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Bias in dissemination of clinical research findings: structured OPEN framework of what, who and why, based on literature review and expert consensus

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ABSTRACT

Objective: The aim of this study is to review highly cited articles that focus on non-publication of studies, and to develop a consistent and comprehensive approach to defining (non-) dissemination of research findings.

Setting: We performed a scoping review of definitions of the term 'publication bias' in highly cited publications.

Participants: Ideas and experiences of a core group of authors were collected in a draft document, which was complemented by the findings from our literature search.

Interventions: The draft document including findings from the literature search was circulated to an international group of experts and revised until no additional ideas emerged and consensus was reached.

Primary outcomes: We propose a new approach to the comprehensive conceptualisation of (non-) dissemination of research.

Secondary outcomes: Our 'What, Who and Why?' approach includes issues that need to be considered when disseminating research findings (What?), the different players who should assume responsibility during the various stages of conducting a clinical trial and disseminating clinical trial documents (Who?), and motivations that might lead the various players to disseminate findings selectively, thereby introducing bias in the dissemination process (Why?).

Conclusions: Our comprehensive framework of (non-) dissemination of research findings, based on the results of a scoping literature search and expert consensus will facilitate the development of future policies and guidelines regarding the multifaceted issue of selective publication, historically referred to as 'publication bias'.

Strengths and limitations of this study

- We present a new comprehensive framework based on results from literature review and international expert consensus on (non-) dissemination of research results.
- Our three step approach considers, for the first time, issues that need to be taken into account when disseminating research findings (What?), different players who should assume responsibility (Who?) and motivations that might lead to selective dissemination of research findings (Why?).
- We only searched Web of Science, with the simple search term 'publication bias'. This way, our literature search might have favoured older publications and systematic reviews of primary research.

BACKGROUND

Systematic reviews of randomised controlled trials provide a valid summary of the available research findings, and are therefore crucial to evidence-based medical decision-making.[1] It has long been recognised that identification of the entire relevant research evidence is essential to produce an unbiased and balanced summary, although non-dissemination of research findings may not necessarily lead to bias. For example, a journal publication may report on all prespecified outcomes and time points, but raw data may still be important for other researchers and research questions. This dissemination is not biased or selective, but, rather, a result of the current publication system. Nevertheless, ideally, all research conducted should be published and easily identifiable. Only under such circumstances can systematic reviews live up to their promise of providing unbiased, high-quality evidence for medical decision-making. However, it is not

always possible to retrieve all eligible evidence for a given topic, as many studies never get published. The phenomenon of non-publication of studies based on the nature and direction of the results is often referred to as 'publication bias'.[2 3]

Interpretations of research evidence can be distorted not only by the non-publication of an entire study—information may also be partially lacking or presented in a way that influences the take-up of the findings, such as selective reporting of outcomes or subgroups, or 'data massaging' (eg, the selective exclusion of patients from the analysis). Thus, over recent years, a new nomenclature for other types of bias related to the non-publication or distortion in the dissemination process of research findings has been developed, such as 'reporting bias',[4] 'time lag bias',[5] 'location bias',[6 7] and many more. Nevertheless, all these different aspects are often still referred to as 'publication bias'. Until now, no consensus on the definition of 'publication bias' has been reached in the literature.

Therefore, we aimed to perform a scoping review of highly cited articles that focus on non-publication of studies and to present the various definitions of biases related to the dissemination of research findings contained in the articles identified. Furthermore, we aimed to develop a comprehensive and consistent framework to defining (non-) dissemination of research findings in an international group of experts in the context of the OPEN Project (To Overcome failure to Publish nEgative fiNdings) based on the findings of our literature search.

METHODS

A detailed protocol of our methods has been published.[8] In brief, the following methods were used for literature search and the development of the 'what, who and why?' framework to defining (non-) dissemination of research findings.

Literature search

Search strategy

Our focus was on highly cited and publicly available articles in order to capture the most widely used definitions of 'publication bias'. Therefore, we searched Web of Science[9] on 19 November 2012. We used the simple search term 'publication bias', which had to be included in the title or abstract and also in the keywords. We chose Web of Science because it presents results of literature searches according to the total number of citations, therefore allowing us to identify the most frequently cited articles. Although we were interested in various aspects of problems in the dissemination process of research findings, we aimed at the identification of different definitions of 'publication bias' and thus decided that the term 'publication bias' should be part of all publications of interest. No language restrictions were applied. We did not search any other database or any grey literature.

Eligibility criteria

We included the 50 most frequently cited articles that focused on biases related to the non-publication or distortion in the dissemination process of research findings from any source and addressed to any audience. Since we were interested in the most common definitions of 'publication bias', we believed that 50 articles would provide enough information. We did not exclude self-citations, because we were interested in the absolute number of citations independent of the people who cited the work. In order to be included, articles needed to use the term 'publication bias' and provide some form of definition of it. We included only full-text articles.

Study selection

Two reviewers independently screened titles and abstracts of search results. If a title or abstract could not be rejected with certainty by both reviewers, the full text of the paper was retrieved and assessed for eligibility. Any disagreement among reviewers was resolved by discussion and consensus or, if needed, by third party arbitration.

Data extraction

A specially designed data extraction form was developed and pilot-tested. KFM and DB independently extracted all relevant information from each eligible article. The following information was collected:

- General characteristics (eg, author names, language and year of publication, journal)
- Number of citations in Web of Science and rank
- Definitions of biases related to the dissemination of research findings

Any disagreement was resolved by discussion and consensus or, if needed, arbitration by a third reviewer.

Data analysis and reporting

Data synthesis involved a descriptive summary of the range of definitions given to describe various forms of biases related to the dissemination of research findings.

Development of the OPEN framework of (non-) dissemination of research findings

We performed a scoping review of definitions of the term 'publication bias' in highly cited publications. In a second step, we proposed a draft regarding the issues that need to be considered when exploring possible biases due to selective dissemination of research findings capturing the ideas and experiences of the core group of authors. We then circulated the draft to all the co-authors and, in a third step, to all members of the OPEN consortium (an international group of experts). Experts reviewed the draft and provided feedback, as required, regarding the issues we identified, or contributed other insights. We continued this process until no additional ideas emerged. There have been three rounds of feedback: In the first round, 8 of 10 authors commented, in the second round, 5 of 10 authors

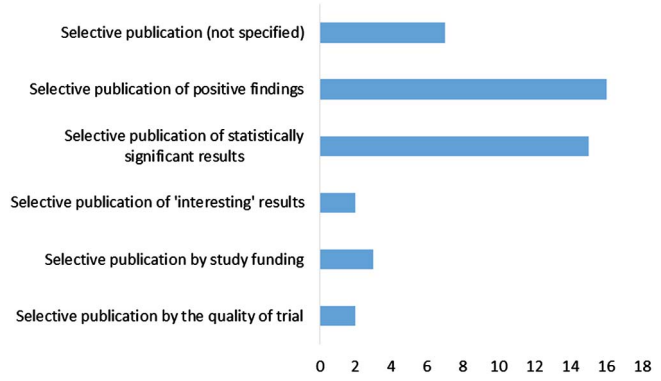

Figure 1 Various reasons for selective publication.

commented and, in the last round, 9 of 10 authors commented.

At the end of this process, we reached consensus regarding the issues that need to be considered when exploring possible biases due to selective dissemination of research findings. Based on this consensus, targeted measures to reduce dissemination bias can be developed and implemented.

RESULTS

Review of existing definitions of 'publication bias'

We included the 50 most highly cited articles that provided a definition of 'publication bias' (see online supplementary file 1: *included articles*). Further information about the included articles is given in online supplementary file 2: *General characteristics of included articles*.

Most of the articles (38/50 articles) defined 'publication bias' as a form of selective publication, for various reasons (figure 1).

Five of the 50 included articles argued that 'publication bias' as a term is not appropriate and that the authors prefer to call this phenomenon 'submitting/editing bias'.

OPEN framework of (non-) dissemination of research findings

We suggest that the traditionally used term 'publication bias' is too limited as it does not include all the various problems that can occur in the process of disseminating research findings. We therefore propose to use the term 'dissemination bias' rather than 'publication bias', as suggested by others,[10 11] because it captures various other problems that can occur throughout the entire process, from the planning and conduct of studies to the dissemination of research evidence.

More importantly, we propose a comprehensive and consistent approach to the issue of (non-) dissemination of research findings that, in part, focuses on the various key groups involved in the knowledge generation and dissemination process. The proposed approach includes three parts: (1) issues that need to be considered when exploring possible biases due to selective dissemination of research findings (What?), (2) stakeholders who could assume responsibility for the various stages of conducting a clinical trial and disseminating clinical trial documents (Who?) and (3) motivations that may lead the various players to disseminate findings selectively, thereby introducing bias in the dissemination process (Why?).

Issues that need to be considered when exploring possible biases due to selective dissemination of research findings (What?)

Based on our scoping review and our experience, the existing definitions of 'publication bias' remain rather vague, as there is currently no agreement in the scientific community about what should be considered a 'publication' and how it should be defined. It is unclear if only a full article in a peer-reviewed journal should be considered a publication, or whether other formats of

Table 1 Characteristics that need to be considered when disseminating research findings (What?)

Type of data	Format/product	Accessibility
▸ Individual data – complete* – incomplete† ▸ Summary (analysed) data – complete* – incomplete†	▸ Grey literature (press, newspaper, any kind of report, patent, technical report from government agencies or scientific research groups, working paper from research groups or committees, executive summary, book chapter, presentation at scientific conferences (abstracts, slides, posters), dissertation/ thesis, trial register entry, submission to regulatory authorities, database/statistical file*‡, regulatory drug trial reports) ▸ Full article published in a journal ▸ Regulatory documents (CSR (clinical study report), ISS (integrated summary of effectiveness or safety), PSURS (periodic safety updates), DAP (drug approval packages), EPAR (European public assessment report), CTD (common technical documents)) ▸ Study protocol, statistical analysis plan ▸ Case report forms ▸ Internal communication	▸ Open to all ▸ Available on request ▸ Restricted§ ▸ Not available outside primary research group

*All raw data.
†Selection of outcome data.
‡Analysed outcome data.
§Including paywall restrictions.

Table 2 Responsibility/influence that different players could assume in the various steps of conducting a clinical trial and in the dissemination of clinical trial documents (Who?)

	Players in the dissemination process										
Steps in trial conduct and dissemination	**Researchers authors**	**Journal editors**	**Peer reviewers of journal articles**	**Funding agencies**	**Pharmaceutical and medical device manufacturers**	**Research ethics committees**	**Research institutions**	**Regulatory agencies**	**Trial register**	**Decision making bodies***	**Readers/ patients/ patient organisations/ benefit assessment agencies/HTA bodies**
Research idea/ research question	x			x	x					x	x
Writing the study protocol	x			x	x	x		x			
Registering the study in a trial register	x	x		x	x	x	x	x	x	x	
Submitting the study protocol for a journal publication	x	x		x	x	x	x	x		x	
Publishing the study protocol		x	x	x	x				x		
Conducting the study/ assessing outcome measures	x				x						
Analysing data	x				x			x			
Writing and submitting a journal article	x				x						
Peer review		x	x								
Publishing journal research		x	x	x	x		x		x		

*Decision-making authorities in healthcare systems (eg, legal entities, such as the Federal Joint Committee in Germany).

Table 3 Motivations of players that might lead to biased dissemination of research result (Why?)

Players	Motivations
Researchers/authors	Publish or perish ▶ The importance of scientists' work is often judged by the amount of papers they publish. Journal publications not only improve the visibility and reputation of investigators, but also represent an increasingly important prerequisite for faculty positions and research funding.[15] Therefore, researchers might be pushed to preferably submit manuscripts with positive results, as they are more likely to be published Career status of authors ▶ *Junior researchers* may be less experienced and therefore may fear consequences less if biased analyses are detected. They might also be in a hurry to generate the most publications possible ▶ Junior and especially mid-career researchers are in need of frequent publications to progress their academic careers, as survival in the system of science depends on reaching a critical amount of publications within a certain time[16] ▶ *Senior researchers* have to make less effort to maintain their already well-established careers. On the other hand, they might be in charge of an institution and therefore try to enhance its publication record Winner takes all ▶ Novel research findings are especially rewarded.[16] Thus, authors will rush such results to a journal. In order to be the first to publish with a minimum expenditure of resources, they will try to anticipate which results are likely to be most impressive to reviewers and editors. On the other hand, authors have no interest in 'wasting their time' in preparing manuscripts with results they consider not sufficiently interesting to achieve publication. Tendency to confirm own expectations and hypotheses ▶ Confirmations of one's own expectations with significant results might be used as proof by researchers that the procedure and findings are sound. Furthermore, a non-significant finding may be interpreted as failure and therefore less 'valuable' or less 'publishable', as various surveys and experiments have described[15] Intellectual interest ▶ Apart from the tendency to confirm their own expectations and hypotheses, researchers wish to demonstrate the truth of their own hypothesis to keep this research area open and not limit the chance for further findings Financial interests ▶ Researchers/authors might be pushed by funders/industry/lobby to report/submit research findings in favour of the product and not submit unfavourable data.[17] Furthermore, conflicts of interest related to companies producing competing products may influence interpretation and reporting of data by researchers/authors Professional interests ▶ Researchers might be pushed to preferably publish results that support the current practice in their respective medical specialty as conflicting results might be damaging to the reputation and financial interest of their profession Miscellaneous ▶ Researchers might decide not to share their data, as they want to benefit from the data themselves, or do not want data to be scrutinised by others, or do not have time or resources to make data available
Journal editors	Frequent citations ▶ Editors are interested in publishing articles that accrue many citations, since frequent citations increase the journal's prestige and attract more readers, authors and subscribers.[18] It is known that 'significant' and theory-confirming results are more often cited by other authors Reader interest ▶ Editors will try to anticipate the interest of readers (who will probably be more interested in new and impressive results). Tendency to confirm own expectations and hypotheses[19] ▶ Confirmations of editor's expectations and significant results might be used as proof by editors that the procedure and findings are sound Financial interests[20] ▶ Journals receive financial rewards for publishing (eg, reprint sales or advertising revenue) Conflict of interests ▶ Personal conflicts of interest might influence editors' decision about manuscripts

Continued

Table 3 Continued

Players	Motivations
Peer reviewers	Tendency to confirm own expectations and hypotheses[19] ▶ Confirmations of peer reviewer's expectations and significant results might be used as proof by peer reviewers that the procedure and findings are sound Maximising reputation while minimising effort ▶ Peer reviewers have a very labour-intensive task[18] and they inevitably have less insight into the research done than the original authors. To minimise their workload they might solve the information problem by relying on proxies to indicate the quality of research work. For example, the status and reputation of authors, the strength and significance of results of the main results as opposed to the scientific merit of the investigation, or even the tendency to confirm the peer reviewer's own expectations and hypotheses might serve as proxies ▶ Consequently, at times, well-designed and conducted studies may not be published if they report null or negative results[21] Conflict of interests ▶ Personal conflicts of interest might influence peer reviewers' decision about manuscripts
(pharmaceutical and device) manufacturers	Marketing of their product ▶ Commercial sponsors are interested in results supporting their product, and try to use such results in the most favourable way for the marketing of their product. Likewise, they may wish to suppress studies when the results do not favour their product ▶ It has been shown that industry-supported research is more likely to present 'positive' results than research funded from non-industry sources, furthermore, industry sponsorship was strongly associated with pro-industry conclusions.[22–24] There is evidence that commercially sponsored research is less frequently published if the results are 'negative'[22 24]
Funding agencies	Increase in visibility ▶ Funding agencies want to be visible and associated with promising research Conflict of interests ▶ Funding agencies, in particular public funders such as hospitals, might be influenced by economic considerations, and therefore favour less expensive treatment options over new and more costly alternatives
Research ethics committees	Lack of financial and personal resources ▶ While many research ethics committees sporadically check publications of approved studies, they lack the financial and personal resources to do so in a systematic manner Insufficient legal basis to require trial registration and unbiased dissemination ▶ While many research ethics committees would prefer to require trial registration and unbiased dissemination of trial findings, most countries currently lack the legal basis for them to do so
Research institutions	Increase in visibility ▶ Research institutions want to be visible and associated with promising research Conflict of interests ▶ Conflicts of interest related to the performance of their own institution
Regulatory agencies	Lack of realising the public interest in unbiased research ▶ While regulatory agencies need to protect commercial interests, their transparency policies explicitly state that the public interest in unbiased clinical data can overrule the commercial interests (especially after marketing approval has been granted). Nevertheless, recent decision making of the European Medicines Agency on more or less restricted access to trial data did not consider 'public interest' arguments[25]
Decision making bodies*	Have an interest in transparency and try to add to the dissemination process through their submission and publishing procedures
Readers/patients/patient organisations	Readers and patients might be more interested in 'positive' or new research findings

*Decision-making authorities in European healthcare systems, such as the Federal Joint Committee in Germany.

publication, such as presentations at scientific conferences, governmental/institutional reports, book chapters, dissertations and theses, should also be considered as such. We decided to summarise the various ways of making research results available to the public by the term 'dissemination'. The characteristics that need to be considered when disseminating research findings are presented in table 1.

Stakeholders who should assume responsibility for the various stages of conducting a clinical trial and disseminating clinical trial documents (Who?), and their motivations (Why?)

Within the OPEN Project, we have identified key groups who are part of the knowledge generation and dissemination process.[12] When exploring their policies and procedures to deal with publication and associated forms of

bias, it was striking that none of them assumed responsibility for, or indicated themselves to be in a position to tackle, this problem. Instead, each group considered it was 'somebody else's problem'.[13 14] The whole dissemination process seems to involve so many different players on various levels, that it can sometimes be difficult to identify clearly who is responsible for the (non-) dissemination of research findings at each stage of the process. In table 2, we list stakeholders who should assume responsibility for the various stages of conducting a clinical trial and disseminating of clinical trial documents (Who?). In table 3, the motivations that may lead the various players to selectively disseminate findings, thereby introducing bias in the dissemination process (Why?), are presented.

DISCUSSION

The phenomenon of (non-)publication and/or non-dissemination of whole studies based on the nature and direction of the results has historically been referred to as 'publication bias'.[3] However, the scientific evidence-base can be distorted not only by the absence of a journal publication of a whole study, but results can also be reported only partially or in a delayed manner, or be misrepresented in a way that influences the take-up and interpretation of the findings. Thus, multiple problems, all related to the dissemination of study findings, can come into play.

In our scoping review we found that there is currently no consistent definition of 'publication bias' and a comprehensive framework for its description has not yet been developed. Multiple published definitions of 'publication bias' exist. Most of the articles (38/50) in our data set defined 'publication bias' as a form of selective publication due to various reasons. Thus, despite the serious consequences of this problem, we found in our scoping review that there is currently no consistent definition of 'publication bias' and a comprehensive framework for its description has not yet been developed.

As a first approach to a comprehensive and consistent framework of (non-) dissemination of research findings, we identified three characteristics ((1) 'Type of data', (2) 'Format/Product' and (3) 'Accessibility') that need to be considered when disseminating research findings (What?). We then focused on the various players who could assume responsibility for the various stages of conducting a clinical trial and disseminating of clinical trial documents (Who?). Furthermore, we tried to describe the motivations that might lead the various players to introduce bias in the dissemination process (Why?).

The proposed framework of (non-) dissemination of research findings is based on the results from literature search and expert consensus of the OPEN group. A limitation should be considered when interpreting our results. We conducted only a very limited literature search and included only 50 articles, since we were interested in the most prevalent definitions of 'publication bias' only. Since we only searched Web of Science, with the simple search term 'publication bias', our literature search might have favoured older publications and systematic reviews of primary research, and might have missed methodological publications. A more comprehensive literature search might have concluded in a wider range of definitions. Also, the representativeness of these articles might be limited since all of the included articles have been published in English, therefore language bias might also play a role.

The 2013 version of the Declaration of Helsinki states that 'Researchers, authors, sponsors, editors and publishers all have ethical obligations with regard to the publication and dissemination of the results of research. Researchers have a duty to make publicly available the results of their research on human participants and are accountable for the completeness and accuracy of their reports'.[26] Despite this, many research results never get disseminated. The (non-)dissemination of study results is of great importance because it distorts the evidence for clinical decision-making, which is increasingly based on syntheses of published research. Using the OPEN 'What, Who and Why?' framework, we were able to clearly structure and comprehensively describe the dissemination process and its responsible stakeholders. We believe that, together with the other results from the OPEN Project and the recommendations[12] derived from these findings, our framework will facilitate the development of future policies and guidelines regarding the multifaceted issue of dissemination bias. We hope that it will help to decrease the problem of (non-) dissemination of research results and enable clinicians to base their medical decisions on the most comprehensive evidence available, which should ultimately increase the quality of patient care.

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REFERENCES

1. Higgins Julian PT, Green S. *Cochrane handbook of systematic reviews of interventions. Version 5.1.0*. The Cochrane Collaboration. 2011. http://www.handbook.cochrane.org
2. Dickersin K. The existence of publication bias and risk factors for its occurrence. *JAMA* 1990;263:1385–9.
3. Easterbrook PJ, Berlin JA, Gopalan R, *et al*. Publication bias in clinical research. *Lancet* 1991;337:867–72.
4. Chan AW, Hróbjartsson A, Haahr MT, *et al*. Empirical evidence for selective reporting of outcomes in randomized trials: comparison of protocols to published articles. *JAMA* 2004;291:2457–65.
5. Hopewell S, Clarke M, Stewart L, *et al*. Time to publication for results of clinical trials. *Cochrane Database Syst Rev* 2007;(2):MR000011.
6. Pittler MH, Abbot NC, Harkness EF, *et al*. Location bias in controlled clinical trials of complementary/alternative therapies. *J Clin Epidemiol* 2000;53:485–9.
7. Vickers A, Goyal N, Harland R, *et al*. Do certain countries produce only positive results? A systematic review of controlled trials. *Controlled Clin Trials* 1998;19:159–66.
8. Müller KF, Briel M, D'Amario A, *et al*. Defining publication bias: protocol for a systematic review of highly cited articles and proposal for a new framework. *Syst Rev* 2013;2:34.
9. Kulkarni AV, Aziz B, Shams I, *et al*. Comparisons of citations in Web of Science, Scopus, and Google Scholar for articles published in general medical journals. *JAMA* 2009;302:1092–6.
10. Song F, Parekh S, Hooper L, *et al*. Dissemination and publication of research findings: an updated review of related biases. *Health Technol Assess* 2010;14:iii, ix–xi, 1–193.
11. Bax L, Moons KG. Beyond publication bias. *J Clin Epidemiol* 2011;64:459–62.
12. Meerpohl JJ, Schell LK, Bassler D, *et al*. Evidence-informed recommendations to reduce dissemination bias in clinical research: conclusions from the OPEN (Overcome failure to Publish nEgative fiNdings) project based on an international consensus meeting. *BMJ Open* 2015;5:e006666.
13. Malički M, Marušić A, Consortium O. Is there a solution to publication bias? Researchers call for changes in dissemination of clinical research results. *J Clin Epidemiol* 2014;67:1103–10.
14. Wager E, Williams P. Project Overcome failure to Publish nEgative fiNdings C. "Hardly worth the effort"? Medical journals' policies and their editors' and publishers' views on trial registration and publication bias: quantitative and qualitative study. *BMJ* 2013;347:f5248.
15. Fanelli D. Do Pressures to Publish Increase Scientist's Bias? An Empirical Support from US States Data. *PLoS ONE* 2010;5:e10271.
16. Stephan PE. The economics of science. *J Econ Lit* 1996;34:1199–235.
17. McDaniel MA, Rothstein HR, Whetzel DL. Publication bias: a case study of four test vendors. *Pers Psychol* 2006;59:927–53.
18. Hojat M, Gonnella JS, Caelleigh AS. Impartial judgment by the "gatekeepers" of science: fallibility and accountability in the peer review process. *Adv Health Sci Educ* 2003;8:75–96.
19. Fanelli D. "Positive" results increase down the hierarchy of the sciences. *PLoS ONE* 2010;5:e10068.
20. Lundh A, Barbateskovic M, Hróbjartsson A, *et al*. Conflicts of interest at medical journals: the influence of industry-supported randomised trials on journal impact factors and revenue—cohort study. *PLoS Med* 2010;7:e1000354.
21. Olson CM, Rennie D, Cook D, *et al*. Publication bias in editorial decision making. *JAMA* 2002;287:2825–8.
22. Lexchin J, Bero LA, Djulbegovic B, *et al*. Pharmaceutical industry sponsorship and research outcome and quality: systematic review. *BMJ* 2003;326:1167–70.
23. Sismondo S. Pharmaceutical company funding and its consequences: a qualitative systematic review. *Contemp Clin Trials* 2008;29:109–13.
24. Lundh A, Sismondo S, Lexchin J, *et al*. Industry sponsorship and research outcome. *Cochrane Database Syst Rev* 2012;12:MR000033.
25. Strech D, Littmann J. Lack of proportionality. Seven specifications of public interest that override post-approval commercial interests on limited access to clinical data. *Trials* 2012;13:100.
26. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *JAMA* 2013;310:2191–4.

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