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Effect of different financial competing interest statements on readers' perceptions of clinical educational articles: a randomised controlled trial

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ABSTRACT

Objectives To investigate how different competing interest (COI) statements affect clinical readers' perceptions of education articles.

Design Randomised controlled trial.

Setting and participants Random sample of UK doctors.

Interventions We created four permutations of each of two clinical reviews (on gout or dyspepsia), which varied only in terms of the COI statement. Volunteers were blinded and randomised to receive one review and asked to complete a questionnaire after reading it. Blinded factorial analyses of variance and analyses of covariance were carried out to assess the influence of each review and type of COI on outcomes.

Primary and secondary outcomes Confidence in the article's conclusions (primary outcome), its importance, their level of interest in the article and their likelihood to change practice after reading it.

Results Of 10 889 doctors invited to participate, 1065 (10%) volunteered. Of these, 749 (70%) completed the survey. Analysis of covariance (adjusting for age, sex, job type, years since qualification) showed no significant difference between the groups in participants' confidence in the article (gout: p=0.32, dyspepsia: p=0.78) or their rating of its importance (gout: p=0.09, dyspepsia: p=0.79). For the gout review, participants rated articles with advisory board and consultancies COI as significantly less interesting than those with no COI (p=0.028 with Bonferroni correction). Among participants indicating that they treat the condition and that the article's recommendations differed from their own practice, there was no significant difference in likelihood to change practice between groups (gout: p=0.59, n=59; dyspepsia: p=0.56, n=80).

Conclusions Doctors' confidence in educational articles was not influenced by the COI statements. Further work is required to determine if doctors do not perceive these COIs as important in educational articles or if they do not pay attention to these statements. More meaningful COI disclosure practices may be needed, which highlight context-specific potential sources of bias to readers.

Trial registration number NCT02548312; Results.

Strengths and limitations of this study

- ► Competing interest (COI) statements have been shown to influence readers' perceptions of research, but this is the first experimental study to look at the effect of COIs in clinical educational material.
- ► A key strength of this study is its randomised study design in a research area where there are few experimental studies.
- ► Financial competing interests are varied; we were only able to evaluate the effect of three financial COI statements compared with none due to the large sample size required.
- ► Our outcome measures were all self-reported and we did not assess objective changes to practice.

INTRODUCTION

Researchers, clinicians and academic institutions often have competing interests, also known as conflicts of interest (COIs), and collaborations with industry are often considered necessary to facilitate progress and innovation in medical research.[1] COIs are defined as 'circumstances that create a risk that professional judgements or actions regarding a primary interest will be unduly influenced by a secondary interest'.[1 2] The possibility that COIs may bias the medical literature and potentially affect patient care has been highlighted in many studies. For example, a 2017 Cochrane review found that drug and device studies sponsored by the manufacturer demonstrated more favourable efficacy and conclusions than studies sponsored by other sources.[3] Whether bias is conscious or unconscious, COIs may therefore compromise the medical evidence which drives development of recommendations for clinical care.[3]

Widespread recognition that COIs may potentially influence decision-making has rendered their open disclosure a common requirement for the publication of research articles in academic medical journals.[3] A systematic review reported that the presence of financial COIs and industry collaborations are concerning to academic and clinical

researchers, particularly as such interests may potentially influence research project decisions, the conduct of research and subsequent publication.[4] Financial ties with industry were considered more acceptable where these were not directly related to the research, disclosure of COIs was upfront and the results of research was freely published.[4]

However, there has been little research exploring the effect of competing interests on reader perceptions. In a randomised trial investigating the effect of the funding source of a clinical trial on clinicians' interpretation of trial results, it was observed that industry sponsorship negatively affected the perceived methodological rigour of a trial and the willingness to change practice based on its findings, independent of trial quality.[5] We have previously reported the results of two randomised controlled trials comparing the effect of COI statements related to financial interests against no competing interests and demonstrated a significantly negative influence of COIs on readers' perceptions of the credibility of medical research.[6 7] Surveys have previously reported a similarly low perceived credibility of industry-initiated or funded drug trials among clinicians.[8] However, in a trial of US physicians who were provided with a clinical trial abstract presenting positive findings of a new drug, randomised to differ in their COI statement, it was found that doctors did not significantly discount for COIs when reporting their likelihood to prescribe the fictitious drug.[9] Nonetheless, when directly asked about the COI, the majority reported that they feel that they should to some degree discount information on the basis of COIs, highlighting that simply publishing COI disclosures may not be sufficient.[9] Similarly, a randomised trial of French general practitioners (GPs) found no evidence of a significant impact of reporting of COIs on GP's confidence in the conclusions of trial abstracts.[10]

Clinical education articles are intended to provide guidance on clinical care for clinicians, yet our understanding of the role of COIs on readers' perceptions of the credibility of such articles, rather than primary research articles, is limited. Educational articles are prone to bias as they typically use non-systematic methods of literature acquisition, and broadly rely on the interpretation of one author, or a small number of authors, on their chosen included literature. Of concern too is evidence from the social sciences suggesting that disclosure of COIs may even enhance bias: conflicted authors may feel a 'moral release' from having simply declared they are conflicted, or may even exaggerate to counteract any expected discounting of their opinion.[11 12] Such potential biases may therefore be extensive, but potentially less visible to their targeted broader clinician readership.

Many years ago, the *American Family Physician* became the first journal to introduce a 'zero tolerance' policy for COIs in clinical educational articles.[13] In the 1990s, *The New England Journal of Medicine* implemented a stringent policy, whereby editorialists had to be free from financial ties to drugs or devices discussed in the editorial,[14 15] but this policy was relaxed in 2002 to exclude only those with significant (US$10 000) financial interest due to difficulties in recruiting authors.[16] In 2015, *The BMJ* implemented a 'zero tolerance' policy on the presence of any relevant financial COI related to industry for authors of its clinical editorials and some education articles.[17] However, some have questioned the need for strict restrictions on the presence of COIs, discussing whether such policies may limit trust, effective industry collaborations or the ability for some experts to contribute to clinical education.[18–21] Evidence is missing in characterising how COI statements influence reader perceptions of educational articles, or indeed if awareness exists of the potential for COIs to influence the conclusions of such articles. We describe a randomised controlled trial to test the effect of a range of common COI statements in educational articles on a clinician readership's confidence in the conclusions of an article, their interest in the article, its perceived importance and on the likelihood that they would change their clinical practice based on the article's findings.

METHODS

Design

Parallel-group randomised controlled trial. The study protocol has previously been published.[22]

Study sample

We took two approaches to the sampling for this study as the first approach did not yield adequate numbers.

Inclusion criteria and exclusion criteria

We included practising doctors in the UK who were receiving *The BMJ* through their membership of the British Medical Association (BMA). We excluded members who had opted out of receiving a copy of *The BMJ*, public health doctors, consultant oral/dental surgeons, retired doctors and student members. We also excluded doctors listed as doing private practice as this was necessary due to the way the data about specialty and grade are stored to ensure compliance with our other exclusion criteria.

Sample 1

We generated a random sample of 2040 BMA members (680 GPs, 680 hospital consultants and 680 junior doctors), randomised each to a group (see 'Methods' section below), and sent them a personalised email invitation from *The BMJ's* editor-in-chief in September 2015 to take part in a research project along with the relevant study materials. A range of clinical specialties and stages of training were included to facilitate generalisability of study findings to the clinical workforce, and the clinical conditions of the educational articles were accordingly selected to reflect conditions which the vast majority of clinicians would be expected to have had experience in managing. Participants were not told the purpose of the study to avoid biassing responses.

Table 1 Group allocations and competing interest (COI) statements

Group	Review	COI type	COI statement
1	Dyspepsia	Honoraria and travel	We have read and understood the *BMJ* policy on declaration of interests and declare the following: DF is funded by a NIH clinician scientist award; SN receives no specific funding; JB has received honoraria and travel expenses from Jenka Pharmaceuticals for lecturing at a conference.
2	Gout	Advisory board and consultancies	We have read and understood the *BMJ* policy on declaration of interests and declare the following: DF is funded by a NIH clinician scientist award; SN receives no specific funding; JB has received fees from Jenka Pharmaceuticals for consultancies and being an advisory board member.
3	Dyspepsia	Research funding	We have read and understood the *BMJ* policy on declaration of interests and declare the following: DF is funded by a NIH clinician scientist award; SN receives no specific funding; JB has received research funding from Jenka Pharmaceuticals.
4	Dyspepsia	None	We have read and understood the *BMJ* policy on declaration of interests and declare the following: DF is funded by a NIH clinician scientist award; SN receives no specific funding; JB has no competing interests.
5	Gout	Honoraria and travel	We have read and understood the *BMJ* policy on declaration of interests and declare the following: DF is funded by a NIH clinician scientist award; SN receives no specific funding; JB has received honoraria and travel expenses from Jenka Pharmaceuticals for lecturing at a conference.
6	Dyspepsia	Advisory board and consultancies	We have read and understood the *BMJ* policy on declaration of interests and declare the following: DF is funded by a NIH clinician scientist award; SN receives no specific funding; JB has received fees from Jenka Pharmaceuticals for consultancies and being an advisory board member.
7	Gout	Research funding	We have read and understood the *BMJ* policy on declaration of interests and declare the following: DF is funded by a NIH clinician scientist award; SN receives no specific funding; JB has received research funding from Jenka Pharmaceuticals.
8	Gout	None	We have read and understood the *BMJ* policy on declaration of interests and declare the following: DF is funded by a NIH clinician scientist award; SN receives no specific funding; JB has no competing interests.

Sample 2

We broadened the sampling frame and took a very large random sample of 11 004 BMA members and asked for volunteers to take part in a research project before assigning them to a study group, as per our protocol. Recruitment for volunteers was open between 6 January 2016 and 28 January 2016.

Intervention

Participants were sent an email with a link to one of two clinical reviews depending on randomised group allocation, on the management of dyspepsia (online supplementary appendix 1) or gout (online supplementary appendix 2), and a link to a short questionnaire on SurveyMonkey on 2 February 2016. Study participants were asked to read the article and then complete the questionnaire. Data collection closed on 3 May 2016.

We selected two clinical reviews previously published by *The BMJ in 2013 describing* two conditions commonly seen by doctors, requiring treatment by drugs, and familiar to all clinical specialties. We shortened and modified these after obtaining permission from the original authors. We changed the authors on the authorship byline to fictional author names and listed fictional institutions. Each of the two clinical reviews had four permutations differing only in the COI statement (from no competing interests to a range of financial interests) for the last of the three authors (table 1). All COI statements appeared at the end of the article's main text, just before the references, in line with usual practice. These statements all had the same fictional author names and where there was a financial COI we used the same fictional pharmaceutical company name but did not mention the company name in the main text of the clinical reviews.

Randomisation and blinding

A random sample of eligible BMA members was generated from the database of all members by staff at the BMA using computer-generated random numbers. JM then randomised members to one of eight groups to receive one of the eight permutations of the clinical reviews using a computer-generated block randomisation procedure, stratified by type of doctor (GPs/hospital consultants/junior doctors) and gender. The eight permutations of the clinical reviews were then randomly assigned a number from 1 to 8 by SS. SS enrolled participants and managed the survey. JM conducted the statistical analysis blinded to the group allocation; participants were identified only by study group number, which was not revealed to JM until after all analysis was completed. Participants were blinded to their study group and were not told that we were testing the effect of various COIs on their perceptions of the articles.

Data collection

We piloted the draft survey with a convenience sample of doctors to ensure the instructions were clear and the questions were not ambiguous. Study participants were asked to read the article and indicate on a 10-point Likert scale (0=not at all, 10=extremely): how confident they were in the conclusions drawn in the article they received, how interesting and important they found the article and how likely they were to change their practice on the basis of the article (see the online supplementary materials of the published protocol for the questionnaire).[22] To reduce question order bias, the presentation order of the questions was randomised for the first three items (confidence, interest and importance).

Contact details and demographic information about BMA members were obtained from the BMA membership database: name, title, email address, specialty, sex, age and date qualified. Survey data were gathered using SurveyMonkey. Non-responding volunteers were sent up to five reminders to complete the survey.

Outcome measures

Primary outcome measure

The primary outcome was the readers' level of confidence in the conclusions drawn in the article, measured on a 10-point Likert scale from 1= 'not at all confident' to 10= 'extremely confident'.

Secondary outcome measures

The three secondary outcomes, all measured on similar 10-point Likert scales, were: readers' ratings of the importance of the article, interest in the article and likelihood to change practice on the basis of the article.

Ethics and trial registration

We did not submit the study for ethical approval as this is not required for this type of survey with doctors in the UK. However, the study proposal and study materials were reviewed by *The BMJ's* Ethics Committee and they did not have substantive ethical concerns. To avoid biassing participants' responses, details of the study objectives and design were not given to participants. The study protocol[22] was not published until data collection was complete so as not to potentially influence participants' responses. Consent to take part was assumed by completion of the study questionnaire. The trial was registered at ClinicalTrials.gov (NCT02548312) just before recruitment commenced.

Statistical analysis

Sample size justification

We calculated that to have 90% power to detect a one-unit difference on the 10-point 'confidence' scale between the groups, 121 readers were needed in each of the four COI statement groups, based on a simple Student's t-test with an estimated SD of 2, with a two-sided 1% significance level to provide some adjustment for multiple testing between the four COI statements. However, as differences between the results for the two clinical reviews were considered important to quantify, a total of 968 readers were required to account for the eight permutations. Assuming a response rate of around 50% based on previous *BMJ* trials of similar design,[6 7] we calculated we needed to invite at least 1936 readers to take part. Accordingly, in sample 1, for each of the eight groups, 255 readers (85 GPs, 85 consultants and 85 junior doctors) were invited to take part. We assumed that a one-unit difference on the 10-point scale was important on the basis that a 0.5-unit difference was important in our previous studies using a 5-point scale.[6 7] Similarly, the observed SD for the 5-point scale was ~1, and hence we assumed that, for a 10-point scale, the SD would be twice as large. As sample 1 only yielded a 9% response rate and we anticipated a similar yield when asking for volunteers, we broadened the sample to 11 004 in sample 2.

Statistical analysis

A factorial analysis of covariance (with COI statement and clinical review type as the two factors) was carried out to assess their impact on the primary outcome (level of confidence) and secondary outcomes (importance, interest and likelihood to change practice) adjusting for the effect of doctor type (GP, consultant or junior doctor), gender, age and the number of years since qualification. Separate analyses of covariance were performed for each of the two clinical reviews, and, in addition, for the subgroups who were currently treating the conditions. The impact on the likelihood to change practice was assessed using X^2 tests. Analyses of variance and X^2 were used to compare non-responders with responders in terms of age, gender, doctor type (GP, consultant or junior doctor) and number of years since qualification.

Patient and public involvement

We did not include patients as study participants. Patients were not involved in setting the research question, designing the study, the conduct of the study or the interpretation of the results. One of The BMJ's patient editors, recently invited patients and members of the public attending a workshop at the Cochrane Colloquium 2018 on '*Meeting the challenge of research empowerment through co-production and expert patient review*' how patients and the public could have been involved in this research and they reported that they did not see relevant opportunities to do so. However, a patient and public reviewer for *The BMJ* did make an interesting suggestion for a further study with the general public as the participants as it is important to know how people value and consider COIs when reading articles.

RESULTS

Samples

Sample 1

Overall, 182/2040 (9%) responded, but the response rate was lower for the article on dyspepsia (81/1020, 8%) than gout (101/1020, 10%). On reading responses to

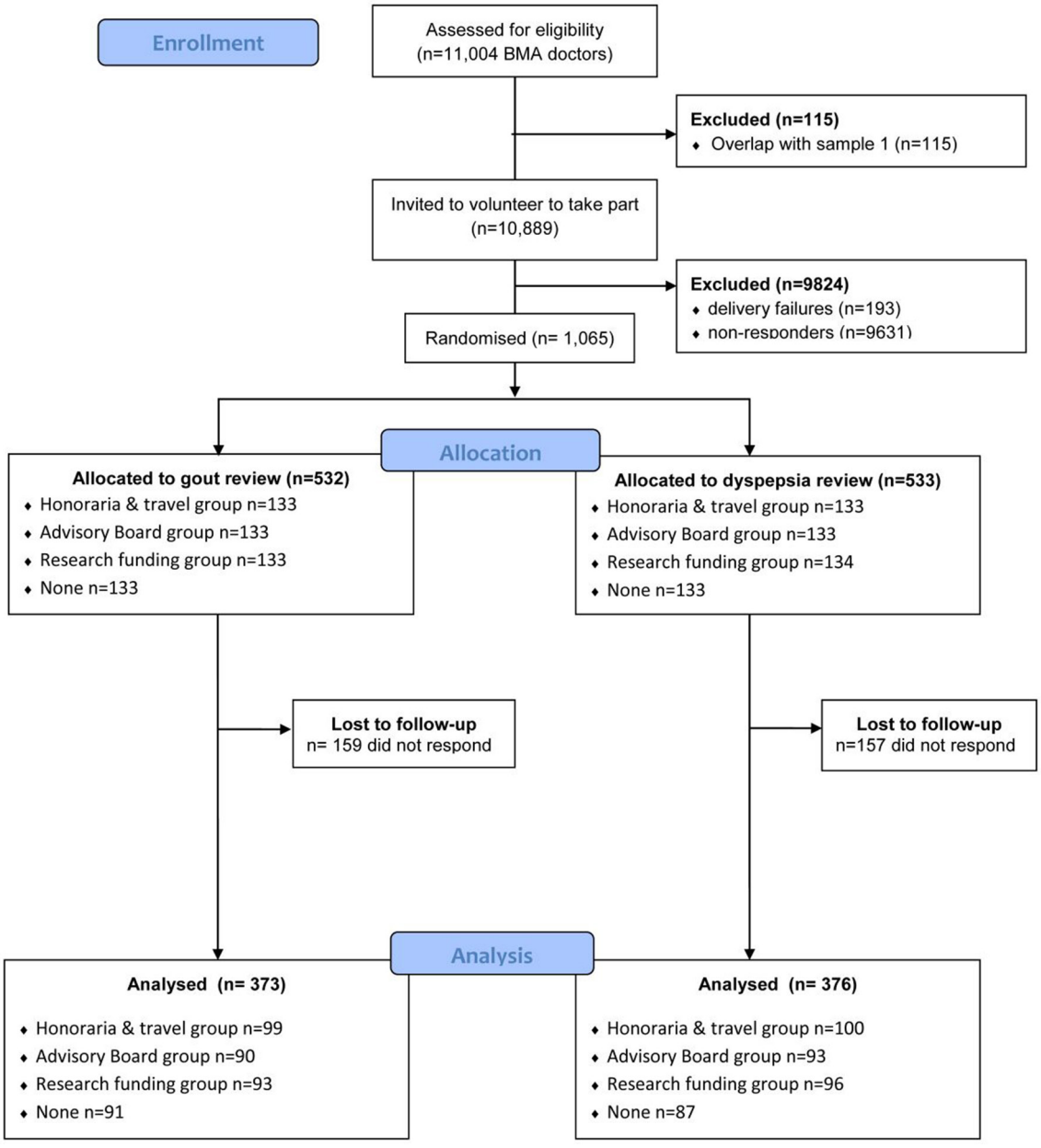

Figure 1 Participant flow chart.

the survey for those who received the dyspepsia review, we identified a problem with the content of the manuscript. A few respondents queried the appropriateness of including a section on prokinetic drugs given the recent withdrawal of drugs and safety concerns but no mention of this in the article. As such, we removed this section from the manuscript before using it in sample 2 and started the study again.

Sample 2

We obtained a random sample of 11 004 BMA members meeting the study eligibility criteria. After removing overlap with sample 1, we invited 10 889 doctors to volunteer to take part in a research project for *The BMJ* (figure 1). On sending the email invitation, 96 email addresses bounced and 97 had already opted out of SurveyMonkey so had to be excluded. Of the 10 696 eligible email addresses, we recruited 1065 volunteers (10%) and 749 (70% of those who volunteered) completed the survey; n=376 dyspepsia and n=373 gout. A third of respondents were consultants, a third GPs and a third junior doctors; 46% were male and the mean age was 44 years (table 2). All analyses are based on data collected in sample 2.

Primary outcome

There was no significant difference between the groups in the readers' level of confidence in the conclusions drawn in the article for the gout (p=0.32) or dyspepsia (p=0.78) reviews (table 3). The mean confidence rating scores for all of the groups receiving the gout review was at least 7 out of 10, and for the dyspepsia review it was at least 6.

Combining results over both reviews showed no differences in confidence between the COI groups (p=0.54), and no evidence of a difference between reviews in the

Table 2 Baseline characteristics by group of allocation

	Advisory board and consultancies	Honoraria and travel	Research funding	None
Gout review				
N	90	99	93	91
Type				
Consultant	37% (33)	37% (37)	37% (34)	33% (30)
General practice	38% (34)	33% (33)	36% (33)	32% (29)
Junior doctor	26% (23)	29% (29)	28% (26)	35% (32)
Male	49% (44)	46% (46)	45% (42)	44% (40)
Mean age (range)	45.5 (24–72)	44.9 (25–75)	42.8 (24–67)	42.9 (24–76)
Mean years' qualified (range)	20.5 (0–47)	19.7 (0–47)	18.3 (0–43)	17.7 (0–45)
Gout review				
N	93	100	96	87
Type				
Consultant	33% (31)	31% (31)	36% (35)	38% (33)
General practice	37% (34)	36% (36)	36% (35)	33% (29)
Junior doctor	30% (28)	33% (33)	27% (26)	29% (25)
Male	45% (42)	48% (48)	43% (41)	48% (42)
Mean age (range)	42.9 (24–76)	43.5 (23–79)	44.7 (25–75)	42.8 (24–67)
Mean years' qualified (range)	19.4 (0–44)	18.3 (0–54)	19.5 (0–47)	18.6 (0–39)

variability between the COI groups (p=0.53), but respondents had a higher level of confidence in the gout review than the dyspepsia review (p<0.001).

Secondary outcomes

Importance of the article

There was no significant difference between the groups in readers' ratings of the level of importance of the article for the gout (p=0.09) or dyspepsia (p=0.79) reviews (table 3).

Combining results over both reviews showed no overall differences in level of importance between the COI groups (p=0.79) and no evidence of a difference between reviews in the variability between the COI groups (p=0.14), but respondents gave higher ratings of importance for the gout review (p=0.002).

Interest in the article

For the gout review, participants rated reviews with advisory board and consultancies COI as significantly less interesting than those with no COI (p=0.018 with Bonferroni correction), but there was no significant difference between the groups for the dyspepsia review (p=0.83) (table 3).

Combining results over both reviews showed no overall differences in level of interest between the COI groups (p=0.46) and no evidence of a difference between reviews in the variability between the COI groups (p=0.12), but respondents gave higher ratings of interest for the gout review (p<0.001).

Likelihood to change practice

Almost half of respondents (178/373, 48%) who received the gout review reported that they were currently treating patients with gout, 28% (103/373) were not currently treating them and 24% (90/373) reported they do not treat patients with this condition. Of those who were currently treating gout, 33% (59/103) indicated that the article recommended practice differing from their current practice.

Over half of respondents (207/376, 55%) who received the dyspepsia review reported that they were currently treating patients with dyspepsia, 23% (85/376) were not currently treating them and 22% (83/376) reported they do not treat patients with this condition. Of those who were currently treating dyspepsia, 39% (80/207) indicated that the article recommended practice differing from their current practice.

Among participants indicating that they treat the condition and that the article's recommendations differed from their own practice, there was no significant difference in likelihood to change practice between groups (gout: p=0.59, n=59; dyspepsia: p=0.56, n=80) (table 4).

Subgroup analysis

Analysis of the subgroups who were currently treating the conditions showed no significant differences between the

Table 3 ANCOVA analysis of the level of confidence, importance and interest in the reviews by intervention group adjusting for age, sex, job type and years since qualification

	COI allocation group, mean (95% CI)				
	Honoraria and travel	Research funding	Advisory board and consultancies	None	P value
Gout review					
N	99	93	90	90*	
Primary outcome					
Level of confidence in conclusions drawn†	7.1 (6.8 to 7.5)	7.4 (7.1 to 7.8)	7.0 (6.7 to 7.4)‡	7.4 (7.0 to 7.8)	0.32
Secondary outcomes					
Importance of article†	6.9 (6.6 to 7.3)	6.7 (6.4 to 7.1)	6.4 (6.1 to 6.8)	7.0 (6.6 to 7.4)	0.09
Level of interest in article†	6.7 (6.5 to 7.0)	6.5 (6.2 to 6.9)	6.2 (5.9 to 6.6)	7.0 (6.7 to 7.4)	0.028§
Dyspepsia review					
N	100	95¶	93	87	
Primary outcome					
Level of confidence in conclusions drawn†	6.2 (5.8 to 6.6)	6.1 (5.7 to 6.5)	6.2 (5.8 to 6.6)**	6.4 (6.0 to 6.8)	0.78
Secondary outcomes					
Importance of article†	6.3 (6.0 to 6.7)	6.3 (5.9 to 6.7)	6.5 (6.2 to 6.9)	6.3 (5.9 to 6.7)	0.79
Level of interest in article†	5.9 (5.5 to 6.3)	5.8 (5.4 to 6.2)	6.0 (5.6 to 6.4)	5.8 (5.4 to 6.2)	0.83

*One respondent did not give ratings for confidence, importance or interest level, hence data here relates to n=90.
†Outcomes measured on 10-point Likert scales with high scores indicating high levels of confidence, importance and interest.
‡One respondent did not give a rating for confidence, hence for this outcome the data relates to n=89.
§Allocation group 'none' had a significantly higher level of interest compared with allocation group 'advisory board and consultancies' (p=0.018 with Bonferroni correction).
¶One respondent did not give ratings for confidence, importance or interest level, hence data here relates to n=95.
**One respondent did not give a rating for confidence or interest, hence for these outcomes the data relates to n=92.
ANCOVA, analysis of covariance; COI, competing interest.

groups for the level of confidence (primary outcome) in the article (gout: p=0.18; dyspepsia: p=0.64) (table 5).

Analysis of non-responders

Respondents who completed the survey were significantly older, had been qualified for longer and were more likely to be female than those who did not complete or volunteer, p<0.05 (table 6).

DISCUSSION

Doctors' confidence in the conclusions drawn in two educational reviews was not significantly influenced by a range of financial COI statements that are commonly reported to journals and frequently occur in medical practice. When the results for the two reviews were combined, we found no significant difference between

Table 4 Likelihood to change practice for those currently treating gout/dyspepsia and their own practice differed from the recommendations given in the review

	Allocation group; % (number)				
	Honoraria and travel	Research funding	Advisory board and consultancies	None	P value
Gout review					
N	16	11	17	15	0.59*
Likely to change practice†	6% (1)	18% (2)	24% (4)	20% (3)	
Dyspepsia review					
N	20	29	19	12	0.56*
Likely to change practice†	0% (0)	7% (2)	10% (2)	8% (1)	

*X^2 test.
†Respondents who scored 10 ('extremely likely') on the rating scale of 1–10 for likelihood to change practice.

Table 5 Analysis of covariance of the level of confidence in the reviews by intervention group adjusting for age, sex, job type and years since qualification for subgroups who were currently treating patients with gout or dyspepsia

	Mean (95% CI)				
	Honoraria and travel	Research funding	Advisory board and consultancies	None	P value
Gout review					
N	46	42	43	46	
Level of confidence in conclusions drawn	7.3 (6.8 to 7.5)	7.7 (7.1 to 8.2)	7.0 (6.4 to 7.5)	7.6 (7.1 to 8.1)	0.18
Dyspepsia review					
N	48	43	59	56	
Level of confidence in conclusions drawn	6.3 (5.7 to 6.8)	6.8 (6.2 to 7.3)	6.4 (5.9 to 6.9)	6.4 (5.9 to 6.9)	0.64

the COI statement groups in the importance or interest doctors attached to the article or their self-reported likelihood to change practice based on the article. However, we did find a significant difference between the groups in level of interest for the gout review; doctors rated the gout review with advisory board and consultancies COI as significantly less interesting than when there was no COI. Subgroup analysis of those who were currently treating the conditions found no significant difference in the level of confidence in the article.

Three previous randomised controlled trials[5–7] on the effect of financial COIs on readers' perceptions of research found strikingly different results. In our first trial,[6] readers randomised to receive a drug study written by three authors with financial COIs (employees of a fictitious company who potentially held stock options in the company) indicated these as significantly less interesting, important, relevant, valid and believable than those randomised to receive the same article written by authors with no COIs declared. In our second trial,[7] we tested the effect on a non-drug study and also varied the type of COI statement (author potentially held stock options in the company vs author was a recipient of funding for studentships and research grants vs no competing interest declared). Once again, we found that overall, importance, relevance, validity and believability ratings were significantly lower in the group with the financial COI statement than in the no competing interest group. Validity ratings for the financial COI statement group were also significantly lower than for the group receiving the research grants statement. The current study sampled doctors from the same large membership database and applied a similar methodology, but found no significant difference in the confidence in the conclusions drawn (primary outcome) between the groups. A third randomised trial exploring the influence of clinical trial funding on clinician perceptions of trials with a high, medium or low methodological rigour, found that industry funding negatively impacted on perceived methodological quality and willingness to implement trial findings regardless of trial quality.[5] However, two further trials of the effects of COIs in trial abstracts, one with US physicians and another with French physicians, found no significant evidence, respectively, that COIs influenced the likelihood to prescribe a fictitious drug or the confidence of physicians in the abstract conclusions.[9 10] In contrast to previous trials evaluating the influence of COIs on readers' perceptions, our study used a clinical review article (where possible biases may be less visible) and subtler financial COIs (although these were still typical of those seen in medical practice).[6 7]

Table 6 Characteristics of volunteers, completers and non-responders

	Volunteered and completed survey (n=749)	Volunteered but did not complete survey (n=316)	Did not volunteer (n=9824)	P value
Type				0.11*
Consultant	35% (264)	36% (114)	33% (3251)	
General practice	35% (263)	29% (92)	33% (3269)	
Junior doctor	30% (222)	35% (110)	34% (3304)	
Male	46% (345)	50% (157)	53% (5189)	0.001*
Mean age (range)	44.0 (23–79)	41.9 (23–71)	42.3 (22–84)	0.001†
Mean years' qualified (range)	19.0 (0–54)	17.1 (0–47)	17.5 (0–58)	0.003†

*X^2 test.
†Analysis of variance.

A key strength of this study is its randomised study design in a research area where there are few experimental studies. This study had several limitations. First, our initial sampling approach yielded a very low response rate of 9% (not unusual for surveys of doctors and researchers)[23–25] and the study was underpowered to show an effect. As such, we broadened the sampling frame by seeking volunteers at the outset and this yielded a response from 70% of those recruited. The initial low response rate was surprising as in both our earlier trials, with postal administration, we achieved response rates of 59%[6 7] and sampled readers from the same membership database. However, mode of administration can influence response rates[26] and response rates across all methods of survey administration have declined over time.[27] The extent to which we can generalise the findings from the small sample of volunteers who had the time, interest and motivation to take part to all readers is unknown; those who volunteered may differ from their peers in ways we did not capture. Second, we excluded doctors in private practice, so we are unable to generalise the results beyond practising National Health Service doctors. However, to get a representative sample, we sampled doctors from a wide range of clinical specialties. We also used two clinical reviews to help make the findings generalisable beyond a single clinical topic. Third, participants were told they were taking part in a research project and this may have influenced the way they read the article and responded to the questions. Fourth, participants were asked to read an article that they might not usually read; approximately half of participants in each group reported that they were not currently treating patients with gout/dyspepsia. While this may have influenced responses, we deliberately selected two general clinical topics commonly presented and the task did not require respondents to have in-depth knowledge of the assigned topic. Further research could study the effects of COI statements in the context of articles that are highly relevant to readers' own clinical practice. Fifth, respondents were significantly older than non-respondents, but this was in keeping with both our previous trials.[6 7] Sixth, we only looked at the effect on self-reported outcome measures not on actual changes to practice. Finally, we were unable to pool the results from our two sampling approaches as we used different recruitment processes and modified one of the reviews.

In a recent cross-sectional study, the authors reported a higher prevalence of disclosed COIs in commentaries, editorials and narrative reviews.[28] This finding, combined with the fact that author bias in educational articles may be less obvious to readers, and our own finding that COI statements do not seem to affect reader perception of such articles, is particularly concerning. Such articles are widely read by clinicians for their summaries of available evidence and clinical care recommendations.[29] Furthermore, our trial used articles on common conditions with relatively uncontroversial treatments, but the role of COIs may be particularly pertinent in articles on the clinical use of novel, potentially expensive, therapeutic agents.

Our findings may be explained by a lower awareness among clinicians that competing interests may influence the conclusions of educational articles, just as they may research articles. Furthermore, educational articles are typically written by highly regarded clinicians who are well known or 'trusted' experts in their field, which may mean that COIs are considered by readers to be less influential or less important in this context. It is also possible that readers did not consider the COIs to be directly relevant to the topics of the educational articles, and the perceived role of COIs may be context-dependent. COI statements may therefore be more meaningful if they were to specify the relevance of a COI to the subject topic, rather than, as an example, simply stating the existence of a tie with a pharmaceutical company. Alternatively, readers may have considered the included COI statements too mild and not sufficiently alarming to warrant greater scepticism of the review's conclusions. For example, a prior randomised trial has demonstrated that COIs incorporating stocks and shares influenced perceptions of research articles more than COIs involving research grants.[7] We only included a COI for the last of the three listed authors and this may have influenced the magnitude of any effect, but our earlier trial only reported a COI for one of three authors and did find a significant effect.[7] Many readers in this study may also have been familiar with the medical conditions under discussion, and their own clinical practice already in alignment with the review conclusions. We further speculate that levels of trust in the educational reviews used in this study may also have been high due to their dissemination by *The BMJ*, a widely read and recognised UK-based general medical journal. Accordingly, our findings may not be generalisable to articles in smaller/specialty journals. However, the disseminated articles were not portrayed to participants as accepted or published *BMJ* articles, but rather formatted to mimic manuscript submissions without indication of whether the submission would be published in the journal.

Future research should aim to explore why COI statements in educational articles may not affect reader perceptions. For instance, as publishing COI statements has become standard practice, do readers now no longer pay attention to such statements? Or do they perceive these as unimportant and unlikely to bias an article's conclusions? Furthermore, our research has focused only on financial COIs but it would also be important to evaluate the effect of non-financial or indirect COIs on readers' perceptions, such as unpaid consultancies which may include reimbursements for travel expenses, meals and drinks.[29] Against the backdrop of risk of industry-guided bias in clinical practice, journal editors need to tackle possible reader inattention towards COIs in educational articles. Possible mitigating solutions include policies that exclude authors with relevant COIs from authoring clinical educational articles (as has been adopted by *The BMJ*),[13 17 30] or a requirement for such articles to be based on systematic, rather than narrative, reviews. Tackling readers' understanding of COIs in educational articles is also crucial.

This may involve emphasising the role of COIs in critical appraisal, as part of the medical curriculum. In addition, given that some form of COI among leadership figures in clinical research is now very common, it is possible that the simple presence of a COI is not sufficient to attract attention. Rather, in addition to reporting COIs, authors or journal editors should consider positioning the COI in relation to the topic of the article so that any context-specific risk of bias is clearer to the reader.

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REFERENCES

1. Lo B, Field MJ. Institute of Medicine (US) Committee on Conflict of Interest in Medical Research, Education, and Practice. *Conflict of interest in medical research, education, and practice*: National Academies Press, 2009.
2. Thompson DF. Understanding financial conflicts of interest. *N Engl J Med* 1993;329:573–6.
3. Lundh A, Lexchin J, Mintzes B, *et al*. Industry sponsorship and research outcome. *Cochrane Database Syst Rev* 2017;2:MR000033.
4. Glaser BE, Bero LA. Attitudes of academic and clinical researchers toward financial ties in research: a systematic review. *Sci Eng Ethics* 2005;11:553–73.
5. Kesselheim AS, Robertson CT, Myers JA, *et al*. A randomized study of how physicians interpret research funding disclosures. *N Engl J Med* 2012;367:1119–27.
6. Chaudhry S, Schroter S, Smith R, *et al*. Does declaration of competing interests affect readers' perceptions? A randomised trial. *BMJ* 2002;325:1391–2.
7. Schroter S, Morris J, Chaudhry S, *et al*. Does the type of competing interest statement affect readers' perceptions of the credibility of research? Randomised trial. *BMJ* 2004;328:742–3.
8. Sackett D. Industry-initiated drug trials are far less credible to Canadian internists than investigator-initiated trials. *Can J Gen Intern Med* 2008;3:29–32.
9. Silverman GK, Loewenstein GF, Anderson BL, *et al*. Failure to discount for conflict of interest when evaluating medical literature: a randomised trial of physicians. *J Med Ethics* 2010;36:265–70.
10. Buffel du Vaure C, Boutron I, Perrodeau E, *et al*. Reporting funding source or conflict of interest in abstracts of randomized controlled trials, no evidence of a large impact on general practitioners' confidence in conclusions, a three-arm randomized controlled trial. *BMC Med* 2014;12:69.
11. PLoS Medicine Editors. Does conflict of interest disclosure worsen bias? *PLoS Med* 2012;9:e100120.
12. Katz D, Caplan AL, Merz JF. All gifts large and small: toward an understanding of the ethics of pharmaceutical industry gift-giving. *Am J Bioeth* 2003;3:39–46.
13. Siwek J. AFP's conflict of interest policy: disclosure is not enough. *Am Fam Physician* 2014;89:161–7.
14. Relman AS. New "Information for Authors"--and readers. *N Engl J Med* 1990;323:56.
15. Kassirer JP, Angell M. Financial conflicts of interest in biomedical research. *N Engl J Med* 1993;329:570–1.
16. Drazen JM, Curfman GD. Financial associations of authors. *N Engl J Med* 2002;346:1901–2.
17. Chew M, Brizzell C, Abbasi K, *et al*. Medical journals and industry ties. *BMJ* 2014;349:g7197.
18. Rosenbaum L. Reconnecting the dots — reinterpreting industry–physician relations. *N Engl J Med Overseas Ed* 2015;372:1860–4.
19. Rosenbaum L. Understanding bias--the case for careful study. *N Engl J Med* 2015;372:1959–63.
20. Rosenbaum L. Beyond moral outrage--weighing the trade-offs of COI regulation. *N Engl J Med* 2015;372:2064–8.
21. Drazen JM. Revisiting the commercial-academic interface. *N Engl J Med* 2015;372:1853–4.
22. Schroter S, Pakpoor J, Morris J, *et al*. Effect of different financial competing interest statements on readers' perceptions of clinical educational articles: study protocol for a randomised controlled trial. *BMJ Open* 2016;6:e012677.
23. Asch DA, Jedrziewski MK, Christakis NA. Response rates to mail surveys published in medical journals. *J Clin Epidemiol* 1997;50:1129–36.
24. Mulligan A, Hall L, Raphael E. Peer review in a changing world: an international study measuring the attitudes of researchers. *Journal of the American Society for Information Science and Technology* 2013;64:132–61.
25. Cunningham CT, Quan H, Hemmelgarn B, *et al*. Exploring physician specialist response rates to web-based surveys. *BMC Med Res Methodol* 2015;15:32.
26. Bowling A. Mode of questionnaire administration can have serious effects on data quality. *J Public Health* 2005;27:281–91 https://doi.org/.
27. Walker A, Maher J, Coulthard M, *et al*; *Living in Britain. Results from the 2000 General Household Survey*. London: The Stationary Office, 2001.
28. Grundy Q, Dunn AG, Bourgeois FT, *et al*. Prevalence of disclosed conflicts of interest in biomedical research and associations with journal impact factors and altmetric scores. *JAMA* 2018;319:408–9.
29. Mintzes B, Grundy Q. The rise of ambiguous competing interest declarations. *BMJ* 2018;361:k1464.
30. Loder E, Brizzell C, Godlee F. Revisiting the commercial-academic interface in medical journals. *BMJ* 2015;350:h2957.