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A scoping review on interventions to improve adherence to reporting guidelines in health research

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A scoping review on interventions to improve adherence to reporting guidelines in health research

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Keywords

Scoping review, knowledge synthesis, reporting guidelines, completeness of reporting, quality of reporting, adherence

Abstract

Objectives: The goal of this study is to identify, analyse and classify interventions to improve adherence to reporting guidelines in order to obtain a wide picture of how the

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3 problem of enhancing the completeness of reporting of biomedical literature has been
4 tackled so far.
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7 **Design:** Scoping review.
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10 **Search strategy:** We searched the MEDLINE, EMBASE, and Cochrane Library databases
11 and conducted a grey literature search for (i) studies evaluating interventions to
12 improve adherence to reporting guidelines in health research and (ii) other types of
13 references describing interventions that have been performed or suggested but never
14 evaluated. The characteristics and effect of the evaluated interventions were analysed.
15 Moreover, we explored the rationale of the interventions identified and determined
16 the existing gaps in research on the evaluation of interventions to improve adherence
17 to reporting guidelines.
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21 **Results:** 109 references containing 31 interventions (11 evaluated) were included.
22 These were grouped into five categories: (1) training, (2) improved understanding, (3)
23 encouraging adherence, (4) monitoring adherence and providing feedback, and (5)
24 collaboration among authors and experts. Only 4 of the interventions found had been
25 evaluated by randomised trials. Research gaps identified included the evaluation of
26 interventions (i) on training and improved understanding of reporting guidelines, (ii) at
27 early stages of research, and (iii) after the process of author revision of the manuscript.
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31 **Conclusions:** This scoping review identifies a wide range of strategies to improve
32 adherence to reporting guidelines that can be taken by different stakeholders. Future
33 randomised trials should evaluate further interventions and address the research gaps
34 identified. This review is part of a larger project whose next goals are (i) to capture
35 editors' perceptions on the barriers and facilitators of some interventions identified in
36 this review, (ii) to explore new interventions, and (iii) to evaluate one of these
37 interventions in collaboration with BMJ Open.
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40 41 42 43 44 45 46 47 48 49 50 51 **Strengths and limitations**

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54 • We considered wide range of reporting guidelines as well as their extensions.
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- Merging the evidence found in the published and grey literature allows us to provide a broad picture of how the problem of enhancing adherence to reporting guidelines has been tackled so far and could be faced in the future.
- The screening and data extraction were performed in duplicate.
- We could have missed evidence of possible interventions that may not be present in the published or grey literature but are instead used in practice and continue to be used.

Background

Approximately 85% of all biomedical research today is estimated to be wasted, due, in part, to incomplete or inaccurate reporting (1). The past two decades have given rise to a number of changes in an effort to help authors and the broader scientific community properly report research methods and findings, which would allow them to contribute to the broader goal of combating waste in biomedical research. The most prominent of these changes has been the inception of reporting guidelines for different study types, data, and clinical areas (2).

The vast majority of reporting guidelines have not yet been assessed as to whether they help improve the reporting of research (3), but some, such as the Consolidated Standards of Reporting Trials (CONSORT) for the reporting of randomised controlled trials (RCTs) (4), have been shown to enhance the completeness of reporting (5,6).

Dozens of systematic reviews have explored the extent of adherence to some reporting guidelines in certain areas of health research (7–10). Saaman et al. (11) went one step further and performed a systematic review of systematic reviews assessing adherence to reporting guidelines. As they considered a broad range of clinical areas and study designs, their results provided a global picture of adherence to reporting guidelines in health research. Although some studies reported acceptable overall levels of completeness of reporting and found that it had improved since the introduction of certain reporting guidelines such as CONSORT, the authors of most of the reviews (43 of 50, 86%) concluded that more improvement is needed or that adherence to reporting guidelines was inadequate, poor, medium or suboptimal. Therefore, it is

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3 warranted to explore and develop strategies to improve the current levels of
4 adherence to reporting guidelines.
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7 In recent years, several initiatives aiming to improve adherence to reporting guidelines
8 have been proposed, some of which have already been evaluated. For example, the
9 effect of journal endorsement of reporting guidelines (3,5,6) and the implementation
10 of writing aid tools for authors such as the CONSORT-based web tool (COBWEB) (12)
11 have been assessed. While some of these strategies have not been shown to have a
12 benefit (3), others report better but still suboptimal levels of reporting (5,6) or even
13 clear benefits (12,13).
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19 As mentioned, several reviews have analysed the quality of reporting in different
20 clinical areas and for different study types (7–10). However, no scoping review has
21 been performed that provides a global picture of different strategies aiming to
22 improve adherence to reporting guidelines. Given the low levels of completeness of
23 reporting in health research that have been observed (11), along with the imperative
24 need to take further actions for mitigating this problem, we considered that
25 performing such a scoping review was warranted.
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33 In addition to analysing the implementation and effect of interventions that have
34 already been evaluated, we aimed to gather other possible strategies that could be
35 implemented and evaluated in the future.
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39 For clarification, some relevant terms used throughout the scoping are defined in Box
40 1, which is based on Stevens et al. (3).
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43 **Box 1:** relevant definitions in the context of this scoping review
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Adherence: Action(s) taken by authors to ensure that a research report is compliant with the items recommended by the appropriate/relevant reporting guideline.

Endorsement: Action(s) taken by journals to indicate their support for the use of one or more reporting guideline(s) by authors submitting research reports for consideration.

Implementation: Action(s) taken by journals to ensure that authors adhere to an endorsed reporting guideline and that therefore published papers are completely reported.

Complete reporting: Pertains to the state of reporting of a study report and whether it is compliant with all the items recommended by the appropriate/relevant reporting guideline.

Methods

As presented in the published protocol (14), this scoping review follows the methodology manual published by the Joanna Briggs Institute for scoping reviews (15).

Objectives

The scoping review questions are:

1. What interventions to improve adherence to reporting guidelines in health research have been evaluated?
2. What further interventions to improve adherence to reporting guidelines have been performed or suggested but never evaluated?

We aim to analyse and classify the interventions found for both questions in order to obtain a wide picture of how the problem of adhering better to reporting guidelines has been tackled so far and can be tackled in the future.

Eligibility criteria

We included:

1. Studies evaluating interventions aiming to improve adherence to reporting guidelines in health research, irrespective of study design.

2. Commentaries, editorials, letters, studies, and online sources describing possible interventions to improve adherence to reporting guidelines that have been performed or suggested but never evaluated.

The reporting guidelines considered were those shown on 8 May 2017 on the EQUATOR (Enhancing the QUALity and Transparency Of Health Research) Network website (16) as “Reporting Guidelines for main study types” (see Supplementary file 1). In addition, we also included QUOROM (Quality of Reporting of Meta-analyses), since it was the precursor of PRISMA.

We considered the following languages: English, Spanish, French, German and Catalan.

Exclusion criteria

We have excluded references that include interventions that do not specifically aim to improve the completeness of reporting, even though these interventions may actually influence completeness. For example, we have excluded clinical trial registration even though it may enhance completeness of reporting, because its main goals are to improve clinical trial transparency while also reducing publication and selective reporting biases.

Search strategy and study selection

On 8 May 2017, we searched PubMed, EMBASE, and Cochrane Library databases for articles published between 1 January 1996 and 31 March 2017, in accordance with our scheduled search (14). The detailed search terms for PubMed can be found in Supplementary file 2.

The retrieved studies were exported into Mendeley and duplicates were removed. One reviewer (DB) first screened the titles and abstracts for eligibility. Each of the other two reviewers (JJK and EC) was randomly assigned 50% of the references and screened the titles and abstracts independently of the first reviewer. The reviewers classified the references into one of the following groups:

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3 A) Evaluated: Includes references describing interventions to improve adherence
4 to reporting guidelines that have been empirically assessed.
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6 B) Non-evaluated: Includes references describing interventions to improve
7 adherence to reporting guidelines that have been performed or suggested but
8 never evaluated.
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11 C) Unclear: Includes references (i) containing vague statements such as “Authors,
12 editors, and journals have to adhere better to reporting guidelines to improve
13 the quality of reporting” or “greater efforts have to be made by authors to
14 check that their research is compliant with [the relevant reporting guideline]”,
15 or (ii) not having the abstract available.
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18 D) Excluded: Includes references (i) not describing interventions to improve
19 adherence to any of the reporting guidelines considered and (ii) describing but
20 not evaluating certain interventions that have already been classified as
21 evaluated.
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28 Disagreements were solved by discussion among the reviewers.
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30 Second, one reviewer (DB) examined the full-text of all group A and B references to
31 confirm the previous classification, then all group C references to reclassify them
32 either as group A, B, or D. Re-classification was verified by the initial reviewer (JJK or
33 EC). Finally, one reviewer (DB) ensured literature saturation by searching the reference
34 lists of included studies, the lists of articles citing them according to PubMed, and the
35 individual studies included in two relevant systematic reviews (3,6).
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41 In addition, we performed a grey literature search, which included: the websites of
42 networks and organizations promoting the use of reporting guidelines (i.e., EQUATOR
43 Network and National Library of Medicine Research Reporting Guidelines and
44 Initiatives); work groups of medical journal editors (i.e., International Committee of
45 Medical Journal Editors (ICMJE) and World Association of Medical Editors (WAME));
46 biomedical journal publishers (i.e., BMJ Publishing Group and BioMed Central); funding
47 agencies (i.e., National Institute of Health (NIH) and European Research Council);
48 online platforms of post-publication peer review (i.e., PubPeer and ScienceOpen); and
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3 the abstract books of the past editions of the International Congress on Peer Review
4 and Biomedical Publication.
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6 7 **Data extraction**

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10 A data extraction form was developed to collect the information necessary for data
11 synthesis. In order to better capture some further relevant aspects of the included
12 references, the original data extraction form proposed in the protocol was updated.
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14 Two reviewers (DB, JJK) independently performed a pilot data extraction on a random
15 sample of 5 articles and subsequently refined the form.
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19 Extracted data included:
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22 1. Publication characteristics: title, year of publication, author, author's affiliation
23 country, and field of study.
- 24
25 2. Characteristics of the intervention:
 - 26
27 a. Classification as evaluated or non-evaluated.
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29 b. Research stage: education, grant writing, protocol writing, manuscript
30 writing, submission, journal peer review, author revision, copy-editing,
31 and post-publication.
 - 32
33 c. Rationale of the intervention, which refers to the deduced reasons why
34 the intervention is evaluated or proposed.
 - 35
36 d. For evaluated interventions: details of the intervention, study design
37 (e.g. RCT, before-after, etc.), reporting guidelines considered and format
38 (checklist, bullet points and/or examples), period of intervention,
39 number of journals and articles involved, effect size of the intervention
40 on adherence to reporting guidelines and measure used to assess this
41 effect.
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45 3. Relevant conclusions.
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51 Two reviewers (DB, JJK) independently performed data extraction for all studies except
52 for the individual studies of the two systematic reviews evaluating journal
53 endorsement of reporting guidelines (3,6), since none of these studies described
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3 further interventions and their results had already been reported in these reviews.
4 Discrepancies between reviewers were discussed and solved by consensus.
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7 **Data synthesis**

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10 Following data extraction, interventions to improve adherence to reporting guidelines
11 were categorised as follows:
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- 14 1. Training: mentoring of different stakeholders on the practical use of reporting
15 guidelines.
 - 16 2. Improved understanding: in-depth focus on the content and requirements of
17 reporting guidelines.
 - 18 3. Encouraging adherence: suggestions and tools to facilitate compliance.
 - 19 4. Monitoring adherence and providing feedback: checking the level of
20 compliance and indicating incorrect or missing items.
 - 21 5. Collaboration among authors and experts: interaction and cooperation on
22 methodology and reporting.
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30 One reviewer (DB) performed the initial categorization, which was verified and refined
31 by the other two reviewers (JJK and EC).
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35 Furthermore, we determined the existing gaps in research on the evaluation of
36 interventions to improve adherence to reporting guidelines. More specifically, we
37 identified which categories of interventions and which research stages have not been
38 addressed so far in studies evaluating interventions.
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43 **Patients and public involvement**

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45 No patients or public were involved in the study.
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48 **Results**

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51 The database search yielded 1399 citations after deduplication (see Figure 1).
52 Screening of titles and abstracts resulted in a first classification, after which 435 papers
53 were included for full text review. We also reviewed the full text of 24 additional
54 references found through forward citation searching. Furthermore, a grey literature
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3 search yielded 7 additional references. Finally, 109 references were included. 90 of
4 them (86 observational and 4 randomised studies) described 11 evaluated
5 interventions and the other 19 (12 research studies, 2 editorials, 2 blogs, 1
6 commentary, 1 essay, and 1 perspective) described 20 non-evaluated interventions.
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10 Among all included references, we identified 31 interventions to improve adherence to
11 reporting guidelines. Some of these interventions appeared in more than one
12 reference and some of the references contained more than one intervention. From
13 those 31 interventions, 4 were categorised as “Training” (1,17-21), 2 as “Improved
14 understanding” (22,23), 15 as “Encouraging adherence” (11,12,20,24,25,27,29-114), 8
15 as “Monitoring adherence and providing feedback” (13,115-117,119,121,122,125), and
16 2 as “Collaboration among authors and experts” (25,84,126-128). Figure 2 displays all
17 those interventions according to their categorization and the research stage where
18 they can be performed. Evaluated interventions are highlighted in bold.
19 Supplementary file 3 provides further details of the implementation of the evaluated
20 interventions.
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24 Research gaps identified (see Figure 3) included the evaluation of interventions (i) on
25 training and improved understanding of reporting guidelines, and (ii) at early stages of
26 research (education, grant writing or protocol writing), and (iii) after the process of
27 author revision of the manuscript (copyediting or post-publication peer review).
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31 Hereafter, we present a brief description of the interventions found for each category.
32 For the sake of clarity, the rationale of those interventions is shown in Table 1.
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35 36 37 38 39 40 41 42 43 **Training**

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45 In a first step, health profession schools could incorporate reporting guidelines into
46 curricula that address research methodology and publication standards (17–21). In line
47 with this, students could develop protocols for coursework and research using
48 reporting guidelines such as SPIRIT (randomised trials) and PRISMA-P (systematic
49 reviews), and educators may encourage adherence to those guidelines and grade the
50 protocols using them (20). For their part, funders may consider supporting author
51 training on reporting guidelines (1). Finally, journals or publishers may consider
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3 investing resources in training editors and reviewers on the content and use of
4 reporting guidelines (1,21).

6 7 ***Improved understanding***

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10 Reporting guideline developers might consider translating them to new languages that
11 have not been addressed yet (22). Also, further databases of examples of good
12 reporting for different reporting guidelines that are accessible to authors can be
13 developed, as has been done for CONSORT (23).

14 15 16 17 ***Encouraging adherence***

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20 First, international scientific associations may play an important role in disseminating
21 and popularizing reporting guidelines to large audiences (24). For their part, funders
22 might require authors to use reporting guidelines as a template for grant application
23 proposals (20). Later on, research ethics boards may require that protocols submitted
24 for ethical approval clearly state which reporting guidelines the study will be using
25 based on the study design, and that reporting guideline checklists are part of the
26 application for ethics approval (11). Funders could also encourage adherence to
27 reporting guidelines by asking for reporting guideline checklists as part of the authors'
28 report (20,25).

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One initiative to support author to adhere to reporting guidelines at the writing stage
of the manuscript has been COBWEB, a writing aid tool that aims to help authors
adequately combine the different extensions of the CONSORT statement (12). This tool
divided the CONSORT items into bullet points showing the key elements that need to
be reported together with examples of adequate reporting. The impact of COBWEB
was evaluated through a randomised trial that showed a large effect of this tool, with a
mean improvement in CONSORT scores of 2.1 on a 0–10 scale for the intervention
group as compared to the control group (12). A second option to support authors at
manuscript writing might be to follow a more structured approach including new
subheadings, boxes and tables with key information for different kinds of study
designs. For example, ClinicalTrials.gov requires a structured approach to register a
study or to report its results (26). This has been shown to be effective: some results

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3 posted on clinicaltrials.gov, especially harms, are more complete than those in
4 corresponding journal articles reporting the same trials (27). In line with this, the
5 American Journal of Orthodontics and Dentofacial Orthopedics (AJO-DO) updated the
6 traditional RCT format and made readily available a sample article including comments
7 and instructions (28). Finally, another option to help authors avoid omissions when
8 writing the manuscript could be that they mark up the text and show where each item
9 of the relevant checklist is addressed (29).
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16 At manuscript submission stage, different editorial actions have been taken to improve
17 adherence to reporting guidelines. The most popular is what has traditionally been
18 defined as journal endorsement of reporting guidelines, which is usually defined as
19 one or more of the three following interventions: (a) journal editorial statement
20 endorsing certain reporting guidelines; (b) requirement or recommendation in
21 journal's 'Instructions to Authors' to follow certain reporting guidelines when
22 preparing their manuscript; or (c) requirement for authors to submit the appropriate
23 reporting guideline checklist together with their manuscript indicating page numbers
24 corresponding to each item (6). Dozens of observational studies have explored the
25 possible effect of journal endorsement of different reporting guidelines in different
26 clinical areas (30–109). A recent systematic review focused on CONSORT evaluations
27 showed relative but suboptimal improvements in the completeness of reporting in
28 journals by following the aforementioned policies (6), while another systematic review
29 considering 9 other guidelines showed no improvements (3).
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41 Journals might also consider other strategies to enhance adherence to reporting
42 guidelines at submission. A first option could be to develop shorter, core versions of
43 reporting guidelines containing key items (110). Second, they might introduce
44 publication officers in order to provide guidance to authors on preparing manuscripts
45 for submission (111). Third, they may ask authors to populate the relevant checklist
46 with text from their report and not accept a submission unless this is provided (112).
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52 Finally, editors may suggest that peer reviewers use reporting guidelines (113). In
53 addition, by asking peer reviewers questions about whether the author has followed
54 reporting guidelines, this might be an indirect way to encourage them (114).
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Monitoring adherence and providing feedback

Having recognised that journal endorsement without implementation does not guarantee adherence to reporting guidelines, some journals have opted for implementing reporting guidelines at peer review. First, an associate editor may assess manuscripts for adherence to the relevant reporting guideline and ask authors to make changes accordingly (115). This process may be repeated until the associate editor thinks that the manuscript can move to the next step of the review process, leading to an editorial decision. This intervention was evaluated at the AJO-DO and showed satisfactory results: 33 of 37 items reached perfect compliance (115). Second, peer reviewers could also assess the manuscripts against the appropriate checklist (116). While the observed effect of this intervention was slightly positive, it was smaller than hypothesized. In fact, investigators pointed out that authors tended to comply better with suggestions coming from standard reviews rather than from reviews against reporting guidelines, implying that it might be difficult to adhere to high methodological standards at late stages of research if these standards are not considered earlier in the research process. Third, journals could also ask trained editorial assistants to check manuscripts against reporting guidelines (117) or to implement automatic peer review tools such as Statreviewer (118), software that automatically checks adherence to reporting guidelines and evaluates the appropriate use and reporting of statistical tests (119). Currently, its performance is being assessed through a pilot trial in collaboration with four BioMed Central Journals (119). In any of those cases, emails could be sent to authors asking them to revise the manuscript according to guidelines (13). To do this, the EQUATOR Network has provided standard letters that can be used a) after checks by an editor or a single peer reviewer, b) after full peer review, or c) alongside acceptance (120). Furthermore, at the time of author revision of the manuscript, Hopewell et al. found no significant effect when incorporating WebCONSORT, a web-based tool that generates a unique list of items customised to the trial design, to the revision process of journals that endorsed CONSORT but had no active policy for implementing it (121). Finally, in a late stage of the publication process, copyediting of the manuscript could also ensure that all items are covered (122).

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3 Once the paper is published, the scientific community could use online platforms of
4 post-publication peer review such as PubPeer (123) or ScienceOpen (124) to evaluate
5 the adherence to reporting guidelines of published articles and to provide feedback to
6 authors (125).
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10 ***Collaboration among authors and experts***

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13 Authors may benefit from collaboration with experts at different stages of research.
14 On the one hand, the involvement of statisticians (or epidemiologists or other
15 quantitative methodologists) in the design, conduct or reporting of the study might
16 contribute to properly reporting key areas such as sample size calculation,
17 randomization, blinding, and appropriate statistical analysis (126). While one study did
18 not find a statistically significant positive relationship between CONSORT scores and
19 statistician involvement (127), others did (84,126,128). On the other hand, it has been
20 hypothesized that the involvement of medical writers during the manuscript writing
21 stage of research could improve the completeness of reporting (25).
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30 **Discussion**

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33 In this scoping review, we identified 31 interventions to improve adherence to
34 reporting guidelines. We have also determined the gaps in research on the evaluation
35 of this type of interventions. By considering a wide range of reporting guidelines as
36 well as their extensions and merging the evidence found in the published and grey
37 literature, this review provides a broad picture of how the problem of enhancing
38 adherence to reporting guidelines has been tackled so far and could be faced in the
39 future.
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46 This study reveals that it is primarily journals that have made most of the efforts to
47 improve adherence to reporting guidelines in health research – although they can
48 certainly do more. Typically, their strategies range from making available editorial
49 statements that endorse certain reporting guidelines, recommending or requiring
50 authors to follow reporting guidelines in the “Instructions to authors”, and requiring
51 authors to submit a reporting guideline checklist together with the manuscript, with
52 page numbers indicated for each item. However, these strategies have been shown
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3 not to have the desired effect (3,6,129). Recent research has called for more active and
4 enforced journal policies throughout the editorial process, such as requiring the use of
5 structured approaches with new subheads adapted to different kinds of study designs
6 (27), which was also found to be beneficial in a new study outside of our search period
7 (130); providing guidance on manuscript preparation (111); making sure the peer
8 review process involves editorial assistants who have specific training on reporting
9 issues (117); and implementing automatic peer review tools (119). Journals will vary in
10 their ability to make some of these strategies effective, depending on factors such as
11 their resources, their guidelines to peer reviewers and the dedication of their editors –
12 many editors and editorial staff work part-time and have limited amount of time.
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21 Moreover, editors' education and performance should be improved. A recent study
22 pointed out that more than a third (39%) of the manuscripts classified as randomised
23 trials by the editorial staff were not actually randomised trials (121,131).
24 Consequently, it seems difficult to improve author and peer reviewer adherence to
25 reporting guidelines if journal gatekeepers are not properly trained in methodological
26 and reporting issues.
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32 Apart from journals, editors and peer reviewers, other key stakeholders such as
33 medical schools, research funders, universities and other research institutions should
34 also take responsibility regarding this issue. This scoping review provides some
35 strategies to follow. However, as the problem is complex and the possible
36 interventions are varied, enhancing the completeness of reporting most likely depends
37 not so much on any isolated action but on a set of strategies by several different
38 stakeholders. These could be enacted at different stages of research, from education
39 to article post-publication.
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47 For interventions aiming to improve adherence to reporting guidelines, we should
48 require the same level of evidence that we require for interventions to improve health.
49 For this reason, it is striking that we found only 4 published randomised trials that
50 evaluated interventions to improve adherence to reporting guidelines
51 (12,113,116,121). Among these trials, statistically significant effect of the intervention
52 was only observed for the use of the writing aid tool for authors COBWEB (12). While
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3 performing an additional review against reporting guidelines showed slightly positive
4 but not significant effect (116), suggesting the use of reporting guidelines to peer
5 reviewers (113) or implementing at the process of author revision of the manuscript
6 the web-based tool WebCONSORT showed no benefit (121). The rest of the
7 evaluations of interventions found (86 of 90) were observational studies, whose results
8 are subject to the influence of confounding factors (6). For example, evaluations of the
9 effect of journal endorsement may be influenced by whether different journals are
10 actively checking that authors adhere to the requirements or recommendations they
11 provide to authors at submission (6). For all these reasons, future randomised trials
12 should be performed to evaluate further interventions to improve adherence to
13 reporting guidelines. Moreover, these trials might consider addressing some of the
14 research gaps identified in this review, such as improving adherence to reporting
15 guidelines at the grant application or protocol writing stages.
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26 A few of the interventions found in this review were shown to enhance adherence to
27 reporting guidelines. However, it is noteworthy there is no evidence that some
28 successful interventions (12,27,115) have been implemented more widely later. For
29 this reason, more resources and efforts are needed to further implement these
30 interventions in other settings, evaluate the effect, and share the results with the
31 scientific community. In any case, it is important to keep in mind that contemporary
32 publication culture may harm the potential improvements in reporting quality. This
33 could result from the fact that most scientists feel that the primary evaluation tool of
34 their research is the quantity of their scientific output rather than its quality (132); and
35 such attitudes may undermine the potential effect of any intervention to improve
36 adherence to reporting guidelines.
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46 Our scoping review has some limitations. First, we did not formally assess the
47 methodological quality of the studies that evaluated interventions. Second, restricting
48 to certain databases or not having standard search terms for the databases searched
49 may have excluded relevant publications. Third, it is possible that we could have
50 missed evidence of possible interventions that may have never been reflected in the
51 published or grey literature but are instead used in practice and continue to be used.
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3 For example, journals might be applying specific editorial strategies that are not
4 publicly available on their websites or in the published literature.
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7 **Conclusion**

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10 This review is part of a larger project whose next goals are (i) to capture editors'
11 perceptions on the barriers and facilitators of some promising interventions identified
12 in this review, (ii) to explore new possible interventions, and (iii) to evaluate one of
13 these interventions in collaboration with BMJ Open.
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18 Improving adherence to reporting guidelines is one of the key issues in order to
19 enhance complete and accurate reporting and therefore reduce waste in research. For
20 example, a decrease in waste of research from 85% to 70% would double the output of
21 valuable research and innovation.
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26 Different stakeholders – such as research funders, ethics boards, and journals – should
27 identify, implement and evaluate further interventions to improve adherence to
28 reporting guidelines.
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31 **List of abbreviations**

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34 AJO-DO: American Journal of Orthodontics and Dentofacial Orthopedics; CONSORT:
35 CONSolidated Standards Of Reporting Trials; COBWEB: CONSORT-based web tool;
36 EQUATOR: Enhancing the QUALity and Transparency Of Health Research; RCT:
37 Randomised Controlled Trial; RG: Reporting Guideline; SPIRIT: Standard Protocol Items:
38 Recommendations for Interventional Trials; PRISMA: Preferred Reporting Items for
39 Systematic Reviews and Meta-Analyses
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46 **Declarations**

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4 respectively. IB is deputy director of French EQUATOR Centre.
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6

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8 EC, and JJK independently performed screening. DB and JJK independently performed data
9 extraction. DB performed initial data synthesis and EC, IB, DM, DGA, and JJK refined it. DB
10 drafted the manuscript. EC, IB, DM, DGA, and JJK made major revisions. All authors read and
11 approved the final version of the manuscript.
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17
18

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29 **Figures, tables and supplementary files**

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32 **Figure 1:** PRISMA flow diagram
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34 **Figure 2:** Typology of interventions to improve adherence to RGs according to type of
35 intervention and research stage. **Legend:** Evaluated interventions are shown in bold.
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38 **Figure 3:** Gaps in research on the evaluation of interventions to improve adherence to
39 reporting guidelines. **Legend:** Each circle represents one intervention. Variables displayed: 1)
40 Circle size: Number of studies evaluating each intervention (bigger = more studies); 2) Circle
41 colour: Study design of those studies (blue for RCTs and green for observational studies) and 3)
42 Circle fill: Kind of RG implementation (plain for checklist and stripes for bullet points and
43 examples). Research gaps are highlighted in red.
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49 **Table 1:** Rationale of the interventions identified.
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51 **Supplementary file 1:** Description of the acronyms and full names of the reporting guidelines
52 shown in the EQUATOR website as “Reporting Guidelines for main study types” on 8 May
53 2017.
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3 **Supplementary file 2:** Search terms for PubMed (from January 1, 1996, to March 31, 2017) via
4 PubMed.
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7 **Supplementary file 3:** implementation details of the evaluated interventions.
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| Group | Intervention | Rationale |
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| Training | Introduction of RGs & journalology into graduate curricula (17-21) | To introduce good research reporting habits early in young researchers' scientific careers. |
| | Student's development of protocols for coursework and research using RGs (20) | |
| | Funder's support of author training on RGs (1) | Authors, editors, and peer reviewers have insufficient training in issues related to reporting. |
| | Training for peer reviewers and editors on RGs by journals (1,21) | |
| Improved understanding | Translation of RGs to further languages (22) | Language barriers may affect the proper use of RGs. |
| | Development of expanded database of examples for each RG (23) | Authors need more examples of good reporting to properly understand certain items. |
| Encouraging adherence | Dissemination of RGs by scientific associations (24) | A large number of researchers are not aware of the existence of RGs. |
| | Author use of RGs as a template for grant application proposals (20) | Using RGs in early stages may facilitate completeness of reporting of published research. |
| | Required checklist for ethics approval application (11) | |
| | Funder's requirement of checklists in author's report (20,25) | |

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| <p>Author use of the writing aid tool COBWEB (12)</p> | <p>A) Authors need help to successfully adhere to RGs at the writing stage and B) Dividing RG items into bullet points and providing examples might help.</p> |
| <p>Author use of a structured approach for reporting research (27)</p> | <p>A) To help authors avoid omissions, B) to aid reviewers and editors in appraising articles and C) to allow more efficient data extraction during the systematic review process.</p> |
| <p>Author markup of the manuscript to indicate where each RG item is addressed (29)</p> | |
| <p>Editorial statement endorsing certain RGs (30-109)</p> | <p>Authors read editorial statements and follow "Instructions to authors".</p> |
| <p>Recommendation or requirement to follow RGs in the "Instructions to authors" (30-109)</p> | |
| <p>Requirement to submit a RG checklist together with the manuscript indicating page numbers corresponding to each item (30-109)</p> | <p>Authors may not consider editorial statements or recommendations in "Instructions to authors" to be important. Compulsory submission of checklists or text mark-up may encourage authors to be more compliant with RGs.</p> |
| <p>Requirement to populate and submit a RG checklist with text from the manuscript (112)</p> | |

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| | Journal development of core versions of RGs containing key items (110) | Focusing on the most important items could be more effective than considering the whole checklist. |
| | Guidance to authors on manuscript preparation by publication officers (111) | Trained journal officers may enhance authors' compliance with RGs during manuscript preparation. |
| | Suggestion for peer reviewers to use RGs (113) | Peer reviewers often do not detect reporting flaws. Therefore, they may need to follow a more systematic approach and use RGs. |
| | Editor's questions to peer reviewers about whether the authors have followed RGs (114) | |
| Monitoring adherence and providing feedback | Completeness of reporting check by editors (115) | Requiring checklists at submission does not guarantee adherence. Editors and peer reviewers have to check whether submitted papers are compliant with RGs. |
| | Peer review against RGs (116) | |
| | Internal peer review against RGs by a trained editorial assistant (117) | It is extremely unlikely that the average clinical peer reviewer has the methodological expertise to check a paper against RGs. |
| | Implementation of the automatic tool Statreviewer (119) | |
| | Email to authors to revise the manuscript according to RGs (13) | |

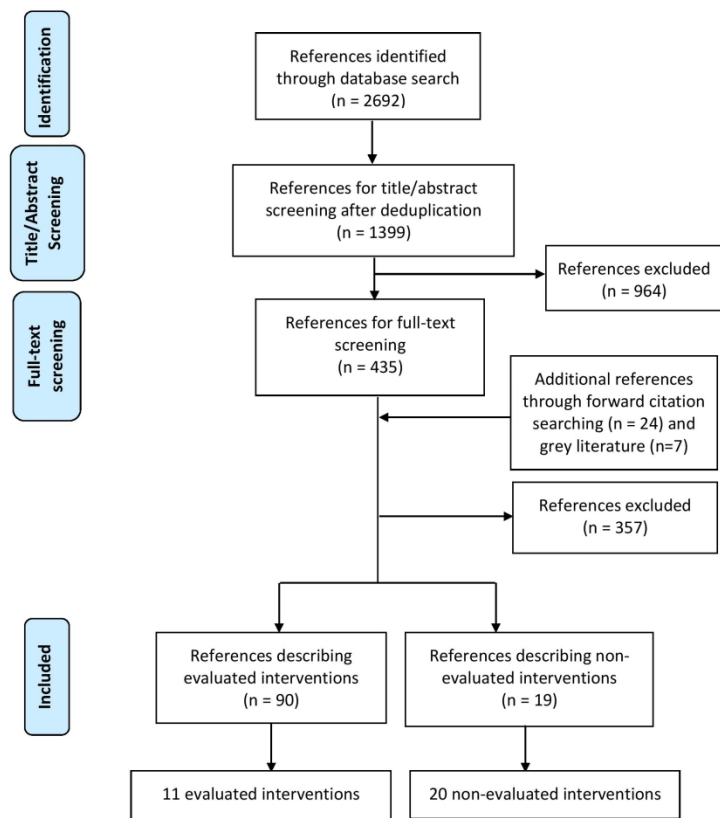
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| | Implementation of the tool WebCONSORT (121) | because they will do anything to get their paper published. |
| | Completeness of reporting check at copy-editing (122) | Copy-editing and post-publication offer alternate time points to improve adherence to RGs. |
| | Post- publication peer review (125) | |
| Collaboration among authors and experts | Statistician involvement (84,126-128) | Professionals with specific knowledge of RGs might help authors when designing, conducting or reporting their research. |
| | Medical writer involvement (25) | |

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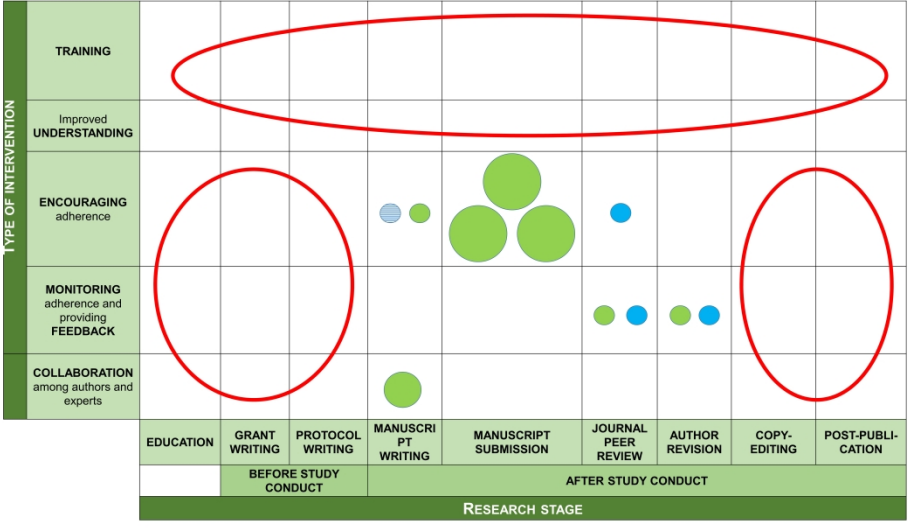
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| TYPE OF INTERVENTION | TRAINING | Introduction of RGs & journalology into graduate curricula (17-21) Student's development of research protocols using RGs (20) | | Funder's support of author training on RGs (1) | | | Training for peer reviewers and editors on RGs by journals (1,21) | | | | |
| | Improved UNDERSTANDING | Translation of RGs to further languages (22) Development of expanded databases of examples for each RG (23) | | | | | | | | | |
| | ENCOURAGING adherence | Dissemination of RGs by scientific associations (24) | Author use of RGs as a template for grant applications' proposals (20) | Required checklist for ethics approval application (11) | Author use of the writing aid tool COBWEB (12) Author use of a structured approach for reporting research (27) Author markup of the manuscript to indicate where each RG item is addressed (29) Funder's requirement of checklists in author's report (20,25) | Journal development of core versions of RGs containing key items (110) Guidance to authors on manuscript preparation by publication officers (111) Requirement to populate and submit a RG checklist with text from the manuscript (112) | Editorial statement endorsing certain RGs (30-109) Recommendation or requirement to follow RGs in the "Instructions to authors" (30-109) Requirement to submit a RG checklist together with the manuscript indicating page numbers corresponding to each item (30-109) | Suggestion for peer reviewers to use RGs (113) Editor's questions to peer reviewers about whether the authors have followed RGs (114) | | | |
| | MONITORING adherence and providing FEEDBACK | | | | | | Completeness of reporting check by editors (115) Peer review against RGs (116) Internal peer review against RGs by a trained editorial assistant (117) Implementation of the automatic tool StatReviewer (119) | Email to authors to revise the manuscript according to RGs (13) Implementation of the web tool WebCONSORT (121) | Completeness of reporting check at copy-editing (122) | Post-publication peer review (125) | |
| | COLLABORATION among authors and experts | | | Medical writer involvement (25) Statistician involvement (84,126-128) | | | | | | | |
| | | EDUCATION | GRANT WRITING | PROTOCOL WRITING | MANUSCRIPT WRITING | MANUSCRIPT SUBMISSION | JOURNAL PEER REVIEW | AUTHOR REVISION | COPY-EDITING | POST-PUBLICATION | |
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| Acronym | Full name |
|----------|---|
| CONSORT | Consolidated Standards of Reporting Trials |
| STROBE | Strengthening the Reporting of Observational Studies in Epidemiology |
| PRISMA | Preferred Reporting Items for Systematic Reviews and Meta-Analyses |
| SRQR | Standards for Reporting Qualitative Research |
| COREQ | Consolidated criteria for Reporting Qualitative research |
| STARD | Standard Protocol Items: Recommendations for Interventional Trials |
| TRIPOD | Transparent Reporting of a multivariable prediction model for Individual Prognosis or Diagnosis |
| SQUIRE | Standards for Quality Improvement Reporting Excellence |
| CHEERS | Consolidated Health Economic Evaluation Reporting Standards |
| SPIRIT | Standard Protocol Items: Recommendations for Interventional Trials |
| PRISMA-P | Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols |
| CARE | Case Report |
| AGREE | Appraisal of Guidelines, Research and Evaluation |
| ARRIVE | Animal Research: Reporting In Vivo Experiments |
| RIGHT | Reporting Tool for Practice Guidelines in Health Care |

| Steps | Search terms |
|-------|--|
| S1 | impact* [tw] |
| S2 | improv* [tw] |
| S3 | enhanc* [tw] |
| S4 | boost* [tw] |
| S5 | inreas* [tw] |
| S6 | influen* [tw] |
| S7 | effect [tw] |
| S8 | S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 |
| S9 | compliance [tw] |
| S10 | adherence [tw] |
| S11 | completeness [tw] |
| S12 | quality of reporting [tw] |
| S13 | reporting quality [tw] |
| S14 | S9 OR S10 OR S11 OR S12 OR S 13 |
| S15 | Consolidated [tw] Standards [tw] Reporting [tw] Trials [tw] OR CONSORT[tw] |
| S16 | Strengthening [tw] Reporting [tw] Observational [tw] Studies [tw] Epidemiology[tw] OR STROBE[tw] |
| S17 | Preferred [tw] Reporting [tw] Items [tw] Systematic [tw] reviews [tw] Meta-Analyses [tw] OR PRISMA[tw] |
| S18 | Standards [tw] Reporting [tw] Qualitative Research[tw] OR SRQR[tw] |
| S19 | Consolidated [tw] Criteria [tw] Reporting [tw] Qualitative [tw] Research[tw] OR COREQ[tw] |
| S20 | Standard [tw] Protocol [tw] Items [tw] Recommendations [tw] Interventional [tw] Trials[tw] OR STARD[tw] |
| S21 | Transparent [tw] Reporting [tw] multivariable [tw] prediction [tw] model [tw] Individual [tw] Prognosis [tw] Diagnosis[tw] OR TRIPOD[tw] |
| S22 | Standards [tw] QUality [tw] Improvement [tw] Reporting [tw] Excellence[tw] OR SQUIRE[tw] |
| S23 | Consolidated [tw] Health [tw] Economic [tw] Evaluation [tw] Reporting [tw] Standards[tw] OR CHEERS[tw] |
| S24 | Standard [tw] Protocol [tw] Items [tw] Recommendations [tw] Interventional [tw] Trials[tw] OR SPIRIT[tw] |
| S25 | Preferred [tw] Reporting [tw] Items [tw] Systematic [tw] Review [tw] Meta-Analysis [tw] Protocols[tw] OR PRISMA-P[tw] |
| S26 | Quality [tw] Reporting [tw] Meta-analyses[tw] OR QUOROM[tw] |
| S27 | Case [tw] Report [tw] AND CARE[tw] |
| S28 | Appraisal [tw] Guidelines [tw] Research [tw] Evaluation[tw] AND AGREE[tw] |
| S29 | Animal [tw] Research [tw] Reporting [tw] Vivo [tw] Experiments[tw] AND ARRIVE[tw] |
| S30 | Reporting [tw] Tool [tw] Practice [tw] Guidelines [tw] Health [tw] Care[tw] AND RIGHT[tw] |
| S31 | S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 |
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| Type of intervention | Intervention | Number of studies and study design | Details of the intervention | RGs implemented | Format of RG implementation | Measure of adherence to RGs | Effect on adherence to RGs |
|----------------------|---|--|---|---|--------------------------------------|--|---|
| Encouraged adherence | Implementation of the writing aid tool COBWEB (12) | 1 RCT | Participants have to write the six domains of the methods section of the manuscript for the protocol they receive. They have access to COBWEB tool for a random three of the six domains. | CONSORT & CONSORT extension for non-pharmacological interventions | Bullet points and examples (6 items) | Mean global score for completeness of reporting (scale 0–10, items weighted). | Significant: increase of 2.1 (95% CI 1.5-2.7) |
| | Author use of a structured approach for reporting research (27) | 1 Observational study (cross-sectional evaluation) | Results are posted in a standard tabular format without discussions or conclusions. | CONSORT | Checklist (4 items) | Percentage compliance of each RG item | Significant: all 4 items studied improved significantly |
| | Journal endorsement (3 interventions, see "Details of the intervention") (30-109) | 80 observational studies (57 cross sectional evaluations of endorsing vs non-endorsing journals, 9 before and after evaluations of endorsing journals before and after endorsement, 14 both kind of evaluations) | A) Editorial statement endorsing certain RGs, B) Recommendation or requirement to follow RGs in the "Instructions to authors", and C) Requirement to submit a RG checklist together with the manuscript indicating page numbers corresponding to each item. | CONSORT (46 of 80) CONSORT extensions (9 of 80) QUOROM (3 of 80) PRISMA (4 of 80) PRISMA extensions (1 of 80) STARD (11 of 80) | Checklist (all items) | Relative proportions of studies adequately reporting any of the item & percentage compliance of each RG item | Significant for CONSORT: 25 items improved, five significantly Not significant for other RGs** |

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|---|--|---|--|---|-----------------------|---|---|
| | | | | STROBE (4 of 80) ARRIVE (1 of 80) CONSORT, STROBE and PRISMA (11 of 80) | | | |
| | Suggestion for peer reviewers to use RGs (113) | 1 RCT | Peer reviewers are sent a standard letter encouraging them to use different reporting guidelines. Reviewers are not asked to report whether they used the reporting guideline in reviewing the manuscript. | CONSORT, QUOROM, STARD | Checklist (all items) | Modified version of Manuscript Quality Assessment Instrument (scale 36-180) | Not significant: increase of 0.9 (95% CI -0.3 to +2.1) |
| Monitoring adherence and providing feedback | Completeness of reporting check by the editors (115) | 1 Observational Study (Before and after evaluation) | Initial submissions are vetted by the editor-in-chief. If the submission is considered appropriate, manuscripts are assessed by the associate editor for CONSORT adherence. Authors are asked to make changes accordingly until associate editor deems appropriate that they move to the next step of the review process leading to an editorial decision. | CONSORT | Checklist (all items) | Percentage compliance of each RG item | Significant: Before – compliance ranged from 0% to 100% (Median 40%) / After – perfect compliance in 33 out of 37 items |

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|--|--|---|-----------------------------------|----------------------------|---|---|
| Additional review against RGs (116) | 1 RCT | A senior statistician does an additional review of all papers and provides authors suggestions on how to follow reporting guideline checklists. | STROBE, CONSORT, STARD | Checklist (all items) | Modified version of Manuscript Quality Assessment Instrument (scale 1 to 9) | Not significant: increase of 0.25 (95% CI -0.05 to +0.54) |
| Active implementation of RG by editors (2 interventions, see "Details of the intervention") (13) | 1 Observational study (Interrupted time series evaluation) | A) Email is sent to authors to revise the abstract according to the guidelines at the revision stage and B) Changes are made by the assistant editors of these journals towards the end of the editorial process. | CONSORT extension for abstracts | Checklist (9 of 17 items) | Monthly mean number of items reported | Significant: increase 1.50 items |
| Implementation of the web-based tool WebCONSORT (121) | 1 RCT | Journal editor includes a link to WebCONSORT in the revision letter to authors. Authors are directed to an automatically generated list of items and a flow diagram customised to their specific trial design. | CONSORT & some CONSORT extensions | Checklist (10 of 25 items) | Percentage of possible items reported for each article | Not significant: increase of 0.04 (95% CI -0.02 to +0.10) |
| Collaboration among authors and experts | 4 Observational studies (cross sectional evaluations) | Statisticians (or epidemiologists or other quantitative methodologists) are involved in the design, conduct or reporting of the study | CONSORT | Checklist (all items) | Percentage of possible items reported for each article | Significant in three studies (84,126,128), not significant in one (127) |

*According to the systematic review by Turner et al. (6) **According to the systematic review by Stevens et al. (3)

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A scoping review on interventions to improve adherence to reporting guidelines in health research

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| | |

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Manuscripts

1 A scoping review on interventions to improve adherence to 2 reporting guidelines in health research

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17 Keywords

18 Scoping review, knowledge synthesis, reporting guidelines, completeness of reporting,
19 quality of reporting, adherence

20 Abstract

21 **Objectives:** The goal of this study is to identify, analyse and classify interventions to
22 improve adherence to reporting guidelines in order to obtain a wide picture of how the

1
2
3 23 problem of enhancing the completeness of reporting of biomedical literature has been
4
5 24 tackled so far.

6
7
8 25 **Design:** Scoping review.

9
10
11 26 **Search strategy:** We searched the MEDLINE, EMBASE, and Cochrane Library databases
12
13 27 and conducted a grey literature search for (i) studies evaluating interventions to improve
14
15 28 adherence to reporting guidelines in health research and (ii) other types of references
16
17 29 describing interventions that have been performed or suggested but never evaluated.
18
19 30 The characteristics and effect of the evaluated interventions were analysed. Moreover,
20
21 31 we explored the rationale of the interventions identified and determined the existing
22
23 32 gaps in research on the evaluation of interventions to improve adherence to reporting
24
25 33 guidelines.

26
27 34 **Results:** 109 references containing 31 interventions (11 evaluated) were included. These
28
29 35 were grouped into five categories: (1) training on the use of reporting guidelines, (2)
30
31 36 improving understanding, (3) encouraging adherence, (4) checking adherence and
32
33 37 providing feedback, and (5) involvement of experts. Research gaps identified included
34
35 38 the evaluation of interventions (i) on training on the use of reporting guidelines and
36
37 39 improving understanding of these, (ii) at early stages of research, and (iii) after the final
38
39 40 acceptance of the manuscript.

40
41 41 **Conclusions:** This scoping review identifies a wide range of strategies to improve
42
43 42 adherence to reporting guidelines that can be taken by different stakeholders. Future
44
45 43 randomised trials should consider evaluating some of the interventions that have not
46
47 44 been assessed yet, therefore addressing the research gaps identified.

48 49 45 **Strengths and limitations**

- 50
51 46
- 52 • We considered wide range of reporting guidelines as well as their extensions.
 - 53 • Merging the evidence found in the published and grey literature allowed us to
 - 54 provide a broad picture of how the problem of enhancing adherence to reporting
 - 55 guidelines has been tackled so far and could be faced in the future.
 - 56 • The screening and data extraction were performed in duplicate.
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4 51 • We could have missed evidence of possible interventions that may not be
5 52 present in the published or grey literature but are instead used in practice and
6
7 53 continue to be used.
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9

10 54 **Background**
11
12

13 55 Approximately 85% of all biomedical research today is estimated to be wasted, due, in
14 56 part, to incomplete or inaccurate reporting (1). The past two decades have given rise to
15 57 a number of changes in an effort to help authors and the broader scientific community
16 58 properly report research methods and findings, which would allow them to contribute
17 59 to the broader goal of combating waste in biomedical research. The most prominent of
18 60 these changes has been the inception of reporting guidelines for different study types,
19 61 data, and clinical areas (2).
20
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27 62 The vast majority of reporting guidelines have not yet been assessed as to whether they
28 63 help improve the reporting of research (3), but some, such as the Consolidated
29 64 Standards of Reporting Trials (CONSORT) for the reporting of randomised controlled
30 65 trials (RCTs) (4), have been shown to enhance the completeness of reporting (5,6).
31
32
33
34

35 66 Dozens of systematic reviews have explored the extent of adherence to some reporting
36 67 guidelines in certain areas of health research (7–10). Saaman et al. (11) went one step
37 68 further and performed a systematic review of systematic reviews assessing adherence
38 69 to reporting guidelines. As they considered a broad range of clinical areas and study
39 70 designs, their results provided a global picture of adherence to reporting guidelines in
40 71 health research. Although some studies reported acceptable overall levels of
41 72 completeness of reporting and found that it had improved since the introduction of
42 73 certain reporting guidelines such as CONSORT, the authors of most of the reviews (43 of
43 74 50, 86%) concluded that more improvement is needed or that adherence to reporting
44 75 guidelines was inadequate, poor, medium or suboptimal. Therefore, it is warranted to
45 76 explore and develop strategies to improve the current levels of adherence to reporting
46 77 guidelines.
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3 78 In recent years, several initiatives aiming to improve adherence to reporting guidelines
4
5 79 have been proposed, some of which have already been evaluated. For example, the
6
7 80 effect of journal endorsement of reporting guidelines (3,5,6) and the implementation of
8
9 81 writing aid tools for authors such as the CONSORT-based web tool (COBWEB) (12) have
10
11 82 been assessed. While some of these strategies have not been shown to have a benefit
12
13 83 (3), others report better but still suboptimal levels of reporting (5,6) or even clear
14
15 84 benefits (12,13).

16
17 85 As mentioned, several reviews have analysed the quality of reporting in different clinical
18
19 86 areas and for different study types (7–10). However, no scoping review has been
20
21 87 performed that provides a global picture of different strategies aiming to improve
22
23 88 adherence to reporting guidelines. Given the low levels of completeness of reporting in
24
25 89 health research that have been observed (11), along with the imperative need to take
26
27 90 further actions for mitigating this problem, we considered that performing such a
28
29 91 scoping review was warranted.

30
31 92 In addition to analysing the implementation and effect of interventions that have
32
33 93 already been evaluated, we aimed to gather other possible strategies that could be
34
35 94 implemented and evaluated in the future.

36
37 95 For clarification, some relevant terms used throughout the scoping are defined in Box
38
39 96 1, which is based on Stevens et al. (3).

40
41 97 **Box 1:** relevant definitions in the context of this scoping review
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Adherence: Action(s) taken by authors to ensure that a research report is compliant with the items recommended by the appropriate/relevant reporting guideline. [These can take place before or after the first version of the manuscript is published.](#)

Endorsement: Action(s) taken by journals to indicate their support for the use of one or more reporting guideline(s) by authors submitting research reports for consideration.

Implementation: Action(s) taken by journals to ensure that authors adhere to an endorsed reporting guideline and that therefore published papers are completely reported.

Complete reporting: Pertains to the state of reporting of a study report and whether it is compliant with all the items recommended by the appropriate/relevant reporting guideline.

98

99 **Methods**

100 As presented in the published protocol (14), this scoping review follows the
101 methodology manual published by the Joanna Briggs Institute for scoping reviews (15).

102 **Objectives**

103 The scoping review questions are:

- 104 1. What interventions to improve adherence to reporting guidelines in health
105 research have been evaluated?
- 106 2. What further interventions to improve adherence to reporting guidelines have
107 been performed or suggested but never evaluated?

108 We aimed to analyse and classify the interventions found for both questions in order to
109 obtain a wide picture of how the problem of adhering better to reporting guidelines has
110 been tackled so far and can be tackled in the future.

111 **Eligibility criteria**

112 We included:

- 113 1. Studies evaluating interventions aiming to improve adherence to reporting
114 guidelines in health research, irrespective of study design.

1
2
3 115 2. Commentaries, editorials, letters, studies, and online sources describing possible
4
5 116 interventions to improve adherence to reporting guidelines that have been
6
7 117 performed or suggested but never evaluated.
8

9
10 118 The reporting guidelines considered were those shown on 8 May 2017 on the EQUATOR
11
12 119 (Enhancing the QUALity and Transparency Of Health Research) Network website (16) as
13
14 120 “Reporting Guidelines for main study types”. In addition, we included QUOROM (Quality
15
16 121 of Reporting of Meta-analyses), since it was the precursor of PRISMA. Supplementary
17
18 122 file 1 shows all reporting guidelines considered.

19
20 123 We considered the following languages: English, Spanish, French, German and Catalan.
21

22 124 **Exclusion criteria**

23
24
25 125 We have excluded references that include interventions that do not specifically aim to
26
27 126 improve the completeness of reporting, even though these interventions may actually
28
29 127 influence completeness. For example, we have excluded clinical trial registration even
30
31 128 though it may enhance completeness of reporting, because its main goals are to improve
32
33 129 clinical trial transparency while also reducing publication and selective reporting biases.
34

35 130 **Search strategy and study selection**

36
37
38 131 On 8 May 2017, we searched PubMed, EMBASE, and Cochrane Library databases for
39
40 132 articles published between 1 January 1996 and 31 March 2017, in accordance with our
41
42 133 scheduled search (14). The detailed search terms for PubMed can be found in the
43
44 134 protocol.
45

46
47 135 The retrieved studies were exported into Mendeley and duplicates were automatically
48
49 136 removed using it. One reviewer (DB) first screened the titles and abstracts for eligibility.
50
51 137 Each of the other two reviewers (JJK and EC) was randomly assigned 50% of the
52
53 138 references and screened the titles and abstracts independently of the first reviewer. The
54
55 139 reviewers classified the references into one of the following groups:

56
57 140 A) Evaluated: Includes references describing interventions to improve adherence to
58
59 141 reporting guidelines that have been empirically assessed.
60

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2
3 142 B) Non-evaluated: Includes references describing interventions to improve
4 adherence to reporting guidelines that have been performed or suggested but
5 143 never evaluated.
6
7 144

8 145 C) Unclear: Includes references (i) containing vague statements such as “Authors,
9 editors, and journals have to adhere better to reporting guidelines to improve
10 146 the quality of reporting” or “greater efforts have to be made by authors to check
11 147 that their research is compliant with [the relevant reporting guideline]”, or (ii)
12 148 not having the abstract available.
13
14 149

15 D) Excluded: Includes references (i) not describing interventions to improve
16 150 adherence to any of the reporting guidelines considered and (ii) describing but
17 151 not evaluating certain interventions that have already been classified as
18 152 evaluated.
19 153

20 154 Disagreements were solved by discussion among the reviewers.
21
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26 155 Second, one reviewer (DB) examined the full-text of all group A and B references to
27 confirm the previous classification, then all group C references to reclassify them either
28 156 as group A, B, or D. Re-classification was verified by the initial reviewer (JK or EC).
29 157 Finally, one reviewer (DB) ensured literature saturation by searching the reference lists
30 158 of included studies, the lists of articles citing them according to PubMed, and the
31 159 individual studies included in two relevant systematic reviews (3,6).
32 160

33 161 In addition, we performed a grey literature search, which included: the websites of
34 162 networks and organizations promoting the use of reporting guidelines (i.e., EQUATOR
35 163 Network and National Library of Medicine Research Reporting Guidelines and
36 164 Initiatives); work groups of medical journal editors (i.e., International Committee of
37 165 Medical Journal Editors (ICMJE) and World Association of Medical Editors (WAME));
38 166 biomedical journal publishers (i.e., BMJ Publishing Group and BioMed Central); funding
39 167 agencies (i.e., National Institute of Health (NIH) and European Research Council); online
40 168 platforms of post-publication peer review (i.e., PubPeer and ScienceOpen); and the
41 169 abstract books of the past editions of the International Congress on Peer Review and
42 170 Biomedical Publication.
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3 171 Some of the included references were described in studies co-authored by some of the
4
5 172 authors this scoping review. These references underwent the same process of screening,
6
7 173 data extraction, and data synthesis as the others.
8
9

10 174 **Data extraction**

11
12 175 A data extraction form was developed to collect the information necessary for data
13
14 176 synthesis. Two reviewers (DB, JJK) independently performed a pilot data extraction on a
15
16 177 random sample of 5 articles and subsequently refined the form.
17
18

19 178 Extracted data included:

- 20
21
22 179 1. Publication characteristics: title, year of publication, author, author's affiliation
23
24 180 country, and field of study.
25
26 181 2. Characteristics of the intervention:
- 27 182 a. Classification as evaluated or non-evaluated.
 - 28
29 183 b. Research stage: education, grant writing, protocol writing, manuscript
30
31 184 writing, submission, journal peer review, copy-editing, and post-
32
33 185 publication.
 - 34
35 186 c. Rationale of the intervention, which refers to the deduced reasons why
36
37 187 the intervention is evaluated or proposed.
 - 38
39 188 d. For evaluated interventions: details of the intervention, study design (e.g.
40
41 189 RCT, before-after, etc.), reporting guidelines considered and format
42
43 190 (checklist, bullet points and/or examples), period of intervention,
44
45 191 number of journals and articles involved, effect size of the intervention
46
47 192 on adherence to reporting guidelines and measure used to assess this
48
49 193 effect.
- 50
51 194 3. Relevant conclusions.

52 195 Two reviewers (DB, JJK) independently performed data extraction for all studies except
53
54 196 for the individual studies of the two systematic reviews evaluating journal endorsement
55
56 197 of reporting guidelines (3,6), since none of these studies described further interventions
57
58 198 and their results had already been reported in these reviews. Discrepancies between
59
60 199 reviewers were discussed and solved by consensus.

200 **Data synthesis**

201 Following data extraction, interventions to improve adherence to reporting guidelines
202 were categorised as follows:

- 203 1. Training on the practical use of reporting guidelines: mentoring of different
204 stakeholders on the practical use of reporting guidelines.
- 205 2. Enhancing accessibility and understanding: dissemination of reporting guidelines
206 and the improvement of authors' understanding of their content.
- 207 3. Encouraging adherence: suggestions and tools to facilitate compliance.
- 208 4. Checking adherence and providing feedback: checking the level of compliance
209 and indicating incorrect or missing items.
- 210 5. Involvement of experts: interaction and cooperation on methodology and
211 reporting.

212 One reviewer (DB) performed the initial categorization, which was verified and refined
213 by the other two reviewers (JJK and EC).

214 Furthermore, we determined the existing gaps in research on the evaluation of
215 interventions to improve adherence to reporting guidelines. More specifically, we
216 identified which categories of interventions and which research stages have not been
217 addressed so far in studies evaluating interventions.

218 **Deviations from the protocol**

219 In order to better capture the most relevant aspects of the included studies, the original
220 data extraction form proposed in the protocol was modified. We removed the health
221 care area of the studies included, refined the research stages considered, and included
222 more details on the implementation of the evaluated interventions.

223 **Patients and public involvement**

224 No patients or public were involved in the study.

225

226 **Results**

227 The database search yielded 1399 citations after deduplication (see Figure 1). Screening
228 of titles and abstracts resulted in a first classification, after which 435 papers were
229 included for full text review. We also reviewed the full text of 24 additional references
230 found through forward citation searching. Furthermore, a grey literature search yielded
231 7 additional references. Finally, 109 references were included. Some of these
232 interventions appeared in more than one reference and some of the references
233 contained more than one intervention. 90 of these references (86 observational and 4
234 randomised studies) described 11 evaluated interventions and the other 19 (12 research
235 studies, 2 editorials, 2 blogs, 1 commentary, 1 essay, and 1 perspective) described 20
236 non-evaluated interventions. Figure 2 displays these 31 interventions according to their
237 categorization and the research stage where they can be performed. Moreover, Table 1
238 shows all interventions in a tabular format together with their rationale.

| Group | Intervention | Rationale |
|---|---|---|
| Training on the practical use of RGs | Introduction of RGs & journalology into graduate curricula (18-22) | To introduce good research reporting habits early in young researchers' scientific careers. |
| | Student's development of protocols for coursework and research using RGs (21) | |
| | Funder's support of author training on RGs (23) | Authors, editors, and peer reviewers have insufficient training in issues related to reporting. |
| | Training for peer reviewers and editors on RGs by journals (22,23) | |
| Enhancing accessibility and understanding | Dissemination of RGs by scientific associations (24) | A large number of researchers are not aware of the existence of RGs. |
| | Translation of RGs to further languages (25) | Language barriers may affect the proper use of RGs. |
| | Development of expanded database of examples for each RG (26) | Authors need more examples of good reporting to properly understand certain items. |
| Encouraging adherence | Author use of RGs as a template for grant application proposals (21) | Using RGs in early stages may facilitate completeness of reporting of published research. |
| | Required checklist for ethics approval application (11) | |
| | Funder's requirement of checklists in author's report (21,108) | |
| | Author use of the writing aid tool COBWEB (12) | A) Authors need help to successfully adhere to RGs at the writing stage and B) Dividing RG items into bullet points and providing examples might help. |
| | Author use of a structured approach for reporting research (47,112) | A) To help authors avoid omissions, B) to aid reviewers and editors in appraising articles and C) to allow more efficient data extraction during the systematic review process. |
| | Author markup of the manuscript to indicate where each RG item is addressed (109) | |
| | Editorial statement endorsing certain RGs (27-46,48-106,113) | Authors read editorial statements and follow "Instructions to authors". |
| Recommendation or requirement to follow RGs in the "Instructions to | | |

| | | |
|--|---|---|
| | authors" (27–46,48–106,113) | |
| | Requirement to submit a RG checklist together with the manuscript indicating page numbers corresponding to each item (27–46,48–106,113) | Authors may not consider editorial statements or recommendations in "Instructions to authors" to be important. Compulsory submission of checklists or text mark-up may encourage authors to be more compliant with RGs. |
| | Requirement to populate and submit a RG checklist with text from the manuscript (114) | |
| | Journal development of core versions of RGs containing key items (110) | Focusing on the most important items could be more effective than considering the whole checklist. |
| | Guidance to authors on manuscript preparation by publication officers (111) | Trained journal officers may enhance authors' compliance with RGs during manuscript preparation. |
| | Suggestion for peer reviewers to use RGs (107) | Peer reviewers often do not detect reporting |
| | Editor's questions to peer reviewers about whether the authors have followed RGs (115) | flaws. Therefore, they may need to follow a more systematic approach and use RGs. |
| Checking adherence and providing feedback | Completeness of reporting check by editors (117) | Requiring checklists at submission does not guarantee adherence. Editors and peer reviewers have to check whether submitted papers are compliant with RGs. |
| | Peer review against RGs (118) | |
| | Internal peer review against RGs by a trained editorial assistant (120) | It is extremely unlikely that the average clinical peer reviewer has the methodological expertise to check a paper against RGs. |
| | Implementation of the automatic tool Statreviewer (121) | |
| | Email to authors to revise the manuscript according to RGs (13) | It might be more effective to ask authors for adherence to RGs during the revision process because they will do anything to get their paper published. |
| | Implementation of the tool WebCONSORT (119) | |
| | Completeness of reporting check at copy-editing (122) | Copy-editing and post-publication offer alternate time points to improve adherence to |
| | Post- publication peer review (123) | RGs. |
| Involvement of | Statistician involvement (78,128-130) | Professionals with specific knowledge of RGs |

| | | |
|---------|----------------------------------|--|
| experts | Medical writer involvement (108) | might help authors when designing, conducting or reporting their research. |
|---------|----------------------------------|--|

239 Among the 11 evaluated interventions identified, we found a variety of measures used
 240 to assess their effect on adherence to reporting guidelines, including:

- 241 • Score for completeness of reporting for each paper, either assigning different or
 242 equal weights to RG items, on a 0-10 scale.
- 243 • Percentage of items reported for each paper.
- 244 • Percentage of compliance per RG item.
- 245 • Score for the Manuscript Quality Assessment Instrument (17) for each paper.

246 Due to the heterogeneity of these measures and for the sake of clarity, we prefer to
 247 omit the information on the exact effect sizes in the main body of the manuscript and
 248 show it in Supplementary file 2, together with the implementation details of the
 249 evaluated interventions. In this way, these effects can be understood in an appropriate
 250 context.

251 Research gaps identified (see Figure 3) included the evaluation of interventions (i) on
 252 training on the use of reporting guidelines and improving understanding of these, and
 253 (ii) at early stages of research (education, grant writing or protocol writing), and (iii) after
 254 the final acceptance of the manuscript (copyediting or post-publication peer review).

255 Hereafter, we describe the interventions found for each category (Table 1 and
 256 Supplementary file 2 summarise these interventions).

257 ***Training on the practical use of reporting guidelines***

258 Four non-evaluated interventions related to educating different stakeholders on the
 259 practical use of reporting guidelines were found (18-23).

260 In a first step, health profession schools could incorporate reporting guidelines into
 261 curricula that address research methodology and publication standards (18–22). In line
 262 with this, students could develop protocols for coursework and research using reporting
 263 guidelines such as SPIRIT (randomised trials) and PRISMA-P (systematic reviews), and

educators may encourage adherence to those guidelines and grade the protocols using them (21). For their part, funders may consider supporting author training on reporting guidelines (23). Finally, journals or publishers may consider investing resources in training editors and reviewers on the content and use of reporting guidelines (22,23).

Enhancing accessibility and understanding

We identified three non-evaluated interventions focused on increasing the awareness of the existence of reporting guidelines, as well as the authors' understanding of content of these (24-26).

First, international scientific associations may play an important role in disseminating and popularizing reporting guidelines to large audiences (24). Second, reporting guideline developers might consider translating them to new languages that have not been addressed yet (25). Finally, further databases of examples of good reporting for different reporting guidelines that are accessible to authors can be developed, as has been done for CONSORT (26).

Encouraging adherence

Fourteen interventions found were associated with different strategies to facilitate compliance with reporting guidelines (11,12,21,27–115). Six of these were evaluated (47)(12,27–46,48–107,113).

Funders might require authors to use reporting guidelines as a template for grant application proposals (21). Later on, research ethics boards may require that protocols submitted for ethical approval clearly state which reporting guidelines the study will be using based on the study design, and that reporting guideline checklists are part of the application for ethics approval (11). Funders could also encourage adherence to reporting guidelines by asking for reporting guideline checklists as part of the authors' report (21,108).

One initiative to support authors adhering to reporting guidelines at the writing stage of the manuscript has been COBWEB, a writing aid tool that aims to help authors adequately combine the different extensions of the CONSORT statement (12). This tool divided the CONSORT items into bullet points showing the key elements that need to be

1
2
3 293 reported together with examples of adequate reporting. The impact of COBWEB was
4
5 294 evaluated in a randomised trial that showed a large effect of this intervention (12) (see
6
7 295 Supplementary file 2 for more details about this and other evaluated interventions). A
8
9 296 second option to support authors at manuscript writing is that they follow a more
10
11 297 structured approach. For example, ClinicalTrials.gov requires authors to report key
12
13 298 information in a tabular format when registering a study or making available its results
14
15 299 (116). This has been shown to be effective: some results posted on this platform,
16
17 300 especially harms, are more complete than those in corresponding journal articles
18
19 301 reporting the same trials (47). Another possibility to improve the structure of
20
21 302 manuscripts is to include new subheadings corresponding to different reporting
22
23 303 guideline items within the traditional IMRaD format (Introduction, Methods, Results,
24
25 304 and Discussion), as the American Journal of Orthodontics and Dentofacial Orthopedics
26
27 305 (AJO-DO) proposed (112). Finally, authors may also avoid omissions when writing the
28
29 306 manuscript if mark up the text and highlight where each item of the relevant checklist is
30
31 307 addressed (109).

32
33 308 At manuscript submission stage, different editorial actions have been taken to improve
34
35 309 adherence to reporting guidelines. The most popular is what has traditionally been
36
37 310 defined as journal endorsement of reporting guidelines, which is usually defined as one
38
39 311 or more of the three following interventions: (a) journal editorial statement endorsing
40
41 312 certain reporting guidelines; (b) requirement or recommendation in journal's
42
43 313 'Instructions to Authors' to follow certain reporting guidelines when preparing their
44
45 314 manuscript; or (c) requirement for authors to submit the appropriate reporting
46
47 315 guideline checklist together with their manuscript indicating page numbers
48
49 316 corresponding to each item (6). Dozens of observational studies have explored the
50
51 317 possible effect of journal endorsement of different reporting guidelines in different
52
53 318 clinical areas (27–46,48–106,113). A recent systematic review focused on CONSORT
54
55 319 evaluations showed relative but suboptimal improvements in the completeness of
56
57 320 reporting in journals by following the aforementioned policies (6), while another
58
59 321 systematic review considering 9 other guidelines showed no improvements (3).

58 322 Journals might also consider other strategies to enhance adherence to reporting
59
60 323 guidelines at submission. A first option could be to develop shorter, core versions of

1
2
3 324 reporting guidelines containing key items, which could be provided to authors as part of
4
5 325 the submission process (110). Second, they might introduce publication officers in order
6
7 326 to provide guidance to authors on preparing manuscripts for submission (111). Third,
8
9 327 editors may ask authors to populate the relevant checklist with text from their
10
11 328 manuscript and not accept a submission unless this is provided (114).

12
13 329 Finally, editors may suggest that peer reviewers use reporting guidelines (107). In
14
15 330 addition, by asking peer reviewers questions about whether the author has followed
16
17 331 reporting guidelines, this might be an indirect way to encourage them (115).

20 332 ***Checking adherence and providing feedback***

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23 333 Eight interventions were related to monitoring level of compliance with reporting
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25 334 guidelines of the manuscripts and providing instructions to authors on how to improve
26
27 335 the reporting of missing or incorrect items (13,117–123). Four of them were evaluated
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29 336 (13,117–119).

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31 337 Some journals have opted for implementing reporting guidelines at peer review. First,
32
33 338 an associate editor may assess manuscripts for adherence to the relevant reporting
34
35 339 guideline and ask authors to make changes accordingly (117). This process may be
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37 340 repeated until the associate editor thinks that the manuscript can move to the next step
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39 341 of the review process, leading to an editorial decision. This intervention was evaluated
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41 342 at the AJO-DO and showed satisfactory results: 33 of 37 items reached perfect
42
43 343 compliance (117). Second, peer reviewers could also assess the manuscripts against the
44
45 344 appropriate checklist (118). While the observed effect of this intervention was slightly
46
47 345 positive, it was smaller than hypothesized. In fact, investigators pointed out that authors
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49 346 tended to comply better with suggestions coming from standard reviews rather than
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51 347 from reviews against reporting guidelines, implying that it might be difficult to adhere
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53 348 to high methodological standards at late stages of research if these standards are not
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55 349 considered earlier in the research process. Third, journals could also ask trained editorial
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57 350 assistants to check manuscripts against reporting guidelines (120) or to implement
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59 351 automatic peer review tools such as Statreviewer (124), software that automatically
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352 checks adherence to reporting guidelines and evaluates the appropriate use and
353 reporting of statistical tests (121). Currently, its performance is being assessed through

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3 354 a pilot trial in collaboration with four BioMed Central Journals (121). In any of those
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5 355 cases, emails could be sent to authors asking them to revise the manuscript according
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7 356 to guidelines (13). To do this, the EQUATOR Network has provided standard letters that
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9 357 can be used a) after checks by an editor or a single peer reviewer, b) after full peer
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11 358 review, or c) alongside acceptance (125). Furthermore, at the time of author revision of
12
13 359 the manuscript, Hopewell et al. found no significant effect when incorporating
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15 360 WebCONSORT, a web-based tool that generates a unique list of items customised to the
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17 361 trial design, to the revision process of journals that endorsed CONSORT but had no active
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19 362 policy for implementing it (119). Finally, in a late stage of the publication process,
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21 363 copyediting of the manuscript could also ensure that all items are covered (122).

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23 364 Once the paper is published, the scientific community could use online platforms of
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25 365 post-publication peer review such as PubPeer (126) or ScienceOpen (127) to evaluate
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27 366 the adherence to reporting guidelines of published articles and to provide feedback to
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29 367 authors (123).

30 368 ***Involvement of experts***

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34 369 Two interventions identified implied interaction and cooperation between authors and
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36 370 experts on methodology and reporting at different stages of research (78,108,128–130).
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38 371 One of them was evaluated (78,128–130).

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40 372 On the one hand, statisticians (or epidemiologists or other quantitative methodologists)
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42 373 may get involved in the design, conduct or reporting of the study might contribute to
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44 374 properly reporting key areas such as sample size calculation, randomization, blinding,
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46 375 and appropriate statistical analysis (129). While three studies found a statistically
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48 376 significant positive relationship between CONSORT scores and statistician involvement
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50 377 (78,129,130), another one did not (128). On the other hand, it has been hypothesized
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52 378 that the involvement of medical writers during the manuscript writing stage of research
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54 379 could improve the completeness of reporting (108).

55 56 380 **Interventions described in papers co-authored by authors of this scoping review**

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3 381 25 (of 109) included references describing 21 (of 31) included interventions were co-
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5 382 authored by at least one of the authors of this scoping review
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7 383 (12,13,63,67,74,76,80,104,107,111,114,115,20,117–120,123,21–23,26,47,54,55).
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10 384 **Discussion**

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13 385 In this scoping review, we identified 31 interventions to improve adherence to reporting
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15 386 guidelines. We have also determined the gaps in research on the evaluation of this type
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17 387 of interventions. By considering a wide range of reporting guidelines as well as their
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19 388 extensions and merging the evidence found in the published and grey literature, this
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21 389 review provides a broad picture of how the problem of enhancing adherence to
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23 390 reporting guidelines has been tackled so far and could be faced in the future.

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25 391 This study reveals that it is primarily journals that have made most of the efforts to
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27 392 improve adherence to reporting guidelines in health research – although they can
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29 393 certainly do more. Typically, their strategies range from making available editorial
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31 394 statements that endorse certain reporting guidelines, recommending or requiring
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33 395 authors to follow reporting guidelines in the “Instructions to authors”, and requiring
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35 396 authors to submit a reporting guideline checklist together with the manuscript, with
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37 397 page numbers indicated for each item. However, these strategies have been shown not
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39 398 to have the desired effect (3,6,131). Recent research has called for more active and
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41 399 enforced journal policies throughout the editorial process, such as requiring the use of
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43 400 structured approaches with new subheadings adapted to different kinds of study
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45 401 designs (112), which was also found to be beneficial in a new study outside of our search
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47 402 period (132); providing guidance on manuscript preparation (111); making sure the peer
48
49 403 review process involves editorial assistants who have specific training on reporting
50
51 404 issues (120); and implementing automatic peer review tools (121). Journals will vary in
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53 405 their ability to make some of these strategies effective, depending on factors such as
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55 406 their resources, their guidelines to peer reviewers and the dedication of their editors –
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57 407 many editors and editorial staff work part-time and have limited amount of time.

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59 408 Moreover, editors’ education and performance should be improved. A recent study
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409 pointed out that more than a third (39%) of the manuscripts classified as randomised

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3 410 trials by the editorial staff were not actually randomised trials (119,133). Consequently,
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5 411 it seems difficult to improve author and peer reviewer adherence to reporting guidelines
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7 412 if journal gatekeepers are not properly trained in methodological and reporting issues.
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10 413 Apart from journals, editors and peer reviewers, other key stakeholders such as medical
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12 414 schools, research funders, universities and other research institutions should also take
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14 415 responsibility regarding this issue. This scoping review provides some strategies to
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16 416 follow. However, as the problem is complex and the possible interventions are varied,
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18 417 enhancing the completeness of reporting most likely depends not so much on any
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20 418 isolated action but on a set of strategies by several different stakeholders. These could
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22 419 be enacted at different stages of research, from education to article post-publication.

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24 420 For interventions aiming to improve adherence to reporting guidelines, we should
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26 421 require the same level of evidence that we require for interventions to improve health.
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28 422 For this reason, it is striking that we found only 4 published randomised trials that
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30 423 evaluated interventions to improve adherence to reporting guidelines (12,107,118,119).
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32 424 Among these trials, statistically significant effect of the intervention was only observed
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34 425 for the use of the writing aid tool for authors COBWEB (12). While performing an
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36 426 additional review against reporting guidelines showed slightly positive but not
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38 427 significant effect (118), suggesting the use of reporting guidelines to peer reviewers
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40 428 (107) or implementing at the process of author revision of the manuscript the web-
41
42 429 based tool WebCONSORT showed no benefit (119). The rest of the evaluations of
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44 430 interventions found (86 of 90) were observational studies, whose results are subject to
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46 431 the influence of confounding factors (6). For example, evaluations of the effect of journal
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48 432 endorsement may be influenced by whether different journals are actively checking that
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50 433 authors adhere to the requirements or recommendations they provide to authors at
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52 434 submission (6). For all these reasons, future randomised trials should be performed to
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54 435 evaluate further interventions to improve adherence to reporting guidelines. Moreover,
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56 436 these trials might consider addressing some of the research gaps identified in this
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58 437 review, such as improving adherence to reporting guidelines at the grant application or
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60 438 protocol writing stages.

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3 439 A few of the interventions found in this review were shown to enhance adherence to
4 reporting guidelines. However, it is noteworthy there is no evidence that some
5 440 successful interventions (12,117) have been implemented more widely later. For this
6 441 reason, more resources and efforts are needed to further implement these
7 442 interventions in other settings, evaluate the effect, and share the results with the
8 443 scientific community. In any case, it is important to keep in mind that contemporary
9 444 publication culture may harm the potential improvements in reporting quality. This
10 445 could result from the fact that most scientists feel that the primary evaluation tool of
11 446 their research is the quantity of their scientific output rather than its quality (134); and
12 447 such attitudes may undermine the potential effect of any intervention to improve
13 448 adherence to reporting guidelines.
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16 450 Our scoping review has some limitations. First, we did not formally assess the
17 451 methodological quality of the studies that evaluated interventions. Second, restricting
18 452 to certain databases or not having standard search terms for the databases searched
19 453 may have excluded relevant publications. Third, it is possible that we could have missed
20 454 evidence of possible interventions that may have never been reflected in the published
21 455 or grey literature but are instead used in practice and continue to be used. For example,
22 456 journals might be applying specific editorial strategies that are not publicly available on
23 457 their websites or in the published literature.
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40 458 This review is part of a larger project whose next goals are (i) to capture editors'
41 459 perceptions on the barriers and facilitators of some promising interventions identified
42 460 in this review, (ii) to explore new possible interventions, and (iii) to evaluate one of these
43 461 interventions in collaboration with BMJ Open.
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48 462 **Conclusion**

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51 463 Improving adherence to reporting guidelines is one of the key issues in order to enhance
52 464 complete and accurate reporting and therefore reduce waste in research.
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56 465 Different stakeholders – such as research funders, ethics boards, and journals – should
57 466 consider implementing and evaluating some of the interventions identified in this study.
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467 **List of abbreviations**

468 AJO-DO: American Journal of Orthodontics and Dentofacial Orthopedics; CONSORT:
469 CONSolidated Standards Of Reporting Trials; COBWEB: CONSORT-based web tool;
470 EQUATOR: Enhancing the QUALity and Transparency Of Health Research; RCT:
471 Randomised Controlled Trial; RG: Reporting Guideline; SPIRIT: Standard Protocol Items:
472 Recommendations for Interventional Trials; PRISMA: Preferred Reporting Items for
473 Systematic Reviews and Meta-Analyses

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483 EC, and JJK independently performed screening. DB and JJK independently performed data
484 extraction. DB performed initial data synthesis and EC, IB, DM, DGA, and JJK refined it. DB
485 drafted the manuscript. EC, IB, DM, DGA, and JJK made major revisions. Due to the strong
486 involvement of JJK and EC at several different stages of the study, all authors agreed to consider
487 them joint senior authors of the scoping review, although EC was the only senior author of the
488 protocol. All authors read and approved the final manuscript, which was completed in April
489 2018. DGA passed away in June 2018 and therefore could not approve the revised manuscript
490 (November 2018).

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1105 **Figures, tables and supplementary files**

1106 **Figure 1:** PRISMA flow diagram.

1107 **Figure 2:** Typology of interventions to improve adherence to RGs according to type of
1108 intervention and research stage. **Legend:** Evaluated interventions are shown in bold.

1109 **Figure 3:** Gaps in research on the evaluation of interventions to improve adherence to reporting
1110 guidelines. **Legend:** Each circle represents one intervention. Variables displayed: 1) Circle size:
1111 Number of studies evaluating each intervention (bigger = more studies); 2) Circle colour: Study
1112 design of those studies (blue for RCTs and green for observational studies) and 3) Circle fill: Kind

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3 1113 of RG implementation (plain for checklist and stripes for bullet points and examples). Research
4 1114 gaps are highlighted in red.

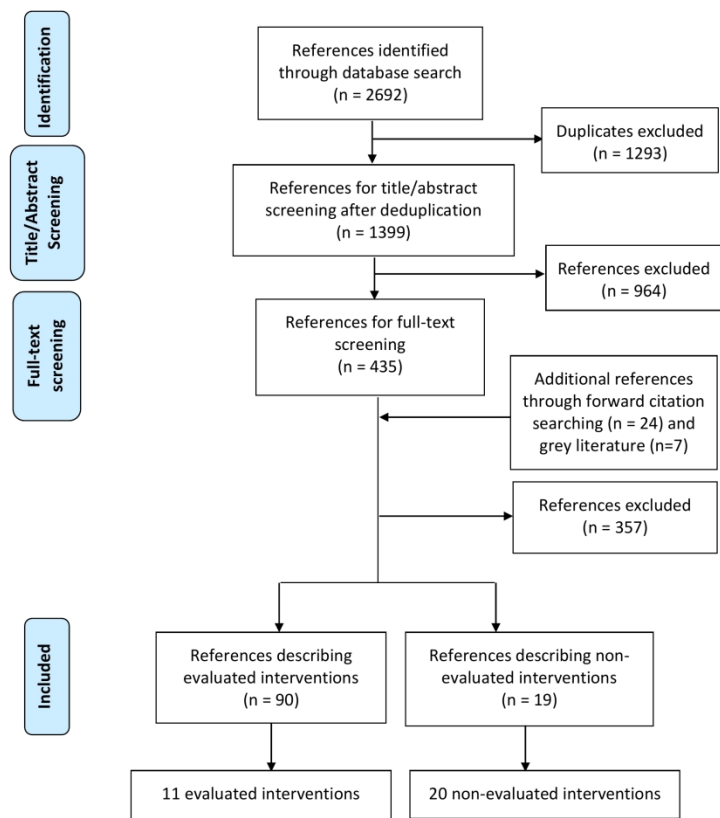
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7 1115 **Table 1:** Rationale of the interventions identified.

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10 1116 **Supplementary file 1:** Description of the acronyms and full names of all reporting guidelines
11 1117 considered.

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14 1118 **Supplementary file 2:** implementation details of the evaluated interventions.
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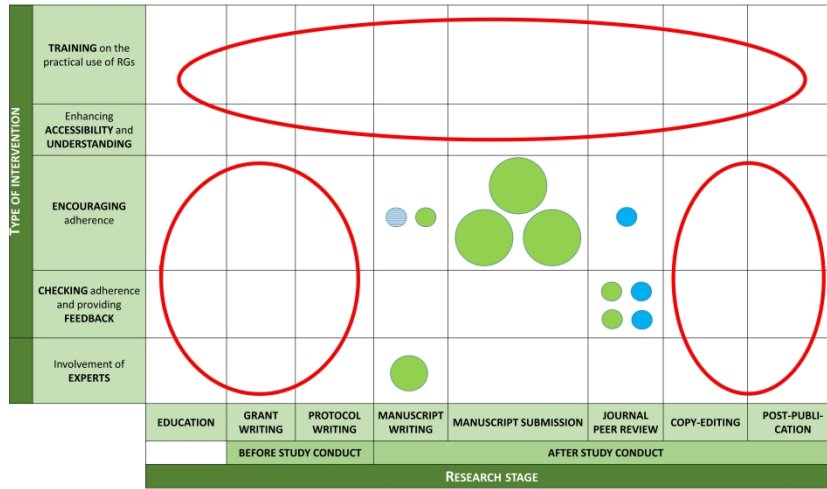
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|-----------------------------|--|--|--|---|---|--|---|---|------------------------------------|-----------------------------|----------------------|-------------------------|---------------------------|------------------------------|----------------------------|---------------------|-------------------------|
| | TRAINING on the practical use of RGs | Introduction of RGs & journalology into graduate curricula (18-22) Student's development of research protocols using RGs (21) | | Funder's support of author training on RGs (23) | | Training for peer reviewers and editors on RGs by journals (22,23) | | | | | | | | | | | |
| | Enhancing ACCESSIBILITY and UNDERSTANDING | Dissemination of RGs by scientific associations (24) Translation of RGs to further languages (25) Development of expanded databases of examples for each RG (26) | | | | | | | | | | | | | | | |
| TYPE OF INTERVENTION | ENCOURAGING adherence | | Author use of RGs as a template for grant applications' proposals (21) | Required checklist for ethics approval application (11) | Author use of the writing aid tool COBWEB (12) | Editorial statement endorsing certain RGs (27-46,48-106,113) | Suggestion for peer reviewers to use RGs (107) | | | | | | | | | | |
| | | | | | Author use of a structured approach for reporting research (17,112) | Recommendation or requirement to follow RGs in the "instructions to authors" (27-46,48-106,113) | | | | | | | | | | | |
| | | | | | Author markup of the manuscript to indicate where each RG item is addressed (109) | Journal development of core versions of RGs containing key items (110) | | | | | | | | | | | |
| | | | | | Funder's requirement of checklists in author's report (21,108) | Requirement to populate and submit a RG checklist with text from the manuscript (114) | | | | | | | | | | | |
| | CHECKING adherence and providing FEEDBACK | | | | | Editor's questions to peer reviewers about whether the authors have followed RGs (115) | | | | | | | | | | | |
| | InvolveMent of EXPERTS | | | Medical writer involvement (108) Statistician involvement (78,128-130) | | | Completeness of reporting check by editors (117) Peer review against RGs (118) Internal peer review against RGs by a trained editorial assistant (120) Implementation of the automatic tool StatReviewer (121) Email to authors to revise the manuscript according to RGs (13) Implementation of the web tool WebCONSORT (119) | Completeness of reporting check at copy-editing (122) | Post-publication peer review (123) | | | | | | | | |
| | | | | | | | | | | EDUCATION | GRANT WRITING | PROTOCOL WRITING | MANUSCRIPT WRITING | MANUSCRIPT SUBMISSION | JOURNAL PEER REVIEW | COPY-EDITING | POST-PUBLICATION |
| | | | | | | | | | | BEFORE STUDY CONDUCT | | | | | | | |
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Typology of interventions to improve adherence to RGs according to type of intervention and research stage.
Legend: Evaluated interventions are shown in bold.

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Gaps in research on the evaluation of interventions to improve adherence to reporting guidelines. Legend: Each circle represents one intervention. Variables displayed: 1) Circle size: Number of studies evaluating each intervention (bigger = more studies); 2) Circle colour: Study design of those studies (blue for RCTs and green for observational studies) and 3) Circle fill: Kind of RG implementation (plain for checklist and stripes for bullet points and examples). Research gaps are highlighted in red.

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| Acronym | Full name |
|----------|---|
| CONSORT | Consolidated Standards of Reporting Trials |
| STROBE | Strengthening the Reporting of Observational Studies in Epidemiology |
| PRISMA | Preferred Reporting Items for Systematic Reviews and Meta-Analyses |
| SRQR | Standards for Reporting Qualitative Research |
| COREQ | Consolidated criteria for Reporting Qualitative research |
| STARD | Standard Protocol Items: Recommendations for Interventional Trials |
| TRIPOD | Transparent Reporting of a multivariable prediction model for Individual Prognosis or Diagnosis |
| SQUIRE | Standards for Quality Improvement Reporting Excellence |
| CHEERS | Consolidated Health Economic Evaluation Reporting Standards |
| SPIRIT | Standard Protocol Items: Recommendations for Interventional Trials |
| PRISMA-P | Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols |
| CARE | Case Report |
| AGREE | Appraisal of Guidelines, Research and Evaluation |
| ARRIVE | Animal Research: Reporting In Vivo Experiments |
| RIGHT | Reporting Tool for Practice Guidelines in Health Care |
| QUOROM | Quality of Reporting of Meta-analyses |

| Type of intervention | Intervention | Number of studies and study design | Details of the intervention | RGs implemented | Format of RG implementation | Measure of adherence to RGs | Effect on adherence to RGs* |
|-----------------------|---|--|---|--|--------------------------------------|---|---|
| Encouraging adherence | Implementation of the writing aid tool COBWEB (12) | 1 RCT | Participants have to write the six domains of the methods section of the manuscript for the protocol they receive. They have access to COBWEB tool for a random three of the six domains. | CONSORT & CONSORT extension for non-pharmacological interventions | Bullet points and examples (6 items) | Mean score for completeness of reporting (scale 0–10, items weighted) | Difference of 2.1 (95% CI 1.5-2.7) |
| | Author use of a structured approach for reporting research (47) | 1 Observational study (cross-sectional evaluation) | Results are posted in a standard tabular format without discussions or conclusions. | CONSORT | Checklist (4 items) | Percentage compliance of each RG item | Difference of 0.16, 0.10, 0.18 and 0.36 for each of the 4 items considered |
| | Journal endorsement (3 interventions, see "Details of the intervention") (27–46,48–106,113) | 80 observational studies (57 cross sectional evaluations of endorsing vs non-endorsing journals, 9 before and after evaluations of endorsing journals before and after endorsement, 14 both kind of evaluations) | A) Editorial statement endorsing certain RGs, B) Recommendation or requirement to follow RGs in the "Instructions to authors", and C) Requirement to submit a RG checklist together with the manuscript indicating page numbers corresponding to each item. | CONSORT (46 of 80) CONSORT extensions (9 of 80) QUOROM (3 of 80) PRISMA (4 of 80) PRISMA extensions (1 of 80) STARD (11 of 80) STROBE (4 of 80) ARRIVE (1 of 80) CONSORT, STROBE and PRISMA (11 of 80) | Checklist (all items) | For CONSORT: percentage of compliance for each item** For other RGs: Mean summed score for completeness of reporting | For CONSORT: 25 items improved (see details for each item on figure 2 on Turner et al. (6)) For CONSORT extension for harms: Difference of 0.04 (99% CI –1.50 to 1.58) |

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|---|--|---|--|------------------------|-----------------------|---|--|
| | | | | | | | <p>For PRISMA: Difference of 0.53 (99% CI 0.02 to 1.03)</p> <p>For STARD: Difference of 0.52 (99% CI -0.11 to 1.16)</p> <p>For STRICTA: Difference of 1.42 (99% CI -0.04 to 2.88)</p> <p>For STROBE: Difference of 1.55 (99% CI -3.19 to 6.29)</p> |
| | Suggestion for peer reviewers to use RGs (107) | 1 RCT | Peer reviewers are sent a standard letter encouraging them to use different reporting guidelines. Reviewers are not asked to report whether they used the reporting guideline in reviewing the manuscript. | CONSORT, QUOROM, STARD | Checklist (all items) | Modified version of Manuscript Quality Assessment Instrument (scale 36-180) | Difference of 0.9 (95% CI -0.3 to +2.1) |
| Checking adherence and providing feedback | Completeness of reporting check by the editors (117) | 1 Observational Study (Before and after evaluation) | Initial submissions are vetted by the editor-in-chief. If the submission is considered appropriate, manuscripts are assessed by the associate editor for CONSORT | CONSORT | Checklist (all items) | Percentage of compliance of each RG item | Before – compliance ranges from 0% to 100% (Median 40%) |

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| | | | adherence. Authors are asked to make changes accordingly until associate editor deems appropriate that they move to the next step of the review process leading to an editorial decision. | | | | After – perfect compliance in 33 out of 37 items |
| | Additional review against RGs (118) | 1 RCT | A senior statistician does an additional review of all papers and provides authors suggestions on how to follow reporting guideline checklists. | STROBE, CONSORT, STARD | Checklist (all items) | Modified version of Manuscript Quality Assessment Instrument (scale 1 to 9) | Difference of 0.25 (95% CI -0.05 to +0.54) |
| | Active implementation of RG by editors (2 interventions, see “Details of the intervention”) (13) | 1 Observational study (Interrupted time series evaluation) | A) Email is sent to authors to revise the abstract according to the guidelines at the revision stage and B) Changes are made by the assistant editors of these journals towards the end of the editorial process. | CONSORT extension for abstracts | Checklist (9 of 17 items) | Monthly mean number of items reported (scale 0 to 9) | Difference of 1.5 items |
| | Implementation of the web-based tool WebCONSORT (119) | 1 RCT | Journal editor includes a link to WebCONSORT in the revision letter to authors. Authors are directed to an automatically generated list of items and a flow diagram customised to their specific trial design. | CONSORT & some CONSORT extensions | Checklist (10 of 25 items) | Percentage of items reported for each article | Difference of 0.04 (95% CI -0.02 to +0.10) |

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|------------------------|---------------------------------------|---|---|---------|-----------------------|---|---|
| Involvement of experts | Statistician involvement (78,128-130) | 4 Observational studies (cross sectional evaluations) | Statisticians (or epidemiologists or other quantitative methodologists) are involved in the design, conduct or reporting of the study | CONSORT | Checklist (all items) | Mean score for completeness of reporting (scale 0-10, items not weighted) | <p>In Diaz-Ordaz (78): No global effect provided (see effects for individual items in Table 2 of the paper)</p> <p>In Pandis et al. (128): Difference of 0.93</p> <p>In Péron et al. (129): No difference in medians</p> <p>In Kloukos et al. (130): 0.27</p> |
|------------------------|---------------------------------------|---|---|---------|-----------------------|---|---|

*Difference between adherence to RGs in intervention and non-intervention group. We did not report the CI of the effect size when authors did not report it in the original papers.

**As the 80 individual studies that belong to this category used different measures of adherence to reporting guidelines, we report here the measures used in the two systematic reviews that summarized the pooled results of most of these studies (3,6).



PRISMA–ScR Checklist*

| Section/topic | # | Checklist item | Reported on page # |
|---------------------------|---|---|--|
| TITLE | | | |
| Title | 1 | Identify the report as a scoping review. | 1 |
| ABSTRACT | | | |
| Structured summary | 2 | Provide a structured summary that includes (as applicable) background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives. | 1,2 |
| INTRODUCTION | | | |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach. | 3,4 ("Background") |
| Objectives | 4 | Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives. | 5 ("Objectives") |
| METHODS | | | |
| Protocol and registration | 5 | Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number. | 5 ("Methods") |
| Eligibility criteria | 6 | Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale. | 5,6 ("Eligibility Criteria", "Exclusion Criteria") |
| Information sources | 7 | Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed. | 6 ("Search Strategy and Study Selection") |
| Search | 8 | Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated. | 6 ("Search Strategy and Study Selection") |
| Study selection | 9 | State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review. For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml | 6,7 ("Search Strategy and Study Selection") |



PRISMA–ScR Checklist*

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| | | | Selection") |
| Data collection process | 10 | Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators. | 8 ("Data Extraction") |
| Data items | 11 | List and define all variables for which data were sought and any assumptions and simplifications made. | 8 ("Data Extraction") |
| Risk of bias in individual studies | 12 | If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate). | N/A |
| Summary measures | 13 | Not applicable for scoping reviews. | N/A |
| Synthesis of results | 14 | Describe the methods of handling and summarizing the data that were charted. | 9 ("Data Synthesis) |

Page 1 of 2

| Section/topic | # | Checklist item 10 | Reported on page # |
|-------------------------------|----|--|--------------------|
| Risk of bias across studies | 15 | Not applicable for scoping reviews. | N/A |
| Additional analyses | 16 | Not applicable for scoping reviews. | N/A |
| RESULTS | | | |
| Study selection | 17 | Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram. | Figure 1 |
| Study characteristics | 18 | For each source of evidence, present characteristics for which data were charted and provide the citations. | 10 ("Results) |
| Risk of bias within studies | 19 | If done, present data on critical appraisal of included sources of evidence (see item 12). | N/A |
| Results of individual studies | 20 | For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives. | 10 ("Results") |
| Synthesis of results | 21 | Summarize and/or present the charting results as they relate to the review questions and objectives. | 10-15 ("Results") |



PRISMA–ScR Checklist*

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| Risk of bias across studies | 22 | Not applicable for scoping reviews. | |
| Additional analysis | 23 | Not applicable for scoping reviews. | |
| DISCUSSION | | | |
| Summary of evidence | 24 | Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups. | 15 ("Discussion") |
| Limitations | 25 | Discuss the limitations of the scoping review process. | 17 ("Discussion") |
| Conclusions | 26 | Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps. | 15-17 ("Discussion") |
| FUNDING | | | |
| Funding | 27 | Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review. | 18 ("Declarations – Funding") |

*Original source: <http://annals.org/aim/fullarticle/2700389/prisma-extension-scoping-reviews-prisma-scr-checklist-explanation>

BMJ Open

A scoping review on interventions to improve adherence to reporting guidelines in health research

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| Primary Subject Heading: | Medical publishing and peer review |
| Secondary Subject Heading: | Medical education and training, Research methods |
| Keywords: | Scoping review, Quality of reporting, Completeness of reporting, Reporting guidelines, Knowledge synthesis, Adherence |
| | |

SCHOLARONE™
Manuscripts

1 A scoping review on interventions to improve adherence to 2 reporting guidelines in health research

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17 Keywords

18 Scoping review, knowledge synthesis, reporting guidelines, completeness of reporting,
19 quality of reporting, adherence

20 Abstract

21 **Objectives:** The goal of this study is to identify, analyse and classify interventions to
22 improve adherence to reporting guidelines in order to obtain a wide picture of how the

1
2
3 23 problem of enhancing the completeness of reporting of biomedical literature has been
4
5 24 tackled so far.

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8 25 **Design:** Scoping review.

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11 26 **Search strategy:** We searched the MEDLINE, EMBASE, and Cochrane Library databases
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13 27 and conducted a grey literature search for (i) studies evaluating interventions to improve
14
15 28 adherence to reporting guidelines in health research and (ii) other types of references
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17 29 describing interventions that have been performed or suggested but never evaluated.
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19 30 The characteristics and effect of the evaluated interventions were analysed. Moreover,
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21 31 we explored the rationale of the interventions identified and determined the existing
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23 32 gaps in research on the evaluation of interventions to improve adherence to reporting
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25 33 guidelines.

26
27 34 **Results:** 109 references containing 31 interventions (11 evaluated) were included. These
28
29 35 were grouped into five categories: (1) training on the use of reporting guidelines, (2)
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31 36 improving understanding, (3) encouraging adherence, (4) checking adherence and
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33 37 providing feedback, and (5) involvement of experts. Additionally, we identified lack of
34
35 38 evaluated interventions (i) on training on the use of reporting guidelines and improving
36
37 39 their understanding, (ii) at early stages of research, and (iii) after the final acceptance of
38
39 40 the manuscript.

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41 41 **Conclusions:** This scoping review identified a wide range of strategies to improve
42
43 42 adherence to reporting guidelines that can be taken by different stakeholders.
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45 43 Additional research is needed to assess the effectiveness of many of these interventions.

46 47 44 **Strengths and limitations**

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50 45
 - We considered wide range of reporting guidelines as well as their extensions.
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 - Merging the evidence found in the published and grey literature allowed us to
- 53
54 47 provide a broad picture of how the problem of enhancing adherence to reporting
- 55
56 48 guidelines has been tackled so far and could be faced in the future.
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58 49
 - The screening and data extraction were performed in duplicate.
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4 50 • We could have missed evidence of possible interventions that may not be
5 51 present in the published or grey literature but are instead used in practice and
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7 52 continue to be used.
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10 53 **Background**

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13 54 Approximately 85% of all biomedical research today is estimated to be wasted, due, in
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15 55 part, to incomplete or inaccurate reporting (1). The past two decades have given rise to
16
17 56 a number of changes in an effort to help authors and the broader scientific community
18
19 57 properly report research methods and findings, which would allow them to contribute
20
21 58 to the broader goal of combating waste in biomedical research. The most prominent of
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23 59 these changes has been the inception of reporting guidelines for different study types,
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25 60 data, and clinical areas (2).

26
27 61 The vast majority of reporting guidelines have not yet been assessed as to whether they
28
29 62 help improve the reporting of research (3), but some, such as the Consolidated
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31 63 Standards of Reporting Trials (CONSORT) for the reporting of randomised controlled
32
33 64 trials (RCTs) (4), have been shown to enhance the completeness of reporting (5,6).

34
35 65 Dozens of systematic reviews have explored the extent of adherence to some reporting
36
37 66 guidelines in certain areas of health research (7–10). Saaman et al. (11) went one step
38
39 67 further and performed a systematic review of systematic reviews assessing adherence
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41 68 to reporting guidelines. As they considered a broad range of clinical areas and study
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43 69 designs, their results provided a global picture of adherence to reporting guidelines in
44
45 70 health research. Although some studies reported acceptable overall levels of
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47 71 completeness of reporting and found that it had improved since the introduction of
48
49 72 certain reporting guidelines such as CONSORT, the authors of most of the reviews (43 of
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51 73 50, 86%) concluded that more improvement is needed or that adherence to reporting
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53 74 guidelines was inadequate, poor, medium or suboptimal. Therefore, it is warranted to
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55 75 explore and develop strategies to improve the current levels of adherence to reporting
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57 76 guidelines.
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3 77 In recent years, several initiatives aiming to improve adherence to reporting guidelines
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5 78 have been proposed, some of which have already been evaluated. For example, the
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7 79 effect of journal endorsement of reporting guidelines (3,5,6) and the implementation of
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9 80 writing aid tools for authors such as the CONSORT-based web tool (COBWEB) (12) have
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11 81 been assessed. While some of these strategies have not been shown to have a benefit
12
13 82 (3), others report better but still suboptimal levels of reporting (5,6) or even clear
14
15 83 benefits (12,13).

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17 84 As mentioned, several reviews have analysed the quality of reporting in different clinical
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19 85 areas and for different study types (7–10). However, no scoping review has been
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21 86 performed that provides a global picture of different strategies aiming to improve
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23 87 adherence to reporting guidelines. Given the low levels of completeness of reporting in
24
25 88 health research that have been observed (11), along with the imperative need to take
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27 89 further actions for mitigating this problem, we considered that performing such a
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29 90 scoping review was warranted.

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31 91 In addition to analysing the implementation and effect of interventions that have
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33 92 already been evaluated, we aimed to gather other possible strategies that could be
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35 93 implemented and evaluated in the future.

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37 94 For clarification, some relevant terms used throughout the scoping are defined in Box
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39 95 1, which is based on Stevens et al. (3).

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41 96 **Box 1:** relevant definitions in the context of this scoping review
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Adherence: Action(s) taken by authors to ensure that a research report is compliant with the items recommended by the appropriate/relevant reporting guideline. These can take place before or after the first version of the manuscript is published.

Endorsement: Action(s) taken by journals to indicate their support for the use of one or more reporting guideline(s) by authors submitting research reports for consideration.

Implementation: Action(s) taken by journals to ensure that authors adhere to an endorsed reporting guideline and that therefore published papers are completely reported.

Complete reporting: Pertains to the state of reporting of a study report and whether it is compliant with all the items recommended by the appropriate/relevant reporting guideline.

97

98 **Methods**

99 As presented in the published protocol (14), this scoping review follows the
100 methodology manual published by the Joanna Briggs Institute for scoping reviews (15).

101 **Objectives**

102 The scoping review questions are:

- 103 1. What interventions to improve adherence to reporting guidelines in health
104 research have been evaluated?
- 105 2. What further interventions to improve adherence to reporting guidelines have
106 been performed or suggested but never evaluated?

107 We aimed to analyse and classify the interventions found for both questions in order to
108 obtain a wide picture of how the problem of adhering better to reporting guidelines has
109 been tackled so far and can be tackled in the future.

110 **Eligibility criteria**

111 We included:

- 112 1. Studies evaluating interventions aiming to improve adherence to reporting
113 guidelines in health research, irrespective of study design.

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2
3 114 2. Commentaries, editorials, letters, studies, and online sources describing possible
4
5 115 interventions to improve adherence to reporting guidelines that have been
6
7 116 performed or suggested but never evaluated.
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10 117 The reporting guidelines considered were those shown on 8 May 2017 on the EQUATOR
11 118 (Enhancing the QUALity and Transparency Of Health Research) Network website (16) as
12 119 “Reporting Guidelines for main study types”. In addition, we included QUOROM (Quality
13 120 of Reporting of Meta-analyses), since it was the precursor of PRISMA. Supplementary
14 121 file 1 shows all reporting guidelines considered.
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20 122 We considered the following languages: English, Spanish, French, German and Catalan.
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23 123 **Exclusion criteria**

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25 124 We have excluded references that include interventions that do not specifically aim to
26 125 improve the completeness of reporting, even though these interventions may actually
27 126 influence completeness. For example, we have excluded clinical trial registration even
28 127 though it may enhance completeness of reporting, because its main goals are to improve
29 128 clinical trial transparency while also reducing publication and selective reporting biases.
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35 129 **Search strategy and study selection**

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38 130 On 8 May 2017, we searched PubMed, EMBASE, and Cochrane Library databases for
39 131 articles published between 1 January 1996 and 31 March 2017, in accordance with our
40 132 scheduled search (14). The detailed search terms for PubMed can be found in the
41 133 protocol.
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46 134 The retrieved studies were exported into Mendeley and duplicates were automatically
47 135 removed using it. One reviewer (DB) first screened the titles and abstracts for eligibility.
48 136 Each of the other two reviewers (JJK and EC) was randomly assigned 50% of the
49 137 references and screened the titles and abstracts independently of the first reviewer. The
50 138 reviewers classified the references into one of the following groups:
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57 139 A) Evaluated: Includes references describing interventions to improve adherence to
58 140 reporting guidelines that have been empirically assessed.
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3 141 B) Non-evaluated: Includes references describing interventions to improve
4 adherence to reporting guidelines that have been performed or suggested but
5 142 never evaluated.
6
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8 144 C) Unclear: Includes references (i) containing vague statements such as “Authors,
9 editors, and journals have to adhere better to reporting guidelines to improve
10 145 the quality of reporting” or “greater efforts have to be made by authors to check
11 146 that their research is compliant with [the relevant reporting guideline]”, or (ii)
12 147 not having the abstract available.
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14 148

15 149 D) Excluded: Includes references (i) not describing interventions to improve
16 150 adherence to any of the reporting guidelines considered and (ii) describing but
17 151 not evaluating certain interventions that have already been classified as
18 152 evaluated.
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26 153 Disagreements were solved by discussion among the reviewers.
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29 154 Second, one reviewer (DB) examined the full-text of all group A and B references to
30 155 confirm the previous classification, then all group C references to reclassify them either
31 156 as group A, B, or D. Re-classification was verified by the initial reviewer (JJK or EC).
32
33 157 Finally, one reviewer (DB) ensured literature saturation by searching the reference lists
34 158 of included studies, the lists of articles citing them according to PubMed, and the
35 159 individual studies included in two relevant systematic reviews (3,6).
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41 160 In addition, we performed a grey literature search, which included: the websites of
42 161 networks and organizations promoting the use of reporting guidelines (i.e., EQUATOR
43 162 Network and National Library of Medicine Research Reporting Guidelines and
44 163 Initiatives); work groups of medical journal editors (i.e., International Committee of
45 164 Medical Journal Editors (ICMJE) and World Association of Medical Editors (WAME));
46 165 biomedical journal publishers (i.e., BMJ Publishing Group and BioMed Central); funding
47 166 agencies (i.e., National Institute of Health (NIH) and European Research Council); online
48 167 platforms of post-publication peer review (i.e., PubPeer and ScienceOpen); and the
49 168 abstract books of the past editions of the International Congress on Peer Review and
50 169 Biomedical Publication.
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3 170 Some of the included references were described in studies co-authored by some of the
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5 171 authors this scoping review. These references underwent the same process of screening,
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7 172 data extraction, and data synthesis as the others.
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10 173 **Data extraction**

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12 174 A data extraction form was developed to collect the information necessary for data
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14 175 synthesis. Two reviewers (DB, JJK) independently performed a pilot data extraction on a
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16 176 random sample of 5 articles and subsequently refined the form.
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18

19 177 Extracted data included:

- 20
21
22 178 1. Publication characteristics: title, year of publication, author, author's affiliation
23
24 179 country, and field of study.
25
26 180 2. Characteristics of the intervention:
- 27 181 a. Classification as evaluated or non-evaluated.
 - 28
29 182 b. Research stage: education, grant writing, protocol writing, manuscript
30
31 183 writing, submission, journal peer review, copy-editing, and post-
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33 184 publication.
 - 34
35 185 c. Rationale of the intervention, which refers to the deduced reasons why
36
37 186 the intervention is evaluated or proposed.
 - 38
39 187 d. For evaluated interventions: details of the intervention, study design (e.g.
40
41 188 RCT, before-after, etc.), reporting guidelines considered and format
42
43 189 (checklist, bullet points and/or examples), period of intervention,
44
45 190 number of journals and articles involved, effect size of the intervention
46
47 191 on adherence to reporting guidelines and measure used to assess this
48
49 192 effect.
- 50
51 193 3. Relevant conclusions.

52 194 Two reviewers (DB, JJK) independently performed data extraction for all studies except
53
54 195 for the individual studies of the two systematic reviews evaluating journal endorsement
55
56 196 of reporting guidelines (3,6), since none of these studies described further interventions
57
58 197 and their results had already been reported in these reviews. Discrepancies between
59
60 198 reviewers were discussed and solved by consensus.

199 **Data synthesis**

200 Following data extraction, interventions to improve adherence to reporting guidelines
201 were categorised as follows:

- 202 1. Training on the practical use of reporting guidelines: mentoring of different
203 stakeholders on the practical use of reporting guidelines.
- 204 2. Enhancing accessibility and understanding: dissemination of reporting guidelines
205 and the improvement of authors' understanding of their content.
- 206 3. Encouraging adherence: suggestions and tools to facilitate compliance.
- 207 4. Checking adherence and providing feedback: checking the level of compliance
208 and indicating incorrect or missing items.
- 209 5. Involvement of experts: interaction and cooperation on methodology and
210 reporting.

211 One reviewer (DB) performed the initial categorization, which was verified and refined
212 by the other two reviewers (JJK and EC).

213 Furthermore, we determined the existing gaps in research on the evaluation of
214 interventions to improve adherence to reporting guidelines. More specifically, we
215 identified which categories of interventions and which research stages have not been
216 addressed so far in studies evaluating interventions.

217 We did not perform a meta-analysis of the observational studies assessing journal
218 endorsement of reporting guidelines that were not included in the two systematic
219 reviews previously mentioned (3,6). We considered that, for the purpose of this scoping
220 review, these systematic reviews provided a reliable picture of the impact of this
221 editorial intervention.

222 **Deviations from the protocol**

223 In order to better capture the most relevant aspects of the included studies, the original
224 data extraction form proposed in the protocol was modified. We removed the health
225 care area of the studies included, refined the research stages considered, and included
226 more details on the implementation of the evaluated interventions.

227 **Patients and public involvement**

228 No patients or public were involved in the study.

229 **Results**

230 The database search yielded 1399 citations after deduplication (see Figure 1). Screening
231 of titles and abstracts resulted in a first classification, after which 435 papers were
232 included for full text review. We also reviewed the full text of 24 additional references
233 found through forward citation searching. Furthermore, a grey literature search yielded
234 7 additional references. Finally, 109 references were included. Some of these
235 interventions appeared in more than one reference and some of the references
236 contained more than one intervention. 90 of these references (86 observational and 4
237 randomised studies) described 11 evaluated interventions and the other 19 (12 research
238 studies, 2 editorials, 2 blogs, 1 commentary, 1 essay, and 1 perspective) described 20
239 non-evaluated interventions. Figure 2 displays these 31 interventions according to their
240 categorization and the research stage where they can be performed. Moreover, Table 1
241 shows all interventions in a tabular format together with their rationale. All
242 interventions reported in this section were found in the literature and do not necessarily
243 correspond to the personal ideas of the scoping review authors.

244

245 Among the 11 evaluated interventions identified, we found a variety of measures used
246 to assess their effect on adherence to reporting guidelines, including:

- 247 • Score for completeness of reporting for each paper, either assigning different or
248 equal weights to RG items, on a 0-10 scale.
- 249 • Percentage of items reported for each paper.
- 250 • Percentage of compliance per RG item.
- 251 • Score for the Manuscript Quality Assessment Instrument (17) for each paper.

252 Due to the heterogeneity of these measures and for the sake of clarity, we prefer to
253 omit the information on the exact effect sizes in the main body of the manuscript and
254 show it in Supplementary file 2, together with the implementation details of the

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3 255 evaluated interventions. In this way, these effects can be understood in an appropriate
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5 256 context.
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8 257 Research gaps identified (see Figure 3) included the evaluation of interventions (i) on
9
10 258 training on the use of reporting guidelines and improving understanding of these, and
11
12 259 (ii) at early stages of research (education, grant writing or protocol writing), and (iii) after
13
14 260 the final acceptance of the manuscript (copyediting or post-publication peer review).
15

16 261 Hereafter, we describe the interventions found for each category (Table 1 and
17
18 262 Supplementary file 2 summarise these interventions).
19

20 21 263 ***Training on the practical use of reporting guidelines***

22
23 264 Four non-evaluated interventions related to educating different stakeholders on the
24
25 265 practical use of reporting guidelines were found (18-23).
26
27

28 266 In a first step, health profession schools could incorporate reporting guidelines into
29
30 267 curricula that address research methodology and publication standards (18–22). In line
31
32 268 with this, students could develop protocols for coursework and research using reporting
33
34 269 guidelines such as SPIRIT (randomised trials) and PRISMA-P (systematic reviews), and
35
36 270 educators may encourage adherence to those guidelines and grade the protocols using
37
38 271 them (21). For their part, funders may consider supporting author training on reporting
39
40 272 guidelines (23). Finally, journals or publishers may consider investing resources in
41
42 273 training editors and reviewers on the content and use of reporting guidelines (22,23).
43

44 274 ***Enhancing accessibility and understanding***

45
46 275 We identified three non-evaluated interventions focused on increasing the awareness
47
48 276 of the existence of reporting guidelines, as well as the authors' understanding of content
49
50 277 of these (24-26).
51

52
53 278 First, international scientific associations may play an important role in disseminating
54
55 279 and popularizing reporting guidelines to large audiences (24). Second, reporting
56
57 280 guideline developers might consider translating them to new languages that have not
58
59 281 been addressed yet (25). Finally, further databases of examples of good reporting for
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1
2
3 282 different reporting guidelines that are accessible to authors can be developed, as has
4
5 283 been done for CONSORT (26).
6
7

8 284 ***Encouraging adherence***

9
10 285 Fourteen interventions found were associated with different strategies to facilitate
11
12 286 compliance with reporting guidelines (11,12,21,27–115). Six of these were evaluated
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14 287 (47)(12,27–46,48–107,113).
15

16 288 Funders might require authors to use reporting guidelines as a template for grant
17
18 289 application proposals (21). Later on, research ethics boards may require that protocols
19
20 290 submitted for ethical approval clearly state which reporting guidelines the study will be
21
22 291 using based on the study design, and that reporting guideline checklists are part of the
23
24 292 application for ethics approval (11). Funders could also encourage adherence to
25
26 293 reporting guidelines by asking for reporting guideline checklists as part of the authors'
27
28 294 report (21,108).
29

30 295 One initiative to support authors adhering to reporting guidelines at the writing stage of
31
32 296 the manuscript has been COBWEB, a writing aid tool that aims to help authors
33
34 297 adequately combine the different extensions of the CONSORT statement (12). This tool
35
36 298 divided the CONSORT items into bullet points showing the key elements that need to be
37
38 299 reported together with examples of adequate reporting. The impact of COBWEB was
39
40 300 evaluated in a randomised trial that showed a large effect of this intervention (12) (see
41
42 301 Supplementary file 2 for more details about this and other evaluated interventions). A
43
44 302 second option to support authors at manuscript writing is that they follow a more
45
46 303 structured approach. For example, ClinicalTrials.gov requires authors to report key
47
48 304 information in a tabular format when registering a study or making available its results
49
50 305 (116). This has been shown to be effective: some results posted on this platform,
51
52 306 especially harms, are more complete than those in corresponding journal articles
53
54 307 reporting the same trials (47). Another possibility to improve the structure of
55
56 308 manuscripts is to include new subheadings corresponding to different reporting
57
58 309 guideline items within the traditional IMRaD format (Introduction, Methods, Results,
59
60 310 and Discussion), as the American Journal of Orthodontics and Dentofacial Orthopedics
311 (AJO-DO) proposed (112). Finally, authors may also avoid omissions when writing the

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3 312 manuscript if mark up the text and highlight where each item of the relevant checklist is
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5 313 addressed (109).
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8 314 At manuscript submission stage, different editorial actions have been taken to improve
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10 315 adherence to reporting guidelines. The most popular is what has traditionally been
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12 316 defined as journal endorsement of reporting guidelines, which is usually defined as one
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14 317 or more of the three following interventions: (a) journal editorial statement endorsing
15
16 318 certain reporting guidelines; (b) requirement or recommendation in journal's
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18 319 'Instructions to Authors' to follow certain reporting guidelines when preparing their
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20 320 manuscript; or (c) requirement for authors to submit the appropriate reporting
21
22 321 guideline checklist together with their manuscript indicating page numbers
23
24 322 corresponding to each item (6). Dozens of observational studies have explored the
25
26 323 possible effect of journal endorsement of different reporting guidelines in different
27
28 324 clinical areas (27–46,48–106,113). A recent systematic review focused on CONSORT
29
30 325 evaluations showed relative but suboptimal improvements in the completeness of
31
32 326 reporting in journals by following the aforementioned policies (6), while another
33
34 327 systematic review considering 9 other guidelines showed no improvements (3).

35 328 Journals might also consider other strategies to enhance adherence to reporting
36
37 329 guidelines at submission. A first option could be to develop shorter, core versions of
38
39 330 reporting guidelines containing key items, which could be provided to authors as part of
40
41 331 the submission process (110). Second, they might introduce publication officers in order
42
43 332 to provide guidance to authors on preparing manuscripts for submission (111). Third,
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45 333 editors may ask authors to populate the relevant checklist with text from their
46
47 334 manuscript and not accept a submission unless this is provided (114).

48 335 Finally, editors may suggest that peer reviewers use reporting guidelines (107). In
49
50 336 addition, by asking peer reviewers questions about whether the author has followed
51
52 337 reporting guidelines, this might be an indirect way to encourage them (115).
53

54 338 ***Checking adherence and providing feedback***

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57 339 Eight interventions were related to monitoring level of compliance with reporting
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59 340 guidelines of the manuscripts and providing instructions to authors on how to improve
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3 341 the reporting of missing or incorrect items (13,117–123). Four of them were evaluated
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5 342 (13,117–119).
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8 343 Some journals have opted for implementing reporting guidelines at peer review. First,
9
10 344 an associate editor may assess manuscripts for adherence to the relevant reporting
11
12 345 guideline and ask authors to make changes accordingly (117). This process may be
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14 346 repeated until the associate editor thinks that the manuscript can move to the next step
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16 347 of the review process, leading to an editorial decision. This intervention was evaluated
17
18 348 at the AJO-DO and showed satisfactory results: 33 of 37 items reached perfect
19
20 349 compliance (117). Second, peer reviewers could also assess the manuscripts against the
21
22 350 appropriate checklist (118). While the observed effect of this intervention was slightly
23
24 351 positive, it was smaller than hypothesized. In fact, investigators pointed out that authors
25
26 352 tended to comply better with suggestions coming from standard reviews rather than
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28 353 from reviews against reporting guidelines, implying that it might be difficult to adhere
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30 354 to high methodological standards at late stages of research if these standards are not
31
32 355 considered earlier in the research process. Third, journals could also ask trained editorial
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34 356 assistants to check manuscripts against reporting guidelines (120) or to implement
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36 357 automatic peer review tools such as Statreviewer (124), software that automatically
37
38 358 checks adherence to reporting guidelines and evaluates the appropriate use and
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40 359 reporting of statistical tests (121). Currently, its performance is being assessed through
41
42 360 a pilot trial in collaboration with four BioMed Central Journals (121). In any of those
43
44 361 cases, emails could be sent to authors asking them to revise the manuscript according
45
46 362 to guidelines (13). To do this, the EQUATOR Network has provided standard letters that
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48 363 can be used a) after checks by an editor or a single peer reviewer, b) after full peer
49
50 364 review, or c) alongside acceptance (125). Furthermore, at the time of author revision of
51
52 365 the manuscript, Hopewell et al. found no significant effect when incorporating
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54 366 WebCONSORT, a web-based tool that generates a unique list of items customised to the
55
56 367 trial design, to the revision process of journals that endorsed CONSORT but had no active
57
58 368 policy for implementing it (119). Finally, in a late stage of the publication process,
59
60 369 copyediting of the manuscript could also ensure that all items are covered (122).

370 Once the paper is published, the scientific community could use online platforms of
371 post-publication peer review such as PubPeer (126) or ScienceOpen (127) to evaluate

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3 372 the adherence to reporting guidelines of published articles and to provide feedback to
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5 373 authors (123).
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8 374 ***Involvement of experts***

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10 375 Two interventions identified implied interaction and cooperation between authors and
11
12 376 experts on methodology and reporting at different stages of research (78,108,128–130).
13
14 377 One of them was evaluated (78,128–130).
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17 378 On the one hand, statisticians (or epidemiologists or other quantitative methodologists)
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19 379 may get involved in the design, conduct or reporting of the study might contribute to
20
21 380 properly reporting key areas such as sample size calculation, randomization, blinding,
22
23 381 and appropriate statistical analysis (129). While three studies found a statistically
24
25 382 significant positive relationship between CONSORT scores and statistician involvement
26
27 383 (78,129,130), another one did not (128). On the other hand, it has been hypothesized
28
29 384 that the involvement of medical writers during the manuscript writing stage of research
30
31 385 could improve the completeness of reporting (108).
32

33 386 **Interventions described in papers co-authored by authors of this scoping review**

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35 387 25 (of 109) included references describing 21 (of 31) included interventions were co-
36
37 388 authored by at least one of the authors of this scoping review
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39 389 (12,13,63,67,74,76,80,104,107,111,114,115,20,117–120,123,21–23,26,47,54,55).
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42 390 **Discussion**

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45 391 In this scoping review, we identified 31 interventions to improve adherence to reporting
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47 392 guidelines. We have also determined the gaps in research on the evaluation of this type
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49 393 of interventions. By considering a wide range of reporting guidelines as well as their
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51 394 extensions and merging the evidence found in the published and grey literature, this
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53 395 review provides a broad picture of how the problem of enhancing adherence to
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55 396 reporting guidelines has been tackled so far and could be faced in the future.

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57 397 This study reveals that most published research aimed at improving adherence to
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59 398 reporting guidelines has been conducted in journals. Typically, journal strategies range
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3 399 from making available editorial statements that endorse certain reporting guidelines,
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5 400 recommending or requiring authors to follow reporting guidelines in the “Instructions
6
7 401 to authors”, and requiring authors to submit a reporting guideline checklist together
8
9 402 with the manuscript, with page numbers indicated for each item. However, these
10
11 403 strategies have been shown not to have the desired effect (3,6,131). Recent research
12
13 404 has called for more active and enforced journal policies throughout the editorial
14
15 405 process, such as requiring the use of structured approaches with new subheadings
16
17 406 adapted to different kinds of study designs (112), which was also found to be beneficial
18
19 407 in a new study outside of our search period (132); providing guidance on manuscript
20
21 408 preparation (111); making sure the peer review process involves editorial assistants who
22
23 409 have specific training on reporting issues (120); and implementing automatic peer
24
25 410 review tools (121). Journals will vary in their ability to make some of these strategies
26
27 411 effective, depending on factors such as their resources, their guidelines to peer
28
29 412 reviewers and the dedication of their editors – many editors and editorial staff work
30
31 413 part-time and have limited amount of time.

32
33 414 Moreover, editors’ education and performance should be improved. A recent study
34
35 415 pointed out that more than a third (39%) of the manuscripts classified as randomised
36
37 416 trials by the editorial staff were not actually randomised trials (119,133). Consequently,
38
39 417 it seems difficult to improve author and peer reviewer adherence to reporting guidelines
40
41 418 if journal gatekeepers are not properly trained in methodological and reporting issues.

42
43 419 Apart from journals, editors and peer reviewers, other key stakeholders such as medical
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45 420 schools, research funders, universities and other research institutions should also take
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47 421 responsibility regarding this issue. This scoping review provides some strategies to
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49 422 follow. However, as the problem is complex and the possible interventions are varied,
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51 423 enhancing the completeness of reporting most likely depends not so much on any
52
53 424 isolated action but on a set of strategies by several different stakeholders. These could
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55 425 be enacted at different stages of research, from education to article post-publication.

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57 426 For interventions aiming to improve adherence to reporting guidelines, we should
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59 427 require the same level of evidence that we require for interventions to improve health.
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428 For this reason, it is striking that we found only 4 published randomised trials that

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3 429 evaluated interventions to improve adherence to reporting guidelines (12,107,118,119).
4
5 430 Among these trials, statistically significant effect of the intervention was only observed
6
7 431 for the use of the writing aid tool for authors COBWEB (12). While performing an
8
9 432 additional review against reporting guidelines showed slightly positive but not
10
11 433 significant effect (118), suggesting the use of reporting guidelines to peer reviewers
12
13 434 (107) or implementing at the process of author revision of the manuscript the web-
14
15 435 based tool WebCONSORT showed no benefit (119). The rest of the evaluations of
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17 436 interventions found (86 of 90) were observational studies, whose results are subject to
18
19 437 the influence of confounding factors. As already mentioned, the impact of journal
20
21 438 endorsement on completeness of reporting was suboptimal (3,6). However,
22
23 439 completeness of reporting improved remarkably when reporting guidelines were
24
25 440 actively implemented by editors (e.g. if editors perform a completeness of reporting
26
27 441 check of the manuscript (117)) and when research results were posted in a tabular
28
29 442 format without discussion or conclusions (47). Future randomised trials should consider
30
31 443 evaluating these interventions or addressing some of the research gaps identified in this
32
33 444 review, such as improving adherence to reporting guidelines at the grant application or
34
35 445 protocol writing stages.

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38 446

39
40 447 A few of the interventions found in this review were shown to enhance adherence to
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42 448 reporting guidelines. However, it is noteworthy there is no evidence that some
43
44 449 successful interventions (12,117) have been implemented more widely later. For this
45
46 450 reason, more resources and efforts are needed to further implement these
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48 451 interventions in other settings, evaluate the effect, and share the results with the
49
50 452 scientific community. In any case, it is important to keep in mind that contemporary
51
52 453 publication culture may harm the potential improvements in reporting quality. This
53
54 454 could result from the fact that most scientists feel that the primary evaluation tool of
55
56 455 their research is the quantity of their scientific output rather than its quality (134); and
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58 456 such attitudes may undermine the potential effect of any intervention to improve
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60 457 adherence to reporting guidelines.

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3 458 Our scoping review has some limitations. First, we did not formally assess the
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5 459 methodological quality of the studies that evaluated interventions. Second, restricting
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7 460 to certain databases or not having standard search terms for the databases searched
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9 461 may have excluded relevant publications. Third, it is possible that we could have missed
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11 462 evidence of possible interventions that may have never been reflected in the published
12
13 463 or grey literature but are instead used in practice and continue to be used. For example,
14
15 464 journals might be applying specific editorial strategies that are not publicly available on
16
17 465 their websites or in the published literature.

18 19 466 **Conclusion**

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22 467 Improving adherence to reporting guidelines is one of the key issues in order to enhance
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24 468 complete and accurate reporting and therefore reduce waste in research.

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26 469 Different stakeholders – such as research funders, ethics boards, and journals – should
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28 470 consider implementing and evaluating some of the interventions identified in this study.

29 30 31 471 **List of abbreviations**

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34 472 AJO-DO: American Journal of Orthodontics and Dentofacial Orthopedics; CONSORT:
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36 473 CONSolidated Standards Of Reporting Trials; COBWEB: CONSORT-based web tool;
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38 474 EQUATOR: Enhancing the QUALity and Transparency Of Health Research; RCT:
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40 475 Randomised Controlled Trial; RG: Reporting Guideline; SPIRIT: Standard Protocol Items:
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42 476 Recommendations for Interventional Trials; PRISMA: Preferred Reporting Items for
43
44 477 Systematic Reviews and Meta-Analyses

45 46 478 **Declarations**

47
48
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50
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52
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54
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56
57 483 Chair (University of Ottawa).

58
59 484 **Competing interests:** DA and DM are Directors of the UK and Canadian EQUATOR Centres,
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1
2
3 485 respectively. IB is deputy director of French EQUATOR Centre.
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5

6 486 **Author contributions:** All authors contributed to conceptualizing and designing the study. DB,
7 487 EC, and JJK independently performed screening. DB and JJK independently performed data
8 488 extraction. DB performed initial data synthesis and EC, IB, DM, DGA, and JJK refined it. DB
9 489 drafted the manuscript. EC, IB, DM, DGA, and JJK made major revisions. Due to the strong
10 490 involvement of JJK and EC at several different stages of the study, all authors agreed to consider
11 491 them joint senior authors of the scoping review, although EC was the only senior author of the
12 492 protocol. All authors read and approved the final manuscript, which was completed in April
13 493 2018. DGA passed away in June 2018 and therefore could not approve the revised manuscript
14 494 (November 2018).

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21 495 **Availability of data and materials:** The datasets used and/or analysed during the current study
22 496 are available from the corresponding author on reasonable request.

23
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25
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28 499 help. This review is part of a larger project whose next goals are (i) to capture editors'
30 500 perceptions on the barriers and facilitators of some promising interventions identified in this
31 501 review, (ii) to explore new possible interventions, and (iii) to evaluate one of these interventions
32 502 in collaboration with BMJ Open.
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39 1097 adequately reflecting what information is actually reported in published papers?
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52 1103 from: <http://www.ncbi.nlm.nih.gov/pubmed/28941813>
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54 1104 133. Cobo E, González JA. Taking advantage of unexpected WebCONSORT results.
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56 1105 *BMC Med* [Internet]. 2016 Dec 5 [cited 2018 Feb 16];14(1):204. Available from:
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58 1106 <http://bmcmecicine.biomedcentral.com/articles/10.1186/s12916-016-0758-4>
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1107 134. Tijdink JK, Schipper K, Bouter LM, Maclaine Pont P, de Jonge J, Smulders YM.

| Group | Intervention | Rationale |
|--------------------------------------|---|---|
| Training on the practical use of RGs | Introduction of RGs & journalology into graduate curricula (18-22) | To introduce good research reporting habits early in young researchers' scientific careers. |
| | Student's development of protocols for coursework and research using RGs (21) | |
| | Funder's support of author training on RGs (23) | Authors, editors, and peer reviewers have insufficient training in issues related to reporting. |
| | Training for peer reviewers and editors | |

1108 How do scientists perceive the current publication culture? A qualitative focus
 1109 group interview study among Dutch biomedical researchers. *BMJ Open*
 1110 [Internet]. 2016 Feb 17 [cited 2017 Sep 28];6(2):e008681. Available from:
 1111 <http://bmjopen.bmj.com/lookup/doi/10.1136/bmjopen-2015-008681>

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1113 **Figures, tables and supplementary files**

1114 **Figure 1:** PRISMA flow diagram.

1115 **Figure 2:** Typology of interventions to improve adherence to RGs according to type of
 1116 intervention and research stage. **Legend:** Evaluated interventions are shown in bold.

1117 **Figure 3:** Gaps in research on the evaluation of interventions to improve adherence to reporting
 1118 guidelines. **Legend:** Each circle represents one intervention. Variables displayed: 1) Circle size:
 1119 Number of studies evaluating each intervention (bigger = more studies); 2) Circle colour: Study
 1120 design of those studies (blue for RCTs and green for observational studies) and 3) Circle fill: Kind
 1121 of RG implementation (plain for checklist and stripes for bullet points and examples). Research
 1122 gaps are highlighted in red.

1123 **Supplementary file 1:** Description of the acronyms and full names of all reporting guidelines
 1124 considered.

1125 **Supplementary file 2:** implementation details of the evaluated interventions.

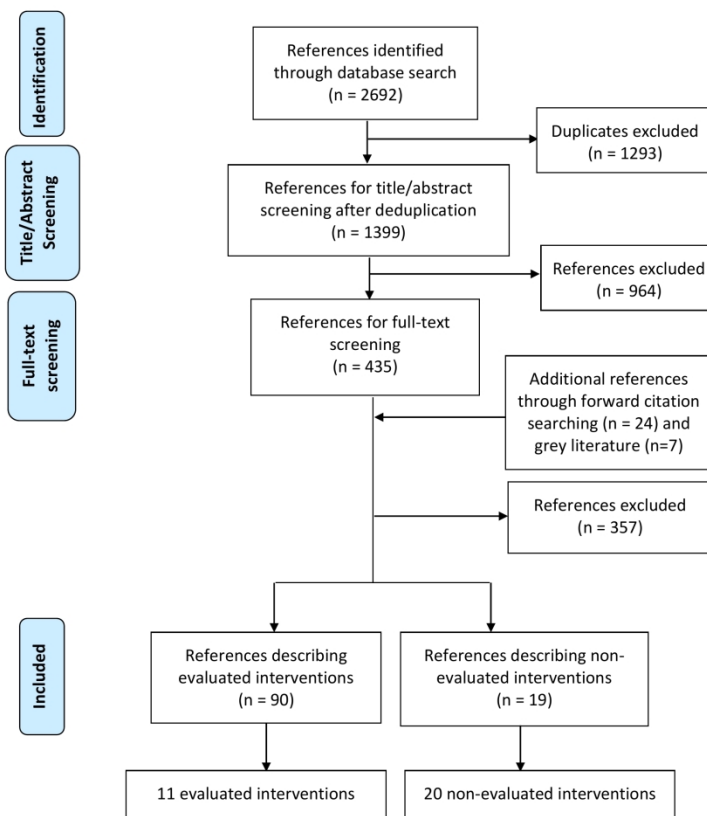
1126 **Table 1:** Rationale of the interventions identified.

| | | |
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| | on RGs by journals (22,23) | |
| Enhancing accessibility and understanding | Dissemination of RGs by scientific associations (24) | A large number of researchers are not aware of the existence of RGs. |
| | Translation of RGs to further languages (25) | Language barriers may affect the proper use of RGs. |
| | Development of expanded database of examples for each RG (26) | Authors need more examples of good reporting to properly understand certain items. |
| Encouraging adherence | Author use of RGs as a template for grant application proposals (21) | Using RGs in early stages may facilitate completeness of reporting of published research. |
| | Required checklist for ethics approval application (11) | |
| | Funder's requirement of checklists in author's report (21,108) | |
| | Author use of the writing aid tool COBWEB (12) | A) Authors need help to successfully adhere to RGs at the writing stage and B) Dividing RG items into bullet points and providing examples might help. |
| | Author use of a structured approach for reporting research (47,112) | A) To help authors avoid omissions, B) to aid reviewers and editors in appraising articles and C) to allow more efficient data extraction during the systematic review process. |
| | Author markup of the manuscript to indicate where each RG item is addressed (109) | |
| | Editorial statement endorsing certain RGs (27-46,48-106,113) | Authors read editorial statements and follow "Instructions to authors". |
| | Recommendation or requirement to follow RGs in the "Instructions to authors" (27-46,48-106,113) | |
| Requirement to submit a RG checklist together with the manuscript indicating page numbers corresponding to each item (27-46,48-106,113) | Authors may not consider editorial statements or recommendations in "Instructions to authors" to be important. Compulsory submission of checklists or text mark-up may encourage authors to be more compliant with RGs. | |
| Requirement to populate and submit a RG checklist with text from the manuscript (114) | | |

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| | Journal development of core versions of RGs containing key items (110) | Focusing on the most important items could be more effective than considering the whole checklist. |
| | Guidance to authors on manuscript preparation by publication officers (111) | Trained journal officers may enhance authors' compliance with RGs during manuscript preparation. |
| | Suggestion for peer reviewers to use RGs (107) | Peer reviewers often do not detect reporting flaws. Therefore, they may need to follow a more systematic approach and use RGs. |
| | Editor's questions to peer reviewers about whether the authors have followed RGs (115) | |
| Checking adherence and providing feedback | Completeness of reporting check by editors (117) | Requiring checklists at submission does not guarantee adherence. Editors and peer reviewers have to check whether submitted papers are compliant with RGs. |
| | Peer review against RGs (118) | |
| | Internal peer review against RGs by a trained editorial assistant (120) | It is extremely unlikely that the average clinical peer reviewer has the methodological expertise to check a paper against RGs. |
| | Implementation of the automatic tool Statreviewer (121) | |
| | Email to authors to revise the manuscript according to RGs (13) | It might be more effective to ask authors for adherence to RGs during the revision process because they will do anything to get their paper published. |
| | Implementation of the tool WebCONSORT (119) | |
| | Completeness of reporting check at copy-editing (122) | Copy-editing and post-publication offer alternate time points to improve adherence to RGs. |
| | Post- publication peer review (123) | |
| Involvement of experts | Statistician involvement (78,128-130) | Professionals with specific knowledge of RGs might help authors when designing, conducting or reporting their research. |
| | Medical writer involvement (108) | |

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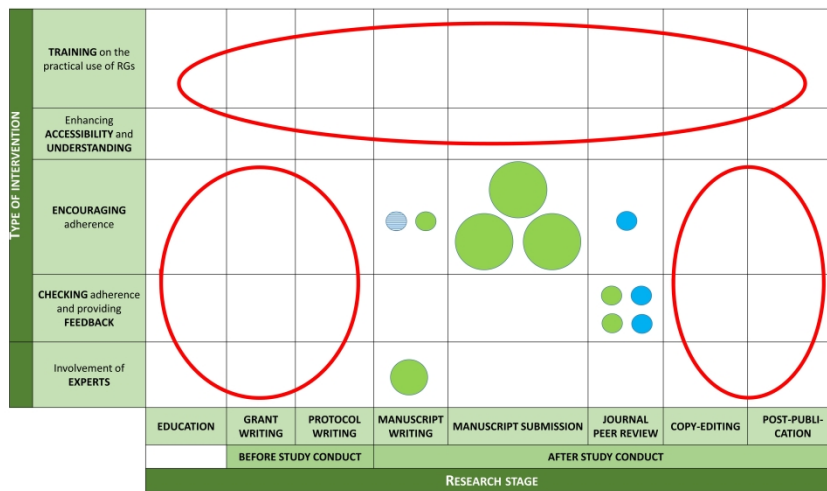
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| TRAINING on the practical use of RGs | Introduction of RGs & journalology into graduate curricula (18-22) | | Funder's support of author training on RGs (23) | | | Training for peer reviewers and editors on RGs by journals (22,23) | | |
| | Student's development of research protocols using RGs (21) | | | | | | | |
| Enhancing ACCESSIBILITY and UNDERSTANDING | Dissemination of RGs by scientific associations (24) | | | | | | | |
| | Translation of RGs to further languages (25) Development of expanded databases of examples for each RG (26) | | | | | | | |
| ENCOURAGING adherence | Author use of RGs as a template for grant applications' proposals (21) | Required checklist for ethics approval application (11) | Author use of the writing aid tool COBWEB (12) | Editorial statement endorsing certain RGs (27-46,48-106,113) | Suggestion for peer reviewers to use RGs (107) | Recommendation or requirement to follow RGs in the "instructions to authors" (27-46,48-106,113) | Requirement to submit a RG checklist together with the manuscript indicating page numbers corresponding to each item (27-46,48-106,113) | Journal development of core versions of RGs containing key items (110) |
| | | | | Author use of a structured approach for reporting research (17,112) | | | | |
| | | | | Author markup of the manuscript to indicate where each RG item is addressed (109) | | | | |
| | | | | Funder's requirement of checklists in author's report (21,108) | | | | |
| CHECKING adherence and providing FEEDBACK | | | | Journal development of core versions of RGs containing key items (110) | Editor's questions to peer reviewers about whether the authors have followed RGs (115) | Guidance to authors on manuscript preparation by publication officers (111) | Requirement to populate and submit a RG checklist with text from the manuscript (114) | Completeness of reporting check by editors (117) |
| | | | | Peer review against RGs (118) | | | | |
| | | | | Internal peer review against RGs by a trained editorial assistant (120) | | | | |
| | | | | Implementation of the automatic tool StatReviewer (121) | | | | |
| | | | | Email to authors to revise the manuscript according to RGs (113) | | | | |
| Implementation of the web tool WebCONSORT (119) | | | | | | | | |
| Involvement of EXPERTS | | | | Medical writer involvement (108) | | | | Completeness of reporting check at copy-editing (122) |
| | | | | Statistician involvement (78,128-130) | | | | |
| | EDUCATION | GRANT WRITING | PROTOCOL WRITING | MANUSCRIPT WRITING | MANUSCRIPT SUBMISSION | JOURNAL PEER REVIEW | COPY-EDITING | POST-PUBLICATION |
| | | BEFORE STUDY CONDUCT | | | AFTER STUDY CONDUCT | | | |
| | RESEARCH STAGE | | | | | | | |

Typology of interventions to improve adherence to RGs according to type of intervention and research stage.
Legend: Evaluated interventions are shown in bold.

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Gaps in research on the evaluation of interventions to improve adherence to reporting guidelines. Legend: Each circle represents one intervention. Variables displayed: 1) Circle size: Number of studies evaluating each intervention (bigger = more studies); 2) Circle colour: Study design of those studies (blue for RCTs and green for observational studies) and 3) Circle fill: Kind of RG implementation (plain for checklist and stripes for bullet points and examples). Research gaps are highlighted in red.

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| Acronym | Full name |
|----------|---|
| CONSORT | Consolidated Standards of Reporting Trials |
| STROBE | Strengthening the Reporting of Observational Studies in Epidemiology |
| PRISMA | Preferred Reporting Items for Systematic Reviews and Meta-Analyses |
| SRQR | Standards for Reporting Qualitative Research |
| COREQ | Consolidated criteria for Reporting Qualitative research |
| STARD | Standard Protocol Items: Recommendations for Interventional Trials |
| TRIPOD | Transparent Reporting of a multivariable prediction model for Individual Prognosis or Diagnosis |
| SQUIRE | Standards for Quality Improvement Reporting Excellence |
| CHEERS | Consolidated Health Economic Evaluation Reporting Standards |
| SPIRIT | Standard Protocol Items: Recommendations for Interventional Trials |
| PRISMA-P | Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols |
| CARE | Case Report |
| AGREE | Appraisal of Guidelines, Research and Evaluation |
| ARRIVE | Animal Research: Reporting In Vivo Experiments |
| RIGHT | Reporting Tool for Practice Guidelines in Health Care |
| QUOROM | Quality of Reporting of Meta-analyses |

| Type of intervention | Intervention | Number of studies and study design | Details of the intervention | RGs implemented | Format of RG implementation | Measure of adherence to RGs | Effect on adherence to RGs* |
|-----------------------|---|--|---|--|--------------------------------------|---|--|
| Encouraging adherence | Implementation of the writing aid tool COBWEB (12) | 1 RCT | Participants have to write the six domains of the methods section of the manuscript for the protocol they receive. They have access to COBWEB tool for a random three of the six domains. | CONSORT & CONSORT extension for non-pharmacological interventions | Bullet points and examples (6 items) | Mean score for completeness of reporting (scale 0–10, items weighted) | Difference of 2.1 (95% CI 1.5-2.7) |
| | Author use of a structured approach for reporting research (47) | 1 Observational study (cross-sectional evaluation) | Results are posted in a standard tabular format without discussions or conclusions. | CONSORT | Checklist (4 items) | Percentage compliance of each RG item | Difference of 0.16, 0.10, 0.18 and 0.36 for each of the 4 items considered |
| | Journal endorsement (3 interventions, see "Details of the intervention") (27–46,48–106,113) | 80 observational studies (57 cross sectional evaluations of endorsing vs non-endorsing journals, 9 before and after evaluations of endorsing journals before and after endorsement, 14 both kind of evaluations) | A) Editorial statement endorsing certain RGs, B) Recommendation or requirement to follow RGs in the "Instructions to authors", and C) Requirement to submit a RG checklist together with the manuscript indicating page numbers corresponding to each item. | CONSORT (46 of 80) CONSORT extensions (9 of 80) QUOROM (3 of 80) PRISMA (4 of 80) PRISMA extensions (1 of 80) STARD (11 of 80) STROBE (4 of 80) ARRIVE (1 of 80) CONSORT, STROBE and PRISMA (11 of 80) | Checklist (all items) | For CONSORT: percentage of compliance for each item** For other RGs: Mean summed score for completeness of reporting** | For CONSORT: 25 items improved (see details for each item on figure 2 on Turner et al. (6)) For CONSORT extension for harms: Difference of 0.04 (99% CI –1.50 to 1.58) (see Stevens et al. (3)) |

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| | | | | | | <p>For PRISMA: Difference of 0.53 (99% CI 0.02 to 1.03) (see Stevens et al. (3))</p> <p>For STARD: Difference of 0.52 (99% CI -0.11 to 1.16) (see Stevens et al. (3))</p> <p>For STRICTA: Difference of 1.42 (99% CI -0.04 to 2.88) (see Stevens et al. (3))</p> <p>For STROBE: Difference of 1.55 (99% CI -3.19 to 6.29) (see Stevens et al. (3))</p> |
| Suggestion for peer reviewers to use RGs (107) | 1 RCT | Peer reviewers are sent a standard letter encouraging them to use different reporting guidelines. Reviewers are not asked to report whether they used the reporting guideline in reviewing the manuscript. | CONSORT, QUOROM, STARD | Checklist (all items) | Modified version of Manuscript Quality Assessment Instrument (scale 36-180) | Difference of 0.9 (95% CI -0.3 to +2.1) |

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|---|--|--|--|---------------------------------|---------------------------|---|---|
| | Completeness of reporting check by the editors (117) | 1 Observational Study (Before and after evaluation) | Initial submissions are vetted by the editor-in-chief. If the submission is considered appropriate, manuscripts are assessed by the associate editor for CONSORT adherence. Authors are asked to make changes accordingly until associate editor deems appropriate that they move to the next step of the review process leading to an editorial decision. | CONSORT | Checklist (all items) | Percentage of compliance of each RG item | Before – compliance ranges from 0% to 100% (Median 40%) After – perfect compliance in 33 out of 37 items |
| Checking adherence and providing feedback | Additional review against RGs (118) | 1 RCT | A senior statistician does an additional review of all papers and provides authors suggestions on how to follow reporting guideline checklists. | STROBE, CONSORT, STARD | Checklist (all items) | Modified version of Manuscript Quality Assessment Instrument (scale 1 to 9) | Difference of 0.25 (95% CI -0.05 to +0.54) |
| | Active implementation of RG by editors (2 interventions, see “Details of the intervention”) (13) | 1 Observational study (Interrupted time series evaluation) | A) Email is sent to authors to revise the abstract according to the guidelines at the revision stage and B) Changes are made by the assistant editors of these journals towards the end of the editorial process. | CONSORT extension for abstracts | Checklist (9 of 17 items) | Monthly mean number of items reported (scale 0 to 9) | Difference of 1.5 items |

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| | Implementation of the web-based tool WebCONSORT (119) | 1 RCT | Journal editor includes a link to WebCONSORT in the revision letter to authors. Authors are directed to an automatically generated list of items and a flow diagram customised to their specific trial design. | CONSORT & some CONSORT extensions | Checklist (10 of 25 items) | Percentage of items reported for each article | Difference of 0.04 (95% CI -0.02 to +0.10) |
| Involvement of experts | Statistician involvement (78,128-130) | 4 Observational studies (cross sectional evaluations) | Statisticians (or epidemiologists or other quantitative methodologists) are involved in the design, conduct or reporting of the study | CONSORT | Checklist (all items) | Mean score for completeness of reporting (scale 0-10, items not weighted) | <p>In Diaz-Ordaz (78): No global effect provided (see effects for individual items in Table 2 of the paper)</p> <p>In Pandis et al. (128): Difference of 0.93</p> <p>In Péron et al. (129): No difference in medians</p> <p>In Kloukos et al. (130): 0.27</p> |

*Difference between adherence to RGs in intervention and non-intervention group. We did not report the CI of the effect size when authors did not report it in the original papers.

**As the 80 individual studies that belong to this category used different measures of adherence to reporting guidelines, we report here the measures used in the two systematic reviews that summarized the pooled results of most of these studies (3,6).



PRISMA–ScR Checklist*

| Section/topic | # | Checklist item | Reported on page # |
|---------------------------|---|---|--|
| TITLE | | | |
| Title | 1 | Identify the report as a scoping review. | 1 |
| ABSTRACT | | | |
| Structured summary | 2 | Provide a structured summary that includes (as applicable) background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives. | 1,2 |
| INTRODUCTION | | | |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach. | 3,4 ("Background") |
| Objectives | 4 | Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives. | 5 ("Objectives") |
| METHODS | | | |
| Protocol and registration | 5 | Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number. | 5 ("Methods") |
| Eligibility criteria | 6 | Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale. | 5,6 ("Eligibility Criteria", "Exclusion Criteria") |
| Information sources | 7 | Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed. | 6 ("Search Strategy and Study Selection") |
| Search | 8 | Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated. | 6 ("Search Strategy and Study Selection") |
| Study selection | 9 | State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review. For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml | 6,7 ("Search Strategy and Study Selection") |



PRISMA-ScR Checklist*

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| | | | Selection") |
| Data collection process | 10 | Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators. | 8 ("Data Extraction") |
| Data items | 11 | List and define all variables for which data were sought and any assumptions and simplifications made. | 8 ("Data Extraction") |
| Risk of bias in individual studies | 12 | If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate). | N/A |
| Summary measures | 13 | Not applicable for scoping reviews. | N/A |
| Synthesis of results | 14 | Describe the methods of handling and summarizing the data that were charted. | 9 ("Data Synthesis) |

Page 1 of 2

| Section/topic | # | Checklist item 10 | Reported on page # |
|-------------------------------|----|--|--------------------|
| Risk of bias across studies | 15 | Not applicable for scoping reviews. | N/A |
| Additional analyses | 16 | Not applicable for scoping reviews. | N/A |
| RESULTS | | | |
| Study selection | 17 | Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram. | Figure 1 |
| Study characteristics | 18 | For each source of evidence, present characteristics for which data were charted and provide the citations. | 10 ("Results) |
| Risk of bias within studies | 19 | If done, present data on critical appraisal of included sources of evidence (see item 12). | N/A |
| Results of individual studies | 20 | For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives. | 10 ("Results") |
| Synthesis of results | 21 | Summarize and/or present the charting results as they relate to the review questions and objectives. | 10-15 ("Results") |



PRISMA–ScR Checklist*

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| Risk of bias across studies | 22 | Not applicable for scoping reviews. | |
| Additional analysis | 23 | Not applicable for scoping reviews. | |
| DISCUSSION | | | |
| Summary of evidence | 24 | Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups. | 15 ("Discussion") |
| Limitations | 25 | Discuss the limitations of the scoping review process. | 17 ("Discussion") |
| Conclusions | 26 | Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps. | 15-17 ("Discussion") |
| FUNDING | | | |
| Funding | 27 | Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review. | 18 ("Declarations – Funding") |

*Original source: <http://annals.org/aim/fullarticle/2700389/prisma-extension-scoping-reviews-prisma-scr-checklist-explanation>