European Radiology (2019) 29:3986–3995
https://doi.org/10.1007/s00330-018-5980-3

IMAGING INFORMATICS AND ARTIFICIAL INTELLIGENCE

Impact and perceived value of journal reporting guidelines among *Radiology* authors and reviewers

Marc Dewey[1] · Deborah Levine[2,3] · Patrick M. Bossuyt[4] · Herbert Y. Kressel[2,3]

Received: 23 November 2018 / Revised: 8 December 2018 / Accepted: 17 December 2018 / Published online: 29 January 2019

Abstract

Objectives To analyse the author-perceived impact on the final manuscript and perceived value of journal reporting guidelines among *Radiology* authors and reviewers.

Methods This survey was conducted among all corresponding authors of original research submissions to *Radiology*. Separately, we surveyed active *Radiology* reviewers. Results were analysed using logistic multivariate regression.

Results Overall, 60% of authors (831/1391) completed the survey. Only 15% (120/821) had used the guideline and checklist when designing the study, significantly more so for PRISMA (55%, 16/29) compared with STARD and STROBE users (17%, 52/310; $p < 0.001$ and 10%, 46/443; $p < 0.001$). For 23% of the surveyed manuscripts (189/821), authors used the guidelines when writing the manuscript; these authors more often reported an impact on the final manuscript (i.e. changes in the content, 57%, 107/189) compared to those who used the guideline when submitting the manuscript (35%, 95/272; $p < 0.001$; OR 0.433, 95% confidence interval [CI] 0.288–0.648, $p < 0.001$) or when the checklist was requested by the editorial office (17%, 41/240; $p < 0.001$; OR 0.156, CI 0.097–0.247, $p < 0.001$). The perceived value of the reporting guideline was rated significantly higher the earlier the authors used the guideline in the research process ($p < 0.001$). The checklist was used by 77% of reviewers (200/259) some or all of the time; 60% (119/199) said it affected their reviews.

Conclusion Reporting guidelines had more author-perceived impact on the final manuscript and higher perceived value the earlier they were used, suggesting that there is a need for enhanced education on the use of these guidelines.

Key Points

- *Only 15% of authors had used the respective reporting guideline and checklist when designing the study.*
- *Almost 4 out of 5 Radiology authors and half of reviewers judged the guideline checklists to be useful or very useful.*
- *Reporting guidelines had more author-perceived impact on manuscripts, i.e. changes that were made in the final manuscript, the earlier authors used them in the research process.*

Keywords Randomised controlled trial · Clinical trial · Diagnostic imaging · Information dissemination · Surveys and questionnaires

Abbreviations

CONSORT	Consolidated Standards of Reporting Trials
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses)
STARD	Standards for Reporting Diagnostic Accuracy
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology

Introduction

To enhance the quality and transparency of original research reporting [1, 2], clinical reporting guidelines have been

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s00330-018-5980-3) contains supplementary material, which is available to authorized users.

✉ Marc Dewey
marc.dewey@charite.de

[1] Charité – Universitätsmedizin Berlin, Humboldt-Universität and Freie Universität zu Berlin, Berlin, Germany

[2] Beth Israel Deaconess Medical Center, Boston, USA

[3] Harvard Medical School and Radiology, Boston, USA

[4] Academic Medical Center, University of Amsterdam, Amsterdam, The Netherlands

developed by researchers, methodologists, and journal editors. The EQUATOR network, an umbrella organisation, provides reporting guidelines that are adapted to each category of research [3]. The most relevant reporting guidelines for imaging publications are CONSORT (*Consolidated Standards of Reporting Trials*) [4, 5], STARD (Standards for Reporting Diagnostic Accuracy) [6, 7], PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) [8, 9], and STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) [10].

Their purpose is to facilitate the reporting of studies for authors and to facilitate readers' assessment of the suitability of the methods and the internal and external validity of the results. While there is encouraging evidence that clinical reporting guidelines improve reporting quality [11], there are also relevant challenges for implementation and dissemination [12]. The perceived value and impact of journal reporting guidelines on the content of final manuscripts are not entirely clear and have not been evaluated in the field of radiology.

A masked randomised trial of conventional peer review versus reviews based on the STROBE and CONSORT guidelines showed that authors adhere more to suggestions from conventional reviews and suggested that authors should be aware of reporting guidelines at the very beginning of their study [13]. Unlike clinical reporting guidelines, the ARRIVE guideline (Animal Research: Reporting of in vivo Experiments) was not found to improve the quality of animal research reporting in a comparison of journals supporting versus those not supporting the guideline [14]. In contrast, the CONSORT statement was shown to improve the quality of reports of randomised controlled trials [15, 16]. Completeness of reporting in diagnostic accuracy studies also improved following the publication of the STARD guideline but remained suboptimal for many articles [17]. The overall quality of reporting of observational studies remained suboptimal in a before-after analysis following the publication of STROBE [18]. An evaluation of the uptake of PRISMA in systematic reviews and meta-analyses found that the quality of reporting continued to be suboptimal [19]. To our knowledge, no study has prospectively and directly assessed the perceived value of standardised clinical reporting guidelines by authors and reviewers in the field of medical imaging.

In February 2016, it became mandatory for all original research manuscripts submitted to *Radiology* presenting STROBE (observational studies) [10], CONSORT (randomised trials) [4, 5], STARD (diagnostic studies) [6], and PRISMA research (meta-analyses) [8, 9] to be accompanied by a guideline checklist before peer review [20]. The journal had endorsed CONSORT and STARD since 2003 and PRISMA since it was introduced. The purpose of this study was thus to address the hypothesis that mandatory use of the reporting guidelines and checklists, based on the journal policy requiring adherence to reporting guidelines and the need to deliver a completed guideline checklist at the time of submission, adds perceived value for authors and manuscript peer reviewers.

Materials and methods

Study objectives

The study had three study objectives: (1) When and how are reporting guidelines and checklists used by authors and reviewers? (2) What is their impact on the content of final manuscript drafts according to authors? and (3) How do authors and reviewers perceive the value of reporting guidelines and related checklists?

Study design

We conducted a non-mandatory online survey among authors of original research submissions that belonged to one of the four reporting guideline categories. This investigation received a waiver of exemption from the committee on clinical investigations at Beth Israel Deaconess Medical Center. Between July 5, 2016, and June 1, 2017, all corresponding authors were contacted by email by a server outside of the editorial office to complete an anonymised online survey within two weeks of manuscript submission, but before the editorial decision was made. The anonymity made it impossible to correlate survey results with manuscript acceptance information and author characteristics. The internet transfer protocol used to access the survey allowed us to identify the country of origin of authors. The full details of the survey are included in Electronic Supplementary Material 1. Free text comments of responders were grouped into positive, negative, or both by one author (MD). After initiation of the author survey, we decided to perform a separate reviewer survey. To cover an overlapping time period, we surveyed reviewers who had performed reviews for *Radiology* since February 2016. This survey was conducted from May 17 until June 1, 2017 (Electronic Supplementary Material 2). The manuscript review system did not allow for identification of types of studies sent to our reviewers, and thus all reviewers active during the time period were surveyed, even those who had not performed reviews of original clinical research studies.

Statistical analysis

Normally distributed data are provided as means (SD), not normally distributed data as medians with interquartile ranges (IQR). We performed chi-square tests to compare proportions. Missing data were not imputed. Two logistic multivariable regression analyses were performed for the author survey to evaluate the strength of associations between manuscript characteristics (country of origin, type of reporting guideline,

when the guideline was used, time passed since submission, and number of articles submitted since January 2016 to the journal) as determinants and first, the reported impact from using the guidelines on the content of the final manuscript according to the authors and second, the perceived usefulness of guidelines in the development of the manuscript as outcomes. The manuscript characteristics included in the analysis were type of reporting guideline relevant for manuscript (CONSORT, STARD, STROBE, PRISMA, using STROBE as reference category), early use of reporting guideline (e.g. when designing the study, when writing the manuscript, when submitting the manuscript, when requested by editors, using when writing the manuscript as the statistical reference category), country of origin (grouped into the following: USA and Canada, China, South Korea, Japan, Germany, France, Italy, UK, other European countries [any country with less than 1% of the overall response]), Middle East, and Latin America, and other countries, using the USA and Canada as the statistical reference category), level of perceived value of the guidelines for authors (very useful, somewhat useful, not very useful, or not at all useful) and number of articles previously published in the journal. This was a convenience sample of a 1-year study period after institution of the mandatory guideline usage. We used SPSS version 22 (SPSS Inc.) and R version 3.4.1 with a significance level of 0.05 in all statistical tests.

Results

During the study period, 1391 research manuscripts that were eligible for one of the four reporting guidelines were submitted. Overall, 60% of the corresponding authors of these manuscripts (831) completed the non-mandatory online survey within 1.5 days (SD 2.7; range 0–17) after the invitation. The response rate of reviewers to the survey conducted over a period of 2 weeks was 32% (259/808).

Consistent with the types of studies submitted to the journal, most manuscript authors reported having used STROBE (54%, 447/829) or STARD (39%, 313/829), and a minority used CONSORT (5%, 40/829) or PRISMA (3%, 29/829). The most common countries of origin are displayed in Table 1. The majority of authors had submitted one or two prior articles to *Radiology* since mandating the use of reporting guideline checklists in February 2016 (59%, 477/813 and 23%, 186/813) while 10% of authors (81/813) had submitted 3 articles, 5% (38/813) 4 articles, 1% (8/813) 5 articles, 0.4% (3/813) 6 articles, and 2% (20/813) more than 6 articles.

Table 1 Authors' countries

Country or region	Frequency	%
USA and Canada	174	20.9
China	164	19.7
South Korea	72	8.6
Japan	65	7.8
Germany	53	6.3
France	52	6.2
Italy	40	4.8
UK	14	1.7
Other European countries	86	10.3
Middle East	19	2.3
Latin America	15	1.8
Other	77	9.2
Total	831	100

Impact of reporting guidelines

In only 15% of manuscript submissions (120/821), the guideline and checklist had been used when designing the study meaning they influenced the content of the final manuscript and thus had an impact. Such early use of the reporting guideline was reported significantly more often by PRISMA users for meta-analyses (55%, 16/29) compared with STARD users for diagnostic accuracy studies (17%, 52/310; $p < 0.001$) and STROBE users for observational studies (10%, 46/443; $p < 0.001$; Fig. 1).

In 23% (189/821) of the surveyed manuscripts, authors had used the guidelines when writing the manuscript; these authors more often reported an impact on the final manuscript (i.e. changes were made to the final manuscript based on the checklist, 57%, 107/189) compared to those who used the guideline when submitting the manuscript (35%, 95/272; $p < 0.001$) or when the checklist was requested by the editorial office (17%, 41/240; $p < 0.001$; Fig. 2). Sections of the manuscripts most commonly affected were Methods (63%, 154/243), Abstract (39%, 94/243), and Results (33%, 80/243) followed by Discussion (25%, 61/243), and Introduction (18%, 43/243) sections, figures (17%, 41/243), and tables (13%, 31/243).

The multivariable logistic regression model showed a reduced author-perceived impact on the manuscript when authors had used guidelines only when submitting the manuscript (OR 0.433, 95% confidence interval [CI] 0.288–0.648, $p < 0.001$) or when requested by editors (OR 0.156, CI 0.097–0.247, $p < 0.001$, Table 2). The country of origin was not associated with the impact of the guidelines on the manuscript. Finally, a higher number of articles already published earlier by the authors also reduced the impact of the guideline and checklist (OR 0.827, CI 0.702–0.962, $p = 0.017$, Table 2).

Perceived value by authors and reviewers

Completing the checklist was considered to be very useful by 31% of the authors (256/819), somewhat useful by 48% (390/819), not very useful by 15% (122/819), and not at all useful by

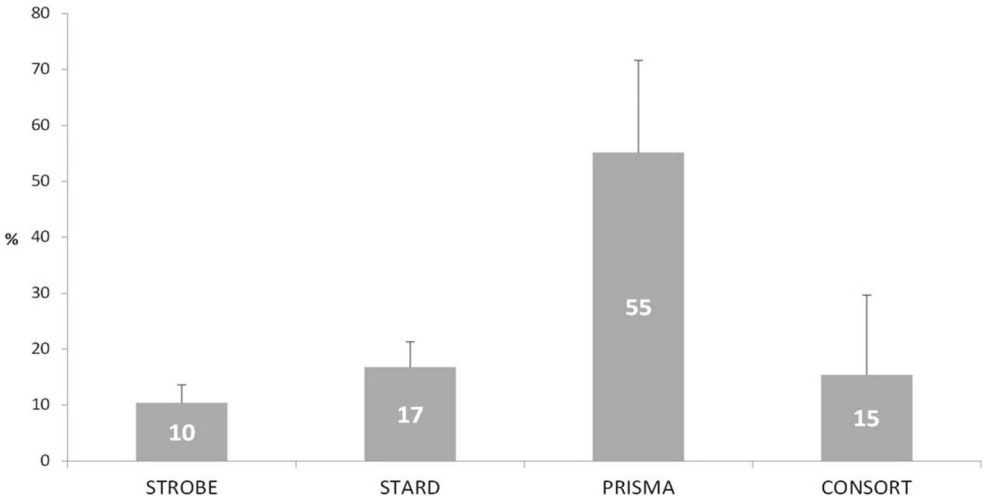

Fig. 1 Proportion of reporting guideline use when designing different study types. Overall, only 15% of authors used the reporting guideline when designing their studies. This was significantly more common for PRISMA users (55%; $p < 0.001$)

6% (51/819; Fig. 3a). The perceived value of the reporting guideline was rated significantly higher the earlier the authors had used the guideline in the research process ($p < 0.001$; Fig. 4).

The checklist was used by 77% of reviewers (200/259) some or all the time; 60% (119/199) said it affected their reviews. Having the checklist for review was considered very useful by 11% (28/256), somewhat useful by 41% (106/256), not very useful by 32% (82/256), and not at all useful by 16% of reviewers (40/256). Figure 3b shows that authors rated the perceived value higher than reviewers ($p < 0.001$).

In the multivariable logistic regression model, a lower perceived value was reported by the authors when using the guideline and checklist submitting the manuscript (OR 0.257, CI 0.137–0.459, $p < 0.001$) or after being requested by the editorial office (OR 0.201, CI 0.107–0.361, $p < 0.001$, Table 3) compared to using the guideline and checklist when writing the manuscript. The value was perceived higher by authors from China (OR 12.3, CI 5.436–33.366, $p < 0.001$), Japan (OR 5.12 with 95% confidence interval 2.18 to 14.15, $p < 0.001$), Italy (OR 2.86, CI 1.17–8.08, $p < 0.05$), and South Korea (OR 2.17, CI 1.09–4.57, $p < 0.001$, Table 3). A lower perceived value was reported by authors with more previously published articles (OR 0.85, CI 0.745–0.990, $p < 0.05$, Table 3).

Free text comments

Seventy-four authors (9%) made comments or provided suggestions for improvements. Of the 59 authors who made comments (80%), 11 also made proposals for further improvements while 15 authors (20%) only made proposals for further improvements (Table 4). Of the 59 comments made by authors 48 were positive (81%), 4 were negative (7%), and 7 mentioned both positive and negative aspects (Table 4).

Eighty-two reviewers (32%) made comments or provided suggestions for improvements. Of the 79 reviewers who made comments (96%), six also made proposals for further

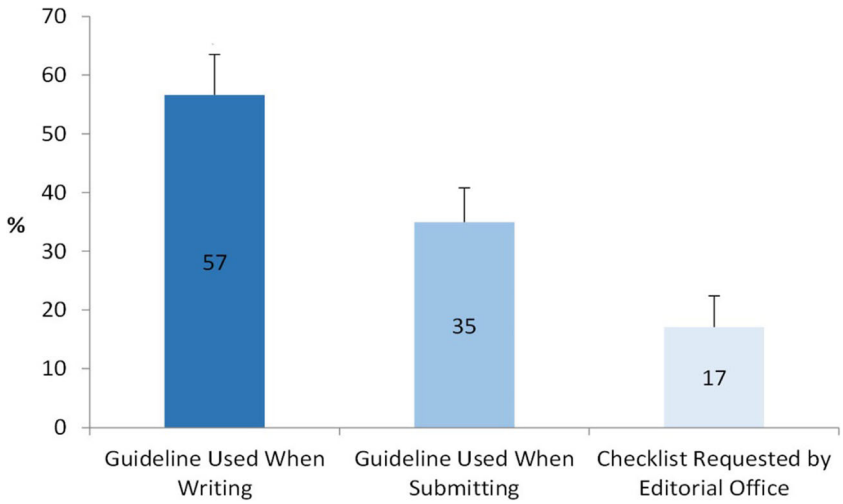

Fig. 2 Impact of the guideline and checklist on the manuscript according to when they were used. Using the reporting guidelines and checklists earlier (e.g., when writing) was associated with a significantly more likely impact on the final manuscript submitted (57%; $p < 0.001$). Results were confirmed by multivariate logistic regression (Table 2)

Table 2 Multivariable logistic regression results for impact of guideline on the manuscript

Variable	OR (CI)	*p*
Reference: STROBE		
QUADAS	1.364 (0.949–1.959)	0.093
PRISMA	1.635 (0.445–6.212)	0.455
CONSORT	1.369 (0.623–2.976)	0.428
Reference: when writing manuscript		
When submitting manuscript	0.433 (0.288–0.648)	< 0.001
When checklist requested by editors	0.156 (0.097–0.247)	< 0.001
Reference: USA and Canada	1	
China	1.538 (0.899–2.638)	0.116
South Korea	0.869 (0.432–1.712)	0.689
Japan	1.348 (0.657–2.726)	0.409
Germany	0.734 (0.325–1.584)	0.441
France	0.828 (0.359–1.829)	0.648
Italy	0.899 (0.389–1.998)	0.797
UK	1.196 (0.268–4.679)	0.802
Other European countries	0.787 (0.398–1.534)2.517	0.486
Middle East	(0.856–7.753)	0.096
Latin America	1.484 (0.399–5.153)	0.537
Other	0.823 (0.426–1.566)	0.557
Time passed since submission	1.002 (0.939–1.066)	0.954
Number of articles published earlier in journal	0.827 (0.702–0.962)	0.017

improvements while 3 reviewers (4%) only made proposals for further improvements (Table 5). Of the 79 comments received 54 were positive (68%), 21 were negative (27%), and 4 mentioned both positive and negative aspects (Table 5).

Discussion

The principal findings of our survey are (1) only 15% of authors had used the reporting guideline and checklist when designing the study while the checklist was used by 77% of reviewers some or all the time; (2) reporting guidelines had more author-perceived impact on manuscripts the earlier in the research process authors used them, e.g. during writing versus when submitting, 60% of reviewers said having the checklist available affected their reviews and (3) almost 4 out of 5 *Radiology* authors and half of reviewers perceived the guideline checklists to be useful or very useful. Importantly, we found that reporting guidelines had the greatest perceived value and impact when used early in the research process. Surprisingly, also meta-analysis researchers used the PRISMA reporting guideline and checklist in only 55% of the cases already when designing their methods suggesting that a large proportion of meta-analysis authors are not experts. While the guideline checklists were not written with the expectation that they would be used during the review process, we found that only half of our reviewers found the checklists to be useful or very useful.

A journal policy requiring adherence to well-designed reporting guidelines may improve reporting quality [20].

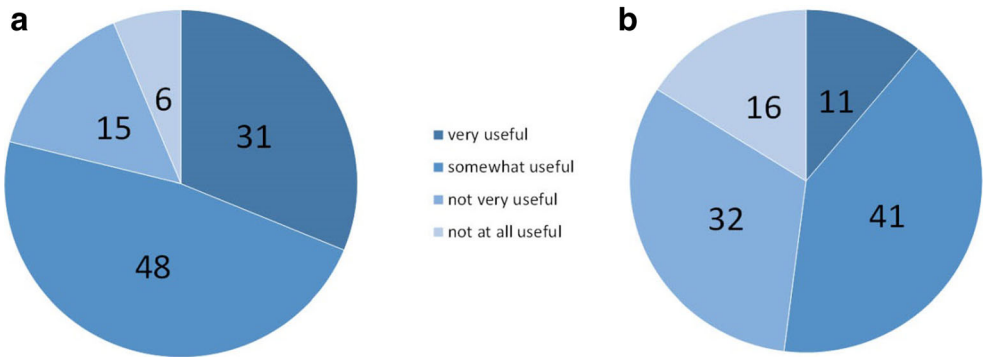

Fig. 3 Comparison of perceived value by authors and reviewers. Authors perceived the value of the reporting guidelines and checklists to be greater (**a**) compared with the responses given by the reviewers (**b**; $p < 0.001$)

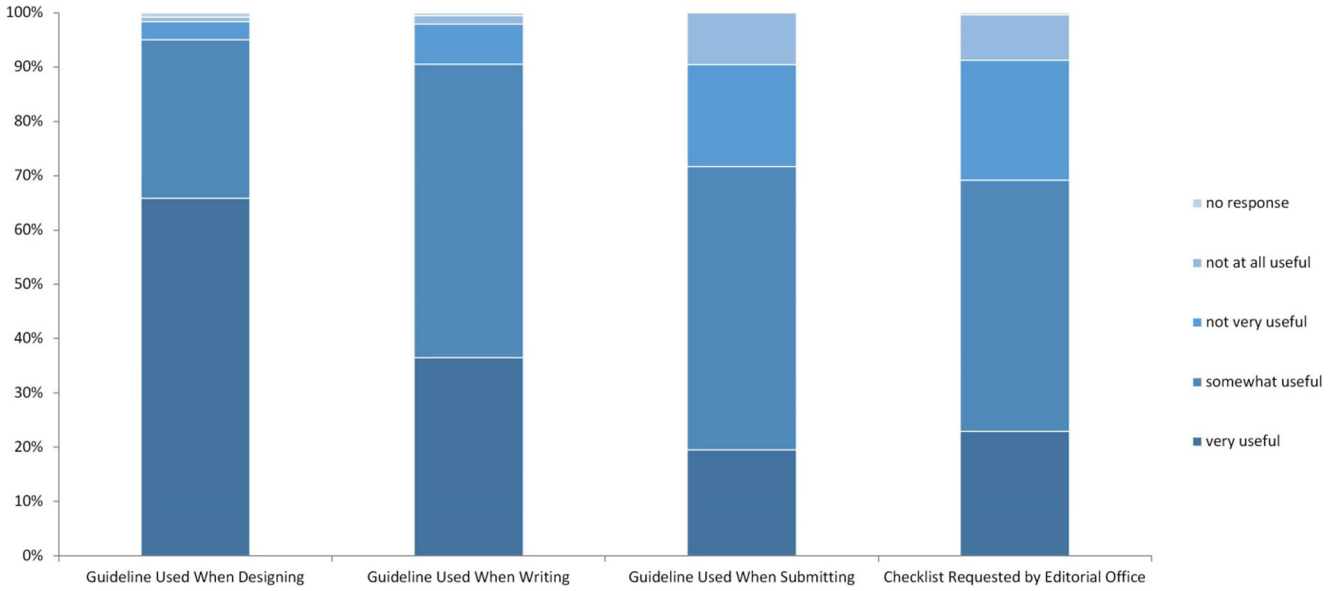

Fig. 4 Perceived value by authors depending on when the guideline was used. The perceived value was significantly greater the earlier the reporting guideline was used in the research process ($p < 0.001$)

Earlier studies suggest that journal endorsement of the CONSORT statement has improved the quality of reporting of randomised controlled trials [20, 21], whereas the quality of reporting has not improved after publication of STROBE [18] and PRISMA [19] but improved over time yet remained suboptimal after publication of STARD [17]. Our study is the first, to our knowledge, to analyse the perceived value of the four journal reporting guidelines (CONSORT, STROBE, STARD, and PRISMA) and impact to authors and reviewers. It adds the following key findings to the existing body of evidence: there is a significantly lower impact and less perceived value when guidelines and checklists are used later in the research process. The early use of guidelines was best, while it was still not optimal, for meta-analysis researchers

Table 3 Multivariable logistic regression results for the author-perceived value

Variable	OR (CI)	*p*
Reference: STROBE		
QUADAS	1.210 (0.809–1.818)	0.355
PRISMA	0.765 (0.226–3.041)	0.679
CONSORT	1.529 (0.526–5.610)	0.472
Reference: when writing manuscript		
When submitting manuscript	0.257 (0.137–0.459)	< 0.001
When checklist requested by editors	0.201 (0.107–0.361)	< 0.001
Reference: USA and Canada	1	
China	12.346 (5.436–33.366)	< 0.001
South Korea	2.178 (1.092–4.579)	0.032
Japan	5.127 (2.183–14.157)	< 0.001
Germany	1.713 (0.825–3.747)	0.160
France	1.800 (0.842–4.079)	0.141
Italy	2.860 (1.172–8.087)	0.030
UK	0.487 (0.136–1.735)	0.261
Other European countries	1.050 (0.548–2.048)	0.884
Middle East	3.939 (1.027–25.943)	0.080
Latin America	1.950 (0.548–9.170)	0.337
Other	1.270 (0.675–2.444)	0.464
Time passed since submission	1.021 (0.950–1.104)	0.589
Number of articles published earlier in journal	0.859 (0.745–0.990)	0.035

Table 4 Authors' free text comments

	Authors ($N = 59$)
Comments	
Positive	48 (81)
Very useful	12 (20)
Helped a lot with writing	12 (20)
Useful	10 (17)
Scientifically rigorous	6 (10)
Helped a lot designing our research	5 (8)
Transparent reporting process	2 (3)
Checklist is a very helpful summary of sometimes confusing guidelines	1 (2)
Negative	4 (7)
Submission is becoming increasingly painful	2 (3)
Checklists cannot fit all types of research	1 (2)
When writing a good manuscript, you already conform to the points	1 (2)
Both (positive and negative aspects)	7 (12)
Helpful at beginning of career, but not at later stage	5 (8)
Important but not covering practical aspects	1 (2)
Useful but may form opinion of *Radiology* as harder journal	1 (2)
Proposals for further improvements	Authors ($N = 26$)
Include the checklist in the online submission process	5 (19)
Guidance for papers not in one of the four guideline categories	5 (19)
Simplify the checklist	5 (19)
Please also consider practical aspects of radiology	2 (8)
Reviewers should fill in the checklist	2 (8)
Checklist should be filled out before submission	2 (8)
Add TRIPOD	1 (4)
Provide a manuscript template to strictly comply with the guidelines	1 (4)
Align with NIH scientific rigour criteria	1 (4)
Authors should know the requirements before designing their study	1 (4)
Better highlight the guideline requirements	1 (4)

Numbers (%). Proportions might not add to 100% because of rounding

using PRISMA, likely because of better guidance in the field of diagnostic meta-analyses and a longer time period since the more wide-spread use of PRISMA. The earlier reporting guidelines and checklists were used in our study the higher their impact on the final manuscript and perceived value, indicating that to enhance article reporting quality, authors should be made aware of reporting guidelines at the very beginning of their study in order to better understand the rationale and importance of each item on the guideline checklists [13].

Despite the fact that our study indicates a perceived value of encouraging adherence to reporting guidelines by mandating their use in journal policies, it is unclear whether this will lead to more consistent adherence and ultimately improved quality of reporting. This may benefit from longer-lasting learning among authors and reviewers to implement guidelines and checklists at the start of new research projects. To achieve this goal, learning processes need to be stimulated by scientific societies, institutions, and journals. Ultimately, future research should compare the scored quality of reporting in imaging journals requesting versus those not requesting the use of reporting guideline checklists, along with studies comparing reporting quality in the same journal before and after utilisation of guidelines.

A major concern raised by several manuscript reviewers responding to our survey was that an author might simply indicate that a specific reporting guideline element was included, without actually including this data in their manuscript. Stronger training programs for trainees and investigators that emphasise the rationale and the importance of reporting guidelines are likely needed. Also, guideline developers should be encouraged to transform reporting guidelines into protocol development tools to have greater effects in the research planning phase and maybe also into strict structure suggestions for manuscripts in elaboration documents. Moreover, novel ways such artificial intelligence to automatically assess for the

Table 5 Reviewers' free text comments

	Reviewers ($N = 79$)
Comments	
Positive	54 (68)
Useful	26 (33)
Helps improve quality of manuscripts	12 (15)
Checklist is informative in reviewing manuscripts	6 (8)
Very useful	5 (6)
Educational exercise for reviewers and authors	3 (4)
Scientifically rigorous	1 (1)
Standardised data presentation	1 (1)
Negative	16 (20)
Authors often do lip service rather than understand the spirit of guidelines	5 (6)
Not very useful	4 (5)
Don't really use them	3 (4)
Additional hurdle for author and reviewer	3 (4)
Stop throwing more work at authors	2 (3)
Not everything is amenable to that sort of "discipline"	1 (1)
Paper is more cumbersome to read with checklist	1 (1)
No impact on reviewing	1 (1)
Useful in theory but in practice not so much	1 (1)
Both (positive and negative aspects)	4 (5)
Helpful at beginning of career, but not at later stage	2 (3)
Bureaucratic but inevitable	1 (1)
Onerous but perhaps necessary	1 (1)
Proposals for further improvements	Reviewers ($N = 9$)
Editorial team should pre-screen the checklist	1 (1)
All authors (not just the first) should be requested to fill out the checklist	1 (1)
Reviewers should check the checklist	1 (1)
Be more specific about how important it is to meet certain criteria	1 (1)
Simplify the checklist	1 (1)
Integrate the checklist with the manuscript in the submission process	1 (1)
Some items on the checklist should be checked by editor or reviewers (and not authors)	1 (1)
Include page locations in checklist	1 (1)
Develop manuscript templates for different categories	1 (1)

Numbers (%). Proportions might not add to 100% because of rounding

presence of reporting items in submitted manuscripts may be helpful. This will also avoid burdening reviewers, who may not always have the time or knowledge to check submitted manuscripts for the presence of all guideline elements. An alternative would be to manually screen all manuscripts at the editorial office level, which would increase scientific editor burden. Another challenge is that the rates of adoption of reporting guidelines are still far from ideal [11], which will require joint efforts by scientific societies, institutions, and journals.

The use of guidelines only improves the transparency in disclosing the methodological details and results of the research done, it does not necessarily lead to a higher quality of the actual methods used. The novelty and potential utility of the research performed cannot be supplanted by even the most transparent reporting. Because of strong heterogeneity in the application of guideline statements in different journals, a common agreement among journals regarding reporting guidelines could improve the quality of research publishing [22]. Another promising solution to tackle this challenge is the use of online writing aids such as the COBWEB tool, which was shown to improve the completeness of manuscripts reporting the results of randomised controlled trials [23]. The primary goal behind mandated use of checklists is to improve the reporting quality of clinical studies to aid in overcoming current reproducibility issues as better reporting of all relevant data elements would allow readers to replicate studies.

The study has a number of limitations, the first being that, due to the anonymised nature of this survey, neither manuscript acceptance information nor author characteristics were available. Authors' responses were not made available to the editorial office and thus could not influence editorial decisions. The respondents were aware of this blinding and thus more likely to provide honest responses about the impact and perceived usefulness of reporting guidelines and checklists. However, this precluded our ability to correlate manuscript fate with use of checklists and the impact on actual reporting quality. Thus, the present study is only the first step in a larger effort to determine the association of reporting guideline use with the ultimate impact of the articles by comparing scored reporting quality of submitted or published manuscripts in different journals from different time periods. The response rate of reviewers was lower than that of the authors, in part due to the retrospective nature of our reviewer survey which surveyed all reviewers utilised during the time period and not just those who assessed clinical research studies. Results of this cross-sectional observational study may have limited generalisability to other journals. Even the most accurate reporting cannot avoid biases in the study design itself [24] and possible over-interpretation of study findings [25].

In conclusion, our cross-sectional study documented that the earlier reporting guidelines and checklists are used by authors during the research process the higher their perceived value and impact on the manuscript. Early use of reporting guidelines however was rare, with only 15% having using reporting guidelines when designing their study and only 23% when writing the manuscript. This leads to the conclusion that much more education of researchers is needed about the benefits of an early use of reporting guidelines. This may also benefit future data sharing initiatives as the quality of initial reporting is improved [26]. Early use of reporting guidelines and checklists will probably require a stronger emphasis in the training of researchers, educating them about the benefits, reviewers should consider ensuring guideline content during their reviews, and it appears pivotal to support journals in their efforts of hard-wiring adherence to reporting guidelines.

Acknowledgments We thank all authors and reviewers for participation in this study. Without the help of the staff at the Radiological Society of Northern America (RSNA), this study would not have been possible. We are also thankful to other members on the editorial board of *Radiology* for discussions. We are thankful to Bettina Herwig for copy editing, to Kyllan Wescott for data management, and to Ivan Perez for help with the multivariable analysis.

Funding Prof. Dewey has received support for this study from the International Society for Strategic Studies in Radiology (Young Leaders Club).

Compliance with ethical standards

Guarantor The scientific guarantor of this publication is Prof. Dr. Marc Dewey.

Conflict of interest The authors of this manuscript declare no relevant relationships with companies and no conflicts of interest.

Statistics and biometry No complex statistical methods were necessary for this paper.

Informed consent This investigation received a waiver of exemption from the committee on clinical investigations at Beth Israel Deaconess Medical Center.

Ethical approval This investigation received a waiver of exemption from the committee on clinical investigations at Beth Israel Deaconess Medical Center.

Methodology
• Prospective

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

References

1. Topol EJ (2016) Money back guarantees for non-reproducible results? BMJ 353:i2770
2. Rennie D, Flanagin A (2014) Research on peer review and biomedical publication: furthering the quest to improve the quality of reporting. JAMA 311:1019–1020
3. The Equator Network. Available via http://www.equator-network.org/. Accessed 28 Sept 2017
4. Moher D, Hopewell S, Schulz KF et al (2010) CONSORT 2010 explanation and elaboration: updated guidelines for reporting parallel group randomised trials. BMJ 340:c869
5. Schulz KF, Altman DG, Moher D; CONSORT Group (2010) CONSORT 2010 statement: updated guidelines for reporting parallel group randomised trials. BMJ 340:c332
6. Bossuyt PM, Reitsma JB, Bruns DE et al (2015) STARD 2015: an updated list of essential items for reporting diagnostic accuracy studies. BMJ 351:h5527
7. Bossuyt PM, Reitsma JB, Bruns DE et al (2003) Towards complete and accurate reporting of studies of diagnostic accuracy: the STARD initiative. Radiology 226:24–28
8. Liberati A, Altman DG, Tetzlaff J et al (2009) The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. BMJ 339:b2700
9. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group (2009) Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. BMJ 339:b2535
10. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative (2007) Strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. BMJ 335:806–808
11. O'Leary JD, Crawford MW (2013) Review article: reporting guidelines in the biomedical literature. Can J Anaesth 60:813–821
12. Grant SP, Mayo-Wilson E, Melendez-Torres GJ, Montgomery P (2013) Reporting quality of social and psychological intervention

trials: a systematic review of reporting guidelines and trial publications. PLoS One 8:e65442
13. Cobo E, Cortés J, Ribera JM et al (2011) Effect of using reporting guidelines during peer review on quality of final manuscripts submitted to a biomedical journal: masked randomised trial. BMJ 343:d6783
14. Leung V, Rousseau-Blass F, Beauchamp G, Pang DSJ (2018) ARRIVE has not ARRIVEd: support for the ARRIVE (animal research: reporting of in vivo experiments) guidelines does not improve the reporting quality of papers in animal welfare, analgesia or anesthesia. PLoS One 13:e0197882
15. Moher D, Jones A, Lepage L; CONSORT Group (Consolidated Standards for Reporting of Trials) (2001) Use of the CONSORT statement and quality of reports of randomized trials: a comparative before-and-after evaluation. JAMA 285:1992–1995
16. Plint AC, Moher D, Morrison A et al (2006) Does the CONSORT checklist improve the quality of reports of randomised controlled trials? A systematic review. Med J Aust 185:263–267
17. Korevaar DA, Wang J, van Enst WA et al (2015) Reporting diagnostic accuracy studies: some improvements after 10 years of STARD. Radiology 274:781–789
18. Pouwels KB, Widyakusuma NN, Groenwold RH, Hak E (2016) Quality of reporting of confounding remained suboptimal after the STROBE guideline. J Clin Epidemiol 69:217–224
19. Page MJ, Moher D (2017) Evaluations of the uptake and impact of the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement and extensions: a scoping review. Syst Rev 6:263
20. Levine D, Kressel HY (2016) Radiology 2016: the care and scientific rigor used to process and evaluate original research manuscripts for publication. Radiology 278:6–10
21. McInnes MD, Bossuyt PM (2015) Pitfalls of systematic reviews and meta-analyses in imaging research. Radiology 277:13–21
22. Mannocci A, Saulle R, Colamesta V et al (2015) What is the impact of reporting guidelines on public health journals in Europe? The case of STROBE, CONSORT and PRISMA. J Public Health (Oxf) 37:737–740
23. Barnes C, Boutron I, Giraudeau B, Porcher R, Altman DG, Ravaud P (2015) Impact of an online writing aid tool for writing a randomized trial report: the COBWEB (Consort-based WEB tool) randomized controlled trial. BMC Med 13:221
24. Schueler S, Walther S, Schuetz GM, Schlattmann P, Dewey M (2013) Methodological quality of diagnostic accuracy studies on non-invasive coronary CT angiography: influence of QUADAS (quality assessment of diagnostic accuracy studies included in systematic reviews) items on sensitivity and specificity. Eur Radiol 23:1603–1622
25. Frank RA, Sharifabadi AD, Salameh JP et al (2018) Citation bias in imaging research: are studies with higher diagnostic accuracy estimates cited more often? Eur Radiol. https://doi.org/10.1007/s00330-018-5801-8
26. Sardanelli F, Alì M, Hunink MG, Houssami N, Sconfienza LM, Di Leo G (2018) To share or not to share? Expected pros and cons of data sharing in radiological research. Eur Radiol 28:2328–2335