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# Consistency between trials presented at conferences, their subsequent publications and press releases

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## Abstract

**Objective** This study examined the extent to which trials presented at major international medical conferences in 2016 consistently reported their study design, end points and results across conference abstracts, published article abstracts and press releases.

**Design** Cross-sectional analysis of clinical trials presented at 12 major medical conferences in the USA in 2016. Conferences were identified from a list of the largest clinical research meetings aggregated by the Healthcare Convention and Exhibitors Association and were included if their abstracts were publicly available. From these conferences, all late-breaker clinical trials were included, as well as a random selection of all other clinical trials, such that the total sample included up to 25 trial abstracts per conference. **Main outcome measures** First, it was determined if trials were registered and reported results in an International Committee of Medical Journal Editors-approved clinical trial registry. Second, it was determined if trial results were published in a peer-reviewed journal. Finally, information on trial media coverage and press releases was collected using LexisNexis. For all published trials, the consistency of reporting of the following characteristics was examined, through comparison of the trials' conference and publication abstracts: primary efficacy endpoint definition, safety endpoint identification, sample size, follow-up period, primary end point effect size and characterisation of trial results. For all published abstracts with press releases, the characterisation of trial results across conference abstracts, press releases and publications was compared. Authors determined consistency of reporting when identical information was presented across abstracts and press releases. Primary analyses were descriptive; secondary analyses included  $\chi^2$  tests and multiple logistic regression.

**Results** Among 240 clinical trials presented at 12 major medical conferences, 208 (86.7%) were registered, 95 (39.6%) reported summary results in a registry and 177 (73.8%) were published; 82 (34.2%) were covered by the media and 68 (28.3%) had press releases. Among the 177 published trials, 171 (96.6%) reported the definition of primary efficacy endpoints consistently across conference and publication abstracts, whereas 96/128 (75.0%) consistently

## WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ The integrity of clinical trials is compromised when researchers selectively report or misreport their findings.
- ⇒ Previous studies have been limited in scope as they have typically focused on a single conference in a particular therapeutic area.

## WHAT THIS STUDY ADDS

- ⇒ In this cross-sectional analysis of clinical trials presented at 12 major medical conferences in the USA in 2016, we analysed the extent to which these trials transparently and consistently reported their outcomes across conference abstracts, publication abstracts and press releases.
- ⇒ Primary efficacy endpoint definitions were consistently reported and results were consistently characterised across conference abstracts and publication abstracts.
- ⇒ Trials also consistently characterised their results across conference abstracts, publication abstracts and press releases.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ Although the majority of trials consistently reported their primary efficacy endpoint definitions and characterised their results consistently, there is still room for improvement in conference reporting practices.
- ⇒ To ensure the integrity, consistency and transparency of all health and medical conference submissions globally, we recommend the adoption of standardised conference reporting guidelines across all health and medical conferences.

identified safety endpoints. There were 107/172 (62.2%) trials with consistent sample sizes across conference and publication abstracts, 101/137

(73.7%) that reported their follow-up periods consistently, 92/175 (52.6%) that described their effect sizes consistently and 157/175 (89.7%) that characterised their results consistently. Among the trials that were published and had press releases, 32/32 (100%) characterised their results consistently across conference abstracts, press releases and publication abstracts. No trial characteristics were associated with reporting primary efficacy end points consistently.

**Conclusions** For clinical trials presented at major medical conferences, primary efficacy endpoint definitions were consistently reported and results were consistently characterised across conference abstracts, registry entries and publication abstracts; consistency rates were lower for sample sizes, follow-up periods, and effect size estimates.

**Registration** This study was registered at the Open Science Framework (<https://doi.org/10.17605/OSF.IO/VGXZY>).

## Introduction

Scientific and medical conferences have typically been regarded as a critical component of the research enterprise, where recent findings are shared, innovative research ideas are generated and new collaborations are created.<sup>1</sup> Scientific and medical conferences attract global researchers and clinicians, sponsors, pharmaceutical companies and media representatives, with attendance ranging from 11 000 to well over 17 000 participants.<sup>1,2</sup>

Clinical trials are often considered the gold standard of evidence on medical interventions and techniques. Therefore, it is critical that their findings, at conferences and their subsequent publications, are reported transparently, consistently and with integrity.<sup>3</sup> If clinical trial reporting does not present an accurate and unbiased reflection of trial results, patients might suffer serious consequences.<sup>4</sup>

Publication bias occurs when trialists do not publish their findings, or only publish positive findings. Relatedly, reporting bias occurs when investigators selectively report outcomes, switch outcomes and under-report adverse events.<sup>5</sup> Another term given to reporting bias and which covers some of its nuances is 'spin'—investigators could inappropriately spin their results positively, including inaccurate claims of benefit, extrapolations from incomplete data or selective or misreporting.<sup>5–8</sup> Publication bias and/or reporting bias may be particularly concerning at global scientific/medical conferences during presentations of clinical trials and/or their subsequent publications, or lack thereof, as investigators might experience pressure to report exciting findings at these meetings. The nature of this pressure is connected with the 'publish or perish' phenomenon, where researchers are incentivised to publish, typically novel positive findings, in order to advance their careers.<sup>9</sup> Such pressure creates an environment which is highly susceptible to misreporting and spin, the consequences of which might include clinicians adopting incorrect evidence into their practice and patients' requesting flawed medical 'advances' due to the press highlighting and promoting these inaccurate findings in their news reports.<sup>10</sup>

Previous studies have shown that inconsistent reporting between conference presentations and subsequent publications is prevalent. For instance, Toma *et al*<sup>11</sup> studied the publication fate and degree of consistency between meeting abstract results and subsequent publications of late-breaking randomised controlled trials (RCT) presented at the American College of Cardiology scientific meeting from 1999 to 2002.<sup>11</sup> The authors identified that 41% of all the RCTs that were subsequently published exhibited

discrepancies between the efficacy estimate reported in the meeting abstract versus the one reported in the subsequent publication for the primary outcome.<sup>11</sup> The discrepancy rate was the same for late-breaker RCTs as for RCTs presented in other sessions.<sup>11</sup> Similarly, Pocock and Collier<sup>12</sup> looked at seven of the late-breaker clinical trials presented at American College of Cardiology Scientific Sessions in 2018.<sup>12</sup> They found that of these seven trials, six (86%) spun their results to emphasise the positive aspects of their findings for the purposes of their conference presentations.<sup>12</sup> While previous evaluations have focused on a single conference in a particular therapeutic area, less is known about inconsistency of reporting at medical conferences across specialties.

Accordingly, our study was conducted to address this gap in the literature. The primary objective of our study was to examine the extent to which trials presented at major international medical conferences in 2016 consistently reported their study design, endpoints and results across conference abstracts, published article abstracts and press releases. As a secondary objective, we aimed to measure the consistency of the reporting of the primary efficacy endpoint definition across conference abstracts, registration entries and publication abstracts for all trials that were both registered and subsequently published.

## Methods

We conducted a cross-sectional analysis of clinical trials presented at major medical conferences in the USA in 2016. Although held in the USA, these medical meetings are typically attended by a global audience. The year 2016 was picked to provide sufficient time for these trials to be published to be able to conduct the comparisons between conference presentation abstracts and corresponding publication abstracts.<sup>13,14</sup>

### Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

### Study sample—inclusion/exclusion

#### Conference selection

Two authors (AR-F and JSR) identified conferences from a list of the largest clinical research meetings held in 2015 in the USA aggregated in by the Healthcare Convention and Exhibitors Association (HCEA).<sup>15</sup> The HCEA is a trade association whose mission is 'to improve the effectiveness and promote the value of all conventions, meetings and exhibitions for the healthcare industry'.<sup>15</sup> We used its report of the top 50 healthcare meetings in the USA in 2015 to identify the clinical research meetings to be included in our study sample. This report was used as it was the most comprehensive report of all clinical research meetings in the USA with details about attendance. Conferences were included if the abstract text was publicly reported and accessible online. We excluded dental conferences from this list as there was no one on our team familiar with clinical trials in the field of dentistry. From 22 major medical conferences identified, 12 conferences were included to compile the clinical trial study sample.

#### Clinical trial selection

Most major conferences have incorporated specialised plenary sessions dedicated to 'late-breaking' clinical research, during which time researchers leading large clinical trials with novel findings present their results for the first time.<sup>11,16</sup> Thus, we comprehensively searched each of the 12 respective conference programmes and websites as well as contacted organising committees and

librarians and other staff affiliated with the associations/societies to ascertain whether they had dedicated late-breaker sessions in 2016. For each conference, we included all late-breaking clinical trials, where available, as well as a random selection of all other clinical trials presented orally or through a poster, such that the total sample included up to 25 trial abstracts per conference. This sample size was not calculated a priori—it was determined based on the practical considerations of reading conference abstracts and identifying their registration details, publications, press releases and media coverage. Conference presentations were eligible for inclusion if they were of clinical studies of any type (eg, interventional or observational), and of any design (eg, superiority, non-inferiority, equivalence or non-comparative). All non-clinical studies, including systematic reviews and meta-analyses, were all excluded from the sample. Since this cross-sectional analysis' unit of analysis is a clinical study, it falls under the broader category of a meta-epidemiological study.<sup>17</sup> We have used the Strengthening the Reporting of Observational Studies in Epidemiology checklist for cross-sectional analyses to ensure that this study reflects the highest standards of reporting.<sup>18</sup>

## Data extraction

### Trial characteristics

We extracted data on the characteristics of each clinical trial. The characteristics included: late-breaker status (yes vs no), type of study (interventional vs observational vs not applicable), primary purpose (therapeutic vs diagnostic vs other vs not applicable), study design (superiority vs non-inferiority vs equivalence vs non-comparative), funder (industry vs academia vs government vs combination vs other vs unclear) and medical conference (American Society of Clinical Oncology (ASCO) vs American Society of Hematology (ASH), American Heart Association (AHA) vs American College of Rheumatology vs American Diabetes Association (ADA) vs Digestive Disease Week (DDW) vs American Thoracic Society (ATS) vs Radiological Society of North America (RSNA) vs American Association for Cancer Research vs Association for Research in Vision & Ophthalmology (ARVO) vs American Urological Association (AUA) vs the American Psychiatric Association (APA)). The majority of trial characteristics were extracted from conference or publication abstracts and information on funding was extracted from registration entries.

## Main outcome measures

### Trial registration and reporting of summary results

We determined if trials were registered and reported results in an International Committee of Medical Journal Editors (ICMJE)-approved clinical trial registry.<sup>19 20</sup> If the trial registration information was not clear from the trial abstract, we manually searched Google, ClinicalTrials.gov or other ICMJE-approved registries using search terms associated with the intervention name, first author and sponsor.

### Trial publication

We searched PubMed and Google using the trials' registration number or abstract title and lead author to determine if trial results were published in a peer-reviewed journal.

### Media coverage and press releases

Finally, we searched LexisNexis and Google using the trials' abstract title and lead author to collect information on the trials' media coverage and press releases. LexisNexis is a database that

aggregates information from thousands of new agencies, including press releases and other media-related documents.<sup>21</sup>

## Consistency measures

For all published trials, we examined the consistency of reporting of the following characteristics, through comparison of the trials' abstracts from conference materials and corresponding manuscript publications (referred to as 'publication abstracts' throughout this study): primary efficacy end point definition, identification of safety end point, sample size, follow-up period, primary end point effect size and characterisation of trial results. We determined consistency of reporting when identical information was presented across the various reporting platforms being compared. As such, consistency was measured as a dichotomous variable (yes vs no).

The primary objective of our study was to measure the consistency of reporting of the primary efficacy end point definition between conference and publication abstracts. As to our study's secondary objective, if the trial was registered, we examined the consistency of the reporting of the primary efficacy end point definition between conference abstract and registration entry; in addition, if the trial was published and registered, we examined the consistency between publication abstracts and registration entries and across all three: conference abstract, registration entry and publication abstract.

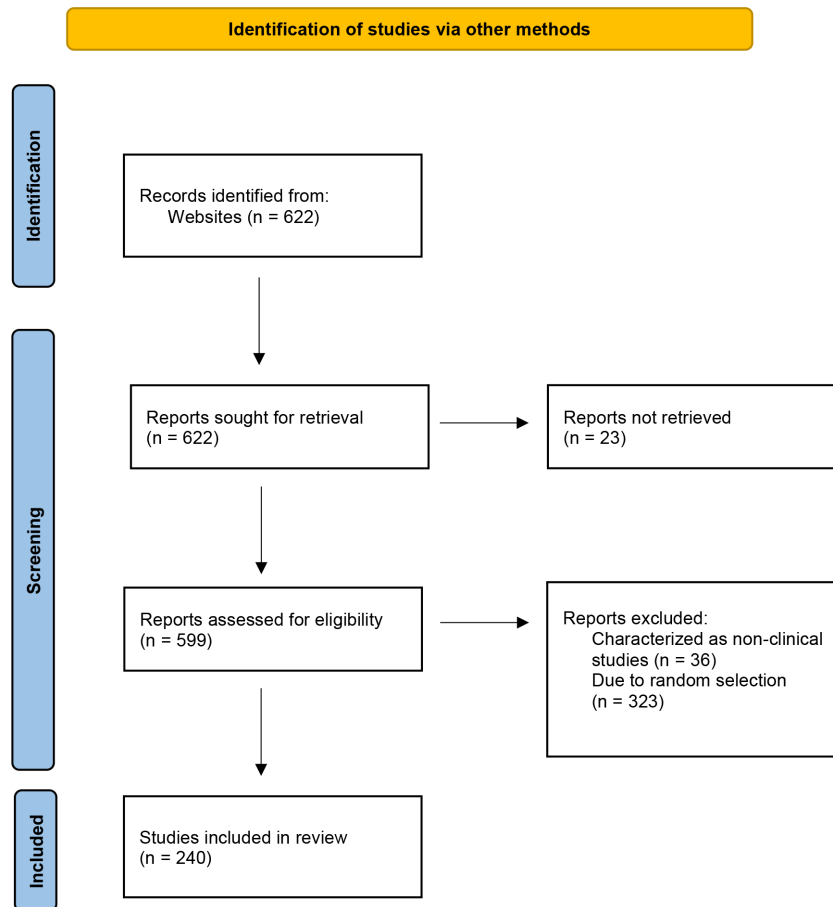
We also compared the characterisation of trial results, both between conference abstracts and publication abstracts and across conference abstracts, press releases and publications. Trial results were categorised as 'positive' if the primary end point was characterised positively, as 'neutral' if the primary end point was characterised negatively and the secondary end point was characterised positively and as 'negative' if the primary and secondary end points were both characterised negatively. These categorisations were made by reading the results and conclusion sections of the abstracts and assessing overall trial findings' 'favourability' that are typically outlined in the 'Conclusion' section.

## Data verification

AR-F independently extracted all the data for the study. An initial random sample of 10% abstracted data was selected for validation by ADZ. Next, the entire (excluding media-related variables) final sample was validated by KH, who also assisted with the extraction of registry-related variables. MG validated all and assisted with the extraction of a proportion of trials for all media-related variables. All discrepancies were resolved through discussion with all data extractors/verifiers. Data extraction and verification were completed in two stages: between 16 November 2018 and 14 June 2019 and between 10 September 2021 and 18 January 2022.

## Statistical analysis

Descriptive statistics were used to characterise the studies selected. Associations between the primary efficacy end point and trial characteristics (eg, late breaker status (yes vs no), primary purpose (categorised as therapeutic, diagnostic or other), funder (categorised as industry, academia, government, combination, other or unclear) and medical conference meeting) were assessed using  $\chi^2$  test or Fisher's exact test. Multiple logistic regression was used to assess the primary efficacy end point when including trial characteristics in the model to determine if the odds of the outcome were influenced by any combination of relevant trial characteristics. Trial characteristics that were included in the model included late breaker status, primary purpose and funder. Analyses were



**Figure 1** PRISMA 2020 flow diagram of selection of trials included in the cross-sectional analysis.<sup>22</sup>

exploratory and multiple comparisons were not accounted for in determining statistical significance ( $p < 0.05$ ). Analyses were conducted in RStudio (V.2022.02.0+443).

## Results

### Trial identification, screening and randomisation

Of the 612 total clinical studies presented at 12 medical conferences in 2016, 586 were eligible for inclusion in the study sample while 36 were excluded as they were later characterised as non-clinical studies. Among the 586 clinical studies, 49 were late-breaking clinical trials and were included in our study sample. Of the remaining 537 trials, 191 were randomly selected for inclusion. **Figure 1** outlines this trial identification, screening and random selection process.<sup>22</sup>

### Trial characteristics

**Table 1** summarises the characteristics of the trials included in our study sample. The 12 conferences selected to make up the clinical trial sample of our study were from the: ASCO, ASH, AHA, American College of Rheumatology, ADA, DDW, ATS, RSNA, American Association for Cancer Research, ARVO, AUA and the APA. Concerning the number of trials per conference, 7 conferences had 25 trials each, the remainder had trials ranging from 2 to 24 per conference.

The majority of the trials in our sample, 191/240 (79.6%), were not late-breaking clinical trials. With regard to type of study, the vast majority were interventional trials (232/240, 96.7%). Concerning the primary purpose of the trials in our sample, most were therapeutic trials, 178/240 (74.2%), 14/240 (5.8%) were diagnostic trials, 47/240

(19.6%) were classified as ‘other’—which included trials testing surgical techniques, exercise/lifestyle interventions, among others—and 1/240 (0.4%) trial did not fall into any category and was classified as ‘not applicable’ (this study used trial data to identify prevalence and risk factors). As to trial design, just over half of the sample were superiority trials (131/240, 54.6%). Regarding the sources of funding, the majority of the trials were industry-funded, 89/240 (37.0%) trials. A sizeable proportion of 30/240 (12.5%) trials did not specify their funding sources.

### Transparency and media-related practices

**Table 2** summarises the transparency and media-related practices of the clinical trials included in our sample. On transparency practices, 208/240 (86.7%) were registered at an ICMJE-approved registry, 95/240 (39.6%) reported summary results at an ICMJE-approved registry and 177/240 (73.8%) were published. As to media-related practices, 82/240 (34.2%) were covered by the media, and 68/240 (28.3%) had press releases issued.

### Consistency of reporting

#### Primary efficacy endpoint definition

#### Primary objective

Among the 177 published trials (**table 3**), 171 (96.6%) reported consistent definitions of primary efficacy endpoints between conference abstracts and publication abstracts. Analyses showed that there were no statistically significant associations found between trial characteristics and primary efficacy endpoint definition consistency between conference and publication abstracts (online supplemental file 1). The logistic regression model also

**Table 1** Characteristics of clinical trials included in the study sample

Trial characteristics	N=240 n (%)
<b>Trials</b>	
Late-breakers	49 (20.4)
Not late-breakers	191 (79.6)
<b>Type of study</b>	
Interventional	232 (96.7)
Observational	8 (3.3)
<b>Primary purpose</b>	
Therapeutic	178 (74.2)
Diagnostic	14 (5.8)
Other	47 (19.6)
Not applicable	1 (0.4)
<b>Design</b>	
Superiority	131 (54.6)
Non-inferiority	11 (4.6)
Equivalence	1 (0.4)
Non-comparative	97 (40.4)
<b>Funder</b>	
Industry	89 (37.0)
Academia	33 (13.8)
Government	16 (6.7)
Combination (any combination of industry, academia, government and other)	49 (20.4)
Other	23 (9.6)
Unclear	30 (12.5)
<b>Meeting</b>	
American Society of Clinical Oncology	25 (10.4)
American Society of Hematology	25 (10.4)
American Heart Association	25 (10.4)
American College of Rheumatology	25 (10.4)
American Diabetes Association	25 (10.4)
Digestive Disease Week	25 (10.4)
American Thoracic Society	25 (10.4)
Radiological Society of North America	24 (10)
American Association for Cancer Research	23 (9.6)
Association for Research in Vision & Ophthalmology	13 (5.4)
American Urological Association	3 (1.3)
American Psychiatric Association	2 (0.8)

demonstrated that there were no statistically significant trial characteristics that altered the chances of the occurrence of consistent reporting of the primary efficacy endpoint definition between conference and publication abstracts.

#### Secondary objective

For the 208 clinical trials that were registered at an ICMJE-approved registry, 187 (89.9%) reported consistent primary efficacy endpoint definitions between conference abstracts and registration entries. For the registered and published trials, 152/171 (88.9%) reported consistency primary efficacy endpoint definitions across conference abstracts, registration entries and publication abstracts.

#### Safety endpoint identification, sample size, follow-up period and effect size

Comparing conference abstracts with publication abstracts, 96/128 (75.0%) trials reported consistent safety endpoints, 107/172 (62.2%) reported consistent sample sizes, 101/137 (73.7%)

**Table 2** Transparency and media-related practices of clinical trials included in the study sample

Transparency practices	N=240 n (%)
<b>Registration</b>	
Yes	208 (86.7)
No	32 (13.3)
<b>Results reporting</b>	
Yes	95 (39.6)
No	113 (47.0)
Not applicable	32 (13.3)
<b>Publication</b>	
Yes	177 (73.8)
No	63 (26.3)
<b>Media coverage</b>	
Yes	82 (34.2)
No	158 (65.8)
<b>Press releases</b>	
Yes	68 (28.3)
No	172 (71.7)

reported consistent follow-up periods and 92/175 (52.6%) reported consistent effect sizes.

#### Results characterisation

Among the 238/240 (99.2%) trials in our sample that characterised their results in their conference abstracts (table 4), 197 (82.8%) were characterised positively, 33 (13.9%) were characterised negatively and 8 (3.4%) had neutral results characterisation. Among 177/240 (73.8%) published trials in our sample, 143 (80.8%) characterised results positively, 26 (14.7%) characterised results

**Table 3** Consistency of reporting between conference, press release and publication abstracts for the clinical trials included in the study sample

Characteristics	Consistency, no. (%)
<b>Primary efficacy endpoint definition</b>	
Conference abstract versus trial registration	187/208 (89.9)
Publication abstract versus trial registration	160/171 (93.6)
Conference abstract versus publication abstract	171/177 (96.6)
Conference abstract versus trial registration versus publication abstract	152/171 (88.9)
<b>Safety endpoint identification</b>	
Conference abstract versus publication abstract	96/128 (75.0)
<b>Sample size</b>	
Conference abstract versus publication abstract	107/172 (62.2)
<b>Follow-up period</b>	
Conference abstract versus publication abstract	101/137 (73.7)
<b>Effect size</b>	
Conference abstract versus publication abstract	92/175 (52.6)
<b>Results characterisation</b>	
Conference abstract versus publication abstract	157/175 (89.7)
Conference abstract versus press release versus publication abstract	32/32 (100)

**Table 4** Conference and publication abstract results characterisation for the clinical trials included in the study sample

Abstracts	Characterisation, no. (%)		
	Positive	Negative	Neutral*
Conference abstract	197/238 (82.8)	33/238 (13.9)	8/238 (3.4)
Publication abstract	143/177 (80.8)	26/177 (14.7)	8/177 (4.5)

\*Trials were classified as 'neutral' if the primary endpoint was characterised negatively and the secondary endpoint was characterised positively.

negatively and 8 (4.5%) had neutral results characterisation. For the published trials (table 3), 157/175 (89.7%) characterised their results consistently between conference and publication abstracts. For the trials that had press releases and were published, 32/32 (100%) characterised their results consistently across conference abstracts, press releases and publication abstracts.

All data and code generated from this study are publicly available.<sup>23</sup>

## Discussion

In this cross-sectional analysis of clinical trial abstracts presented at major medical conferences in 2016, nearly all reported consistent primary efficacy endpoint definitions between conference and publication abstracts. Similarly, for nearly 90% of these trials, results were characterised consistently between conference abstracts and publication abstracts. Previous studies however show varied findings about the prevalence of consistent reporting in the medical literature. Naturally, methodological differences in measuring consistent reporting may have led to such variations between studies. For instance, a retrospective review of discrepancies between conference abstracts and published manuscripts in plastic surgery studies published in 2021 found that 81% of the published studies were consistently reported.<sup>24</sup> In a scoping review of comparisons between abstracts and full reports in primary biomedical research, Li *et al*<sup>25</sup> found that the level of consistency ranged from 55% to 95%, which included consistency in designating a primary outcome measure.<sup>25</sup> On a related note, some studies looked at the prevalence of spin in the medical literature and a systematic review found that 75% of non-inferiority oncology trials had evidence of misleading reporting (spin).<sup>26</sup> Another study identified spin in 34.5% of abstracts of systematic reviews and meta-analyses in emergency medicine.<sup>27</sup> Similarly, Roberts *et al*<sup>28</sup> evaluated spin in abstracts of cardiology trials and found evidence of spin in 27.3% of trial abstracts.<sup>28</sup>

There were lower rates of consistent reporting among other trial characteristics between conference and publication abstracts, including sample sizes, follow-up periods and effect size estimates, which does not rule out the possibility of misreporting at conferences and/or their subsequent publications. For instance, for sample size, safety endpoint and effect size reporting consistency, we found rates that ranged between 50% and 75%. These differences are to be expected for some of these characteristics as trial conference presentations often present preliminary data with shorter follow-up periods and smaller sample sizes, as trials could still be recruiting participants, and consequently, varying effect sizes. We are in agreement with Dagi *et al*,<sup>24</sup> who recommended that authors should indicate in their conference abstracts whether sample size is final at the time of presentation.<sup>24</sup> That trial safety endpoint consistency between conference and publication abstracts was not as high as the consistency of primary efficacy endpoint definition is an indication that trials typically focus more on reporting efficacy endpoints over safety endpoints.<sup>5</sup>

As for trial transparency and media-related practices, it was noteworthy that close to 90% of trials were registered at an

ICMJE-approved registry. A much smaller proportion of around 40% reported summary results; this was expected as not all trials are required to report their summary results in ClinicalTrials.gov under the Food and Drug Administration Amendments Act of 2007,<sup>29-31</sup> and not all ICMJE-approved registries have a section dedicated to the reporting of summary results. Although still low at 73.8%, the publication rate of the trials in our sample was higher than a previous study that found that 39.1% of abstracts from the American Academy of Ophthalmology meeting in 2008 made it to formal publication,<sup>32</sup> however our study's publication rate was similar to a study by Schwartz *et al*,<sup>10</sup> who found that in 3 years after the meeting, 25% of studies presented major scientific meetings held in 1998 still remained unpublished.<sup>10</sup> In 2009, Chalmers and Glasziou estimated that 85% of research is wasted annually, equating to around US\$170 billion; one major contributor to this figure is that 50% of studies are never published in full.<sup>33</sup> Ross *et al*<sup>34</sup> also discussed the implications of the lack of dissemination of study results: the disruption in the scientific process, the lack of evidence forming the basis of decision-making and the ethical responsibilities to honour trial participants who risked their health to participate in scientific research.<sup>34</sup> The Declaration of Helsinki also outlined the ethical obligations of publishing all results from clinical trials, positive and negative.<sup>34 35</sup> One recommendation to vouchsafe the formal publication of all clinical trials is that funders should play an active role in ensuring the clinical studies they fund make it to formal publication. For instance, funders could support a dedicated team of staff responsible to follow-up with primary investigators of clinical trials to follow the progress of the clinical trials they lead and to ensure that their results are published, be they positive or negative.

Moving forward, it would be ideal that all health and medical conferences adopt standardised reporting practices for abstract submissions, such as those recommended by Good Practice for Conference Abstracts and Presentations (GPCAP).<sup>36 37</sup> These standardised reporting practices ensure that conference submissions accurately report their methods and results according to the Consolidated Standards of Reporting Trials abstract guidelines, along with sharing their trial registration numbers, funding sources and other study characteristics.<sup>36 37</sup> By following standardised reporting practices such as GPCAP, conferences can ensure the integrity, consistency and transparency of all health and medical conference submissions globally.<sup>36</sup> In addition, with the growing adoption of preprints for clinical and health sciences research,<sup>38 39</sup> health and medical conferences should encourage authors of abstracts to be presented at meetings to post full articles describing their research on a preprint platform. This would allow all interested members of the research community, including those unable to attend the conferences, to have free and complete access to the new information being disseminated via the meeting, enhancing scientific communication.

Our study has several limitations. First, by only evaluating the consistency of reporting of trial characteristics between conference and publication abstracts for the primary efficacy endpoint, we did not consider the consistency of reporting for secondary

endpoints. However, secondary endpoints are often not included in conference/publication abstracts due to word count restrictions. Furthermore, on many occasions we noticed that trials registered multiple primary efficacy endpoints and so it is likely that our results could have overestimated the consistency of reporting of the primary efficacy endpoint definition as trials could have also consistently misreported their primary efficacy endpoint definition. Third, we did not identify the various types of spin or the nuances of spin that could have taken place, for instance, overinterpretation or distortion of results, and discordance between results and their interpretation.<sup>7</sup> Fourth, we did not investigate which trials were required to share their summary results according to the Food and Drug Administration Amendments Act of 2007, which mandated registration and results reporting for certain clinical trials at ClinicalTrials.gov.<sup>30</sup> Fifth, while measuring effect size consistency between conference and publication abstracts, we looked for identical effect sizes and did not measure differences of effect size or overlapping 95% CIs between conference and publication abstracts. Sixth, the methods to retrieve subsequent publications might have missed publications in less visible sources such as journals with poor indexation or in a different language. Lastly, we originally set out to analyse 550 clinical trial conference abstracts. However, not all conferences had their abstracts available online, and it is unclear whether our findings remain consistent with a larger sample. A strength of this study is that 12 conferences were assessed, providing insight into the overall consistency of results and outcome reporting between conference abstracts, registration entries and publication abstracts in a wide cross-section of health and medical conferences.

Clinical trial integrity is enhanced and ensured through the consistent and transparent reporting of conduct and results. Therefore, it is encouraging to note that the majority of clinical trials presented at major health and medical conferences in 2016 consistently reported the primary efficacy endpoint definition and characterisation of results across conference abstracts and publication abstracts. However, there were lower rates of consistent reporting for other trial characteristics such as sample size, safety and effect size reporting. Investigators should make efforts to ensure that all reports of a clinical trial are consistent, and provide clear explanations for when changes occur. Adoption of preprints and standardised reporting practices for conference abstracts may foster more consistent and transparent clinical trial reporting.

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**Contributors** AR-F designed and led the study, extracted and verified data, conducted the statistical analyses, wrote the first draft of the manuscript, edited the manuscript and is the guarantor of the study; KH extracted and verified data and edited the manuscript; MG extracted and verified data and edited the manuscript; JR provided statistical consulting for the study and edited the manuscript; ADZ verified data and edited the manuscript; JDW provided statistical consulting and edited the manuscript and JSR designed the study, provided statistical consulting, edited the manuscript and provided mentorship for AR-F's postdoctoral fellowship throughout the study.

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#### References

- Sarabipour S, Khan A, Seah YFS, *et al*. Changing scientific meetings for the better. *Nat Hum Behav* 2021;5:296–300.
- eLife Community Ambassadors. Improving conferences. Available: <https://elifelifeambassadors.github.io/improving-conferences/> [Accessed 01 Mar 2022].
- Wallach JD, Gonsalves GS, Ross JS. Research, regulatory, and clinical decision-making: the importance of scientific integrity. *J Clin Epidemiol* 2018;93:88–93.
- Boutron I, Altman DG, Hopewell S, *et al*. Impact of spin in the Abstracts of articles reporting results of randomized controlled trials in the field of cancer: the SPIIN randomized controlled trial. *J Clin Oncol* 2014;32:4120–6.
- Heneghan C, Goldacre B, Mahtani KR. Why clinical trial outcomes fail to translate into benefits for patients. *Trials* 2017;18:122.
- Boutron I, Dutton S, Ravau P, *et al*. Reporting and interpretation of randomized controlled trials with statistically nonsignificant results for primary outcomes. *JAMA* 2010;303:2058–64.
- Chiu K, Grundy Q, Bero L. 'Spin' in published biomedical literature: a methodological systematic review. *PLoS Biol* 2017;15:e2002173.
- Diong J, Butler AA, Gandevia SC, *et al*. Poor statistical reporting, inadequate data presentation and spin persist despite editorial advice. *PLoS One* 2018;13:e0202121.
- Grimes DR, Bauch CT, Ioannidis JPA. Modelling science trustworthiness under publish or perish pressure. *R Soc Open Sci* 2018;5:171511.
- Schwartz LM, Woloshin S, Baczek L. Media coverage of scientific meetings: too much, too soon? *JAMA* 2002;287:2859–63.
- Toma M, McAlister FA, Bialy L, *et al*. Transition from meeting abstract to full-length journal article for randomized controlled trials. *JAMA* 2006;295:1281–7.
- Pocock SJ, Collier TJ. Critical appraisal of the 2018 ACC scientific sessions late-breaking trials from a statistician's perspective. *J Am Coll Cardiol* 2018;71:2957–69.
- Rivero C, Dechartres A, Perrodeau E, *et al*. Timing and completeness of trial results posted at ClinicalTrials.gov and published in journals. *PLoS Med* 2013;10:e1001566.
- Ross JS, Mocanu M, Lampropoulos JF, *et al*. Time to publication among completed clinical trials. *JAMA Intern Med* 2013;173:825–8.
- Healthcare Convention & Exhibitors Association. Top 50 largest healthcare meetings report. Available: <https://www.hcea.org/> [Accessed 16 Feb 2022].
- Ioannidis JPA. Are medical conferences useful? And for whom? *JAMA* 2012;307:1257–8.
- Murad MH, Wang Z. Guidelines for reporting meta-epidemiological methodology research. *Evid Based Med* 2017;22:139–42.
- von Elm E, Altman DG, Egger M, *et al*. Strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *BMJ* 2007;335:806–8.
- World Health Organization. Primary registries. Available: <https://www.who.int/clinical-trials-registry-platform/network/primary-registries> [Accessed 30 Mar 2022].
- International Committee of Medical Journal Editors. Clinical trials registration. Available: <http://www.icmje.org/about-icmje/faqs/clinical-trials-registration/> [Accessed 30 Mar 2022].
- Wikipedia contributors. LexisNexis, 2022. Wikipedia, The free encyclopedia. Available: <https://en.wikipedia.org/w/index.php?title=LexisNexis&oldid=1110985831>
- Page MJ, McKenzie JE, Bossuyt PM, *et al*. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71.
- Rowhani-Farid A, Hong K, Grewal M. Data from: consistency between trials presented at conferences, their subsequent publications, and press releases. *Open Science Framework* 2022.
- Dagi AF, Parry GJ, Labow BI, *et al*. Discrepancies between conference Abstracts and published manuscripts in plastic surgery studies: a retrospective review. *Plast Reconstr Surg Glob Open* 2021;9:e3828.
- Li G, Abbade LPF, Nwosu I, *et al*. A scoping review of comparisons between abstracts and full reports in primary biomedical research. *BMC Med Res Methodol* 2017;17:181.
- Ito C, Hashimoto A, Uemura K, *et al*. Misleading reporting (spin) in Noninferiority randomized clinical trials in oncology with statistically not significant results: a systematic review. *JAMA Netw Open* 2021;4:e2135765.
- Ferrell MC, Schell J, Ottwell R, *et al*. Evaluation of spin in the abstracts of emergency medicine systematic reviews and meta-analyses. *Eur J Emerg Med* 2021:118–25.
- Roberts WB, Cooper CM, Khattab M, *et al*. Evaluation of "Spin" in the Abstracts of randomized controlled trial reports in cardiology. *J Osteopath Med* 2020;120:732–9.
- ClinicalTrials.gov. FDAAA 801 and the final rule. Available: <https://clinicaltrials.gov/ct2/manage-recs/fdaaa> [Accessed 11 Feb 2022].
- Tse T, Williams RJ, Zarin DA. Reporting "basic results" in ClinicalTrials.gov. *Chest* 2009;136:295–303.
- ClinicalTrials.gov. About the results database. Available: <https://clinicaltrials.gov/ct2/about-site/results> [Accessed 24 Mar 2022].
- In:Mimouni M, Krauthammer M, Abualhasan H, *et al*. Publication outcome of Abstracts submitted to the American Academy of ophthalmology meeting. *J Med Libr Assoc* 2018;106:57–64.
- Chalmers I, Glasziou P. Avoidable waste in the production and reporting of research evidence. *Lancet* 2009;374:86–9.
- Ross JS, Tse T, Zarin DA, *et al*. Publication of NIH funded trials registered in ClinicalTrials.gov: cross sectional analysis. *BMJ* 2011;344:d7292.
- World Medical Association. Declaration of Helsinki – ethical principles for medical research involving human subjects. Available: <https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/> [Accessed 03 Mar 2022].
- Foster C, Wager E, Marchington J, *et al*. Good practice for conference Abstracts and presentations: GPCAP. *Res Integr Peer Rev* 2019;4:11.
- Consort - Abstracts. Available: <http://www.consort-statement.org/extensions?ContentWidgetId=562> [Accessed 10 Jun 2022].
- Krumholz HM, Bloom T, Sever R, *et al*. Submissions and Downloads of preprints in the first year of medRxiv. *JAMA* 2020;324:1903–5.
- Massey DS, Opere MA, Wallach JD, *et al*. Assessment of Preprint policies of top-ranked clinical journals. *JAMA Netw Open* 2020;3:e2011127.



**Supplementary File 1: Correlations of trial characteristics with consistency of primary efficacy endpoint definition between conference and publication abstracts**

<b>Trial Characteristics</b>	<b>Independence test<sup>1</sup> results</b>	<b>p</b>
<b>Late-breaker status</b>	OR=Inf (95%CI=0.42, Inf)	0.34
<b>Type of study</b>	OR=0.15 (95%CI=0.01, 8.53)	0.19
<b>Primary purpose</b>	X <sup>2</sup> =4.16, df=2	0.12
<b>Study Design</b>	X <sup>2</sup> =0.86, df=3	0.83
<b>Funder</b>	X <sup>2</sup> =5.53, df=5	0.35
<b>Medical conference meeting</b>	X <sup>2</sup> =6.94, df=11	0.80
<sup>1</sup> Chi-square tests and Fisher's exact tests (when sample size was less than 10). Significance value was set at $p < 0.05$		