a Delphi survey, and the follow-up consensus meeting with international experts in delirium research reported in this paper. We envisage REDEEMS will support more consistent and complete reporting of future delirium biomarker studies and thus contribute to knowledge and knowledge synthesis of delirium pathophysiology.

.....

Table 3. The final REDEEMS guideline

Item number	REDEEMS items
1	Study rationale
a	State the biomarker under study (including nature of the specimen)
b	Describe the biological hypothesis(es) tested*
2	Ascertainment of delirium
a	Describe the training and/or credentials of personnel who ascertained delirium cases
b	Specify the delirium tool and/or diagnostic process that was used to ascertain cases
c	Describe frequency, timing and duration of delirium assessment
3	Outcome measures
a	Define and justify all clinical endpoint(s) and their measures (including relationship to delirium where relevant)
4	Assay procedure
a	Specify the assay method used with a detailed protocol that includes reagents/kits
b	Describe the methods of preservation, storage and processing of the biological sample
c	Describe the assay validation method for repeatability and robustness including the sensitivity limits of the assay
d	Specify the inter- and intra- assay coefficients of variation
e	Specify the method of blinding biomarker results
5	Timing of collection of the biological sample
a	Precisely describe the time of collection of the biological sample in relation to delirium (onset, presence, resolution)
b	Provide a rationale for the timing of the sample collection based on the clinical scenario, the hypothesis being tested, and/or the study design
6	Confounding variables
a	State the confounding variables assessed and whether or not they were specified <i>a priori</i>
b	Clearly define and provide justification for the confounding variables (including the relationship to delirium where relevant)
7	Sample size
a	Describe how sample size was determined and provide a rationale
8	Statistical analysis
a	Account for clinical and biomarker missing data in the analysis plan based on the design of the study
b	State how confounding variables were accounted for in the analysis
9	Univariate and multivariable analysis
a	Report the estimated effect size or the p values with their Confidence Intervals (CI)
b	Specify whether the biomarker was dichotomised using a cut-point and/or threshold
c	Specify the number of included participants and reasons for attrition or missing data
d	Describe how model assumptions were verified (multivariable)

* If the study is not testing a specific hypothesis, authors should state that it is undertaking an un-biased or exploratory approach

ACKNOWLEDGEMENTS

The authors would like to acknowledge all Delphi survey and consensus meeting participants for their time, effort and expertise.

FUNDING

This work was supported by a research award from the Australasian Delirium Association (2019).

Submitted: May 02, 2022 CET, Accepted: June 17, 2022 CET



This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CCBY-4.0). View this license's legal deed at <http://creativecommons.org/licenses/by/4.0> and legal code at <http://creativecommons.org/licenses/by/4.0/legalcode> for more information.

REFERENCES

1. Ryan DJ, O'Regan NA, Caoimh RÓ, et al. Delirium in an adult acute hospital population: Predictors, prevalence and detection. *BMJ Open*. 2013;3(1):e001772. doi:10.1136/bmjopen-2012-001772
2. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. 5th ed. American Psychiatric Publisher; 2013. doi:10.1176/appi.books.9780890425596
3. Bruera E, Bush SH, Willey J, et al. Impact of delirium and recall on the level of distress in patients with advanced cancer and their family caregivers. *Cancer*. 2009;115(9):2004-2012. doi:10.1002/cncr.24215
4. Salluh JIF, Wang H, Schneider EB, et al. Outcome of delirium in critically ill patients: Systematic review and meta-analysis. *BMJ*. 2015;350(may19 3):h2538. doi:10.1136/bmj.h2538
5. Pezzullo L, Streatfeild J, Hickson J, Teodorczuk A, Agar MR, Caplan GA. Economic impact of delirium in Australia: A cost of illness study. *BMJ Open*. 2019;9(9):e027514. doi:10.1136/bmjopen-2018-027514
6. Williams ST, Dhesi JK, Partridge JSL. Distress in delirium: Causes, assessment and management. *Eur Geriatr Med*. 2019;11(1):63-70. doi:10.1007/s41999-019-00276-z
7. Maldonado JR. Delirium pathophysiology: An updated hypothesis of the etiology of acute brain failure. *Int J Geriatr Psychiatry*. 2017;33(11):1428-1457. doi:10.1002/gps.4823
8. National Cancer Institute. NCI Dictionary of Cancer Terms. Accessed November 28, 2017. <https://www.cancer.gov/publications/dictionaries/cancer-terms/def/biomarker>
9. Amgarth-Duff I, Hosie A, Caplan G, Agar M. A systematic review of the overlap of fluid biomarkers in delirium and advanced cancer-related syndromes. *BMC Psychiatry*. 2020;20(1):1-32. doi:10.1186/s12888-020-02584-2
10. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: Guidelines for reporting observational studies. *Int J Surg*. 2014;12(12):1495-1499. doi:10.1016/j.ijsu.2014.07.013
11. Simera I, Altman DG, Moher D, Schulz KF, Hoey J. Guidelines for reporting health research: The EQUATOR network's survey of guideline authors. *PLoS Med*. 2008;5(6):e139. doi:10.1371/journal.pmed.0050139
12. Begg C, Cho M, Eastwood S, et al. Improving the quality of reporting of randomised controlled trials: The CONSORT statement. *JAMA*. 1996;276(8):637. doi:10.1001/jama.1996.03540080059030
13. Moher D, Schulz KF, Simera I, Altman DG. Guidance for developers of health research reporting guidelines. *PLoS Med*. 2010;7(2):e1000217. doi:10.1371/journal.pmed.1000217
14. Simera I, Moher D, Hoey J, Schulz KF, Altman DG. A catalogue of reporting guidelines for health research. *Eur J Clin Invest*. 2010;40(1):35-53. doi:10.1111/j.1365-2362.2009.02234.x
15. Gnanapavan S, Hegen H, Khalil M, et al. Guidelines for uniform reporting of body fluid biomarker studies in neurologic disorders. *Neurology*. 2014;83(13):1210-1216. doi:10.1212/wnl.00000000000000809
16. Altman DG, McShane LM, Sauerbrei W, Taube SE. Reporting recommendations for tumor marker prognostic studies (REMARK): Explanation and Elaboration. *BMC Med*. 2012;10(1). doi:10.1186/1741-7015-10-51
17. Amgarth-Duff I, Hosie A, Caplan G, Agar M. Toward Best Practice Methods for Delirium Biomarker Studies: An International Modified Delphi Study. *Int J Geriatr Psychiatry*. 2020;35(7):737-748. doi:10.1002/gps.5292
18. Keeney S, Hasson F, McKenna H. Consulting the oracle: Ten lessons from using the Delphi technique in nursing research. *J Adv Nurs*. 2006;53(2):205-212. doi:10.1111/j.1365-2648.2006.03716.x
19. Equator Network. Developing your reporting guideline. Accessed June 25, 2020. <https://www.equator-network.org/toolkits/developing-a-reporting-guideline/developing-your-reporting-guideline/>
20. Marshall MN. Sampling for qualitative research. *Fam Pract*. 1996;13(6):522-526. doi:10.1093/fampra/13.6.522
21. Patton MQ. *Qualitative Research & Evaluation Tools*. 4th ed. SAGE; 2015.

22. Hopewell S, Dutton S, Yu LM, Chan AW, Altman DG. The quality of reports of randomised trials in 2000 and 2006: Comparative study of articles indexed in PubMed. *BMJ*. 2010;340(mar23 1):c723. [doi:10.1136/bmj.c723](https://doi.org/10.1136/bmj.c723)

23. Smidt N, Rutjes AWS, van der Windt DAWM, et al. The quality of diagnostic accuracy studies since the STARD statement: Has it improved? *Neurology*. 2006;67(5):792-797. [doi:10.1212/01.wnl.0000238386.41398.30](https://doi.org/10.1212/01.wnl.0000238386.41398.30)

24. Plint AC, Moher D, Morrison A, et al. Does the CONSORT checklist improve the quality of reports of randomised controlled trials? A systematic review. *Med J Aust*. 2006;185(5):263-267. [doi:10.5694/j.1326-5377.2006.tb00557.x](https://doi.org/10.5694/j.1326-5377.2006.tb00557.x)

25. Hirst A, Altman DG. Are peer reviewers encouraged to use reporting guidelines? A survey of 116 health research journals. *PLoS ONE*. 2012;7(4):e35621. [doi:10.1371/journal.pone.0035621](https://doi.org/10.1371/journal.pone.0035621)

SUPPLEMENTARY MATERIALS

Supplementary Files

Download: <https://deliriumjournal.com/article/36531-development-of-the-reporting-essentials-for-delirium-biomarker-studies-redeems-guideline/attachment/93474.pdf>
