UNIVERISTÉ PARIS DESCARTES

École Doctorale Pierre Louis de Santé Publique:
Épidémiologie et Sciences de l'information Biomédicale

Centre de Recherche Épidémiologie et Statistique Sorbonne Paris Cité
INSERM UMR 1153, Équipe METHODS

Dissémination et communication des résultats de la recherche clinique dans les médias

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Thèse de doctorat de santé publique
Spécialité : Épidémiologie

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Présentée et soutenue publiquement le 18 octobre 2017

Jury

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ACKNOWLEDGEMENT

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AFFILIATIONS

1. INSERM U 1153, Paris, France

2. Université Paris Descartes Sorbonne Paris cité, Paris, France

FUNDING

ARTICLES

Paper 1

PLOS ONE: 2015 Oct. 16; doi: 10.1371/journal.pone.0140889: **Title;** Interpretation of Results of Studies Evaluating an Intervention Highlighted in Google Health News: A Cross-Sectional Study of News. Authors; **Haneef R**, Lazarus C, Ravaud P, Yavchitz A, Boutron I

Paper 2

BMC Research Integrity and Peer Review: 2017 Jul. 1; doi: 10.1186/s41073-0033-z: **Title;** Factors associated with online media attention to research: A cohort study of articles evaluating cancer treatments. Authors; **Haneef R**, Ravaud P, Baron G, Ghosn L, Boutron I

Paper 3

BMJ Open (accepted): Title; Dissemination of 2014 Dual Anti-Platelet Therapy (DAPT) trial results: A systematic review of scholarly and media attention over 7 months. Authors; Sharp K M*, **Haneef R***, Ravaud P, Boutron I

These authors contributed equally to this work as a first author.

OTHER SCIENTIFIC PUBLICATIONS

1. **BMJ Open** (*accepted*)**, Title;** Interpretation of health news reporting results with or without spin: Protocol for a prospective meta-analysis of 16 randomized controlled trials. Authors; **Haneef R**, Yavchitz A, Ravaud P, Baron G, Oransky I, Schwitzer G, Boutron I

2. **J Clin Epidemiol** 2016 Sept**;** doi: 10.1016/j.jclinepi.2016.04.012: **Title;** Impact of external peer review on distorted reporting in reports of non-randomized studies of therapeutic interventions published in open peer-review journals. Authors; Lazarus C, **Haneef R,** Ravaud P, Hopewell S, Altman D G, Boutron I

3. **BMC Med** 2016 Jan. 28; doi: 10.1186/s12916-016-0551-4: **Title;** Public availability of results of observational studies evaluating an intervention registered at ClinicalTrials.gov. Authors; Baudart M, Ravaud P, Baron G, Dechartres A, **Haneef R**, Boutron I

4. **BMC Med Res Methodol** 2015 Oct. 13; doi: 10.1186/s12874-015-0079-x: **Title;** Classification and prevalence of spin in abstracts of non-randomized studies evaluating an intervention. Authors; Lazarus C, **Haneef R**, Ravaud P, Boutron I

ABSTRACT IN ENGLISH

Mass media and social networks are important sources of disseminating and communicating clinical research. The term "spin" is used when the presentation and interpretation of the results of a study is distorted by the authors intentionally or unintentionally. Spins exaggerate the beneficial effects of interventions and underestimate adverse effects.

The main objectives of this PhD were (I) to assess the prevalence of spin in health news, as well as identify and classify different strategies of spin; (II) to identify factors associated with dissemination of research results through online media, and (III) to explore how results of a trial reported with spin were disseminated to the scientific community and online media, using the 2014 DAPT trial as a case study.

For the first aim, we performed a cross-sectional study of health news and described the distortion of research results of studies evaluating an intervention in Google health news. We developed a classification of spin for health news and showed a high prevalence of spin.

For the second aim, we performed a cohort study of articles evaluating cancer treatments and identify factors associated with high online media attention. The primary outcome was the attention received by media and social networks measured by Altmetric score. Our results highlighted the importance of open access and press releases.

Finally, we performed a systematic review of attention received by media and social networks surrounding the DAPT study which were reported with spin and undermine the adverse effects of the treatment. We showed that the interpretation of results by authors was rarely criticized.

These results highlighted the importance of spin in mass media and provided a tool (classification of spin) to improve the dissemination of research results.

Keywords: Spin, Health news, Cancer treatments, Online media attention, Altmetric score, Dissemination

RESUMÉ

Les medias et les réseaux sociaux constituent une source importante de diffusion et de communication des résultats de la recherche clinique. Le terme « spin » est utilisé lorsque la présentation et l'interprétation des résultats d'une étude sont déformées par les auteurs que ce soit intentionnellement ou involontairement. Les spins exagèrent les effets bénéfiques des interventions et sous-estiment les effets indésirables.

Les principaux objectifs de ce travail étaient :1) d'évaluer la prévalence des « spins » dans les articles de presse, d'identifier les différentes stratégies de spin et de développer une classification de spin ; 2) d'identifier les facteurs associés à une diffusion des résultats via les réseaux sociaux et 3) d'étudier comment les articles scientifiques rapportés avec des spins diffusent via les réseaux sociaux, à partir de l'exemple de l'essai DAPT 2014.

Dans un premier temps, nous avons réalisé une revue systématique des articles de presse décrivant les résultats d'études évaluant une intervention et indexés dans la rubrique santé de Google. Nous avons développé une classification des stratégies de spin pour les articles de presse et montré que la prévalence des spins est élevée.

Dans un deuxième temps, nous avons réalisé une étude de cohorte d'articles évaluant les traitements contre le cancer pour identifier les facteurs associés à une attention médiatique élevée. Le critère de jugement principal était l'attention portée par les médias et les réseaux sociaux mesuré par le « score Altmetric ». Nos résultats ont montré l'importance de l'accès libre et des communiqués de presse.

Enfin, nous avons effectué une analyse systématique de l'attention portée par les médias et les réseaux sociaux autour de l'étude DAPT qui était rapporté avec des spins sous estimant les effets indésirable de l'intervention. Nous avons montré que l'interprétation des résultats par les auteurs sont rarement contredits.

Ces travaux ont permis de mettre en évidence l'importance des spins dans les medias et de développer des outils (classification de spin) pour améliorer la diffusion des résultats de la recherche.

Le mot de clés: Spin, Les articles de presse, Les traitements de cancer, L'attention dans la media par internet, Le score Altmetric, Dissémination

INTRODUCTION

1. Dissemination of research results: A complex system

Over the past decades, the widespread use of online mass media has become an important source of disseminating and communicating medical research especially through news media [1] and social media [2]. Online news media, science blogs and social media may play a role in disseminating research among important stakeholders such as policy makers, care providers, patients and the general public.

There are surveys which have highlighted that general public get information related to science through media: 1. A survey performed by the Committee of Concerned Journalists and Pew Research Center for the People and Press in 2003 showed that more than half of US adults follow heath news closely [3]. 2. A poll conducted by Ipsos MORI in 2002 found that almost 90% of the general public gets most of its information about science from mass media [4]. Finally, the Canadian Institute of Health Research in 2014 reported that nearly 9 in 10 Canadians make decisions affecting their health as direct result of media reports [5]. Therefore, efficient and undistorted communication of the findings of medical research is fundamentally important to physicians, researchers, and ultimately the public [6].

There are a wide range of sources that are used to disseminate medical research. With the involvement of different sources, communication of information has become very complex. Consequently, the translation of scientific results from one source to the next may be influenced and accuracy might be compromised.

Following are the important sources to disseminate research to the scientific community and public:

o **Publications**

Publications are the primary source to disseminate research results within the scientific community. Sometimes, study results are presented in conferences to communicate with other scientists and different health care professionals.

o **Press releases**

Press releases are widely used by medical researchers and editors of medical journals to attract media attention [7] and to promote their research toward their institutions, journalists and the public [8]. In theory, a press release should provide journalists with basic and accurate information needed to develop a news story and to publish it in the mass media. According to an independent medical news rating organization, more than one third of US health news stories seem to rely solely or largely on press releases and are developed based on the facts reported in press releases [9]. In this review, the author evaluated the quality of 500 health news stories and found that journalists usually fail to discuss the quality of the evidence, the existence of alternative options, and the absolute magnitude of potential benefits and harms.

de Semir V et al. assessed whether press releases about journal articles were associated with publication of subsequent newspaper stories [10]. The authors performed a retrospective analysis of newspaper stories, journal press releases and journal table of contents. They collected press releases from four scientific journals (*BMJ, Nature, Science* and *the Lancet*), along with newspaper stories related to scientific research published in seven newspapers (*The New York Times, Le Figaro, Le Monde, El Pais, La Vanguardia, La Repubblica* and *International Herald Tribune*). The main study outcomes were the number of stories that contained reference to articles appearing in four scientific journals and number of newspapers stories that referred to journals articles described in press releases. They analyzed 1060 newspapers stories; 142 referred to journal articles. Of the 142, 119 (84%) referred to articles mentioned in press releases and 23 (16%) to articles not mentioned in press releases. They concluded that articles described in press releases are associated with the subsequent publication of newspaper stories on the same topic [10].

In another study, Stryker also assessed whether press releases affect the amount of news coverage of a journal article due to its newsworthiness (i.e., the fact that the most

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newsworthy journal articles are selected for press release) [11]. The author selected 95 articles appearing in *JAMA* and *NEJM* that were defined as being "newsworthy" for a press release, and the quantity of relevant news coverage was estimated by using the LEXIS-NEXIS database. He showed a noticeable difference in media coverage between articles with and without press releases: articles with press releases generated an average of 26.6 media stories, whereas those without a press release produced an average of only 5.94 stories [11]. Finally, Stryker concluded that medical journals issue press releases for articles containing the characteristics journalists are looking for and press releases predicted newspaper coverage largely.

The quality of press releases influences the quality of associated newspaper stories [12].

o **News**

A major source to disseminate and communicate medical research and health information to patients and their families is the news media, where new developments and advances in medical research are frequently reported [1, 13]. These news items can have a large audience and could affect the behaviour of patients who look for new treatments to improve their health [1, 14].

o **Online media sources and social media**

Over the past decade, online social media websites have become extraordinarily popular both for private use and as a platform for marketing, as well as to aid dissemination of information across global community [2]. Social media is a category of online resources combining user participation and communication [15]. These range from social networks, such as Facebook, blogging, microblogging (Twitter), to video-sharing sites (YouTube) and photo-sharing sites (Instagram) [15]. Twitter and Facebook currently have more than 300 million active tweeters and 1 billion members worldwide, respectively [2]. In response to the increasing numbers of online users, a variety of peer-reviewed medical journals are

expanding their social media presence in an attempt to better engage their readers [15-17]. By having different blog and social media sites, journals allow the end-user to self-select the genre of knowledge they wish to receive [18]. Social media (i.e., Twitter) can predict highly cited articles within the first 3 days of article publication [19].

2. Mass media

2.1. Impact of mass media

Mass media refers to channels of communication that intend to reach a mass audience through various means such as television, radio, printed or online news items, etc.[20].

There is evidence showing that the contents of mass media can influence the behaviour of the scientific community, as well as that of care providers and the public.

○ **Impact on Scientific community**

A quasi-experimental study [6] compared the number of scientific citations of articles published in the New England Journal of Medicine that were covered by the New York Times to similar articles not covered by the Times. The authors also performed a comparison during a 3 month period when the New York Times was on strike but continued to prepare an "edition of record" that was not distributed to the public because of the strike. Journal articles publicized by the Times received 72.8 percent more scientific citations than control articles (not covered by the Times) *(see figure 1)*.
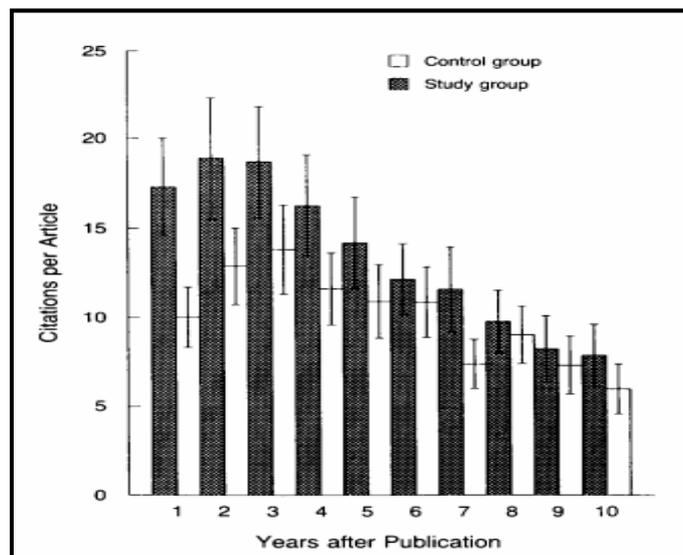
Figure 1: Mean (±SE) Number of Scientific Citations of 25 Journal Articles Covered by the Times (Study group) and 33 Journals Articles Not Covered by the Times (Control group). These articles were published in the journal in 1979, and citations were tracked for the 10 years from 1980 to 1989 [6].

(Figure 1 is extracted from the paper "Importance of the lay press in the transmission of medical knowledge", published in 1991 in NEJM).

This effect was not present for articles published during the strike; articles covered by the Times during this period were no more likely to be cited than those not covered, *(see figure 2)* [6]. The authors concluded that the coverage of medical research in the popular press amplifies the transmission of medical information from the scientific literature to the research community [6].
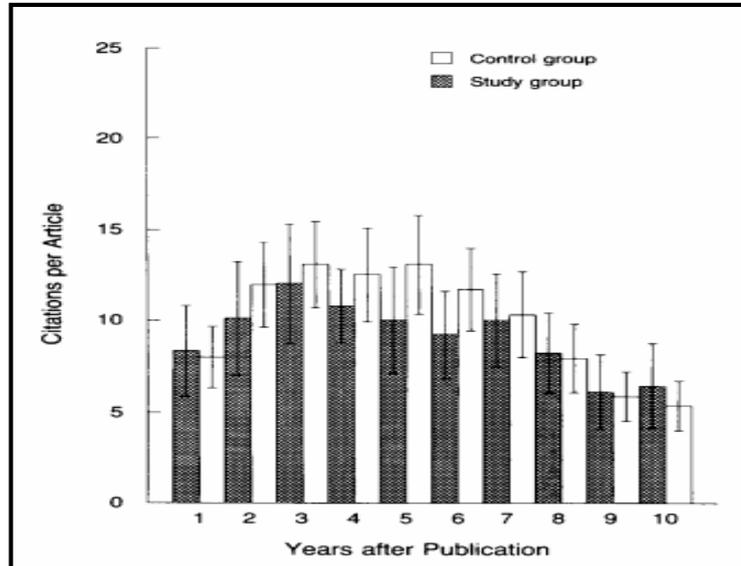
Figure 2: Mean (±SE) Number of Scientific Citations of 9 Journal Articles Covered by the Times during Its Strike (Study group) and 16 Journals Articles Not Covered by the Times during Its Strike (Control group). These articles were published in the Journal during the

strike period (August 10, 1978, to November 5, 1978), and citations were tracked for the

10 years from 1979 to 1988 [6].

(Figure 2 is extracted from the paper "Importance of the lay press in the transmission of

medical knowledge", published in 1991 in NEJM).

o **Impact on clinical practice**

Several studies focusing on specific domains showed an impact of media coverage on clinical practice and patients/public behaviour.

A study of physician practice assessed the relationship between mass media coverage and testing for group A streptococcal (GAS) disease in a pediatric emergency department [14]. This was a retrospective observational study. The investigators found a clear and substantial increase in such testing following the peak in media attention (testing rate increased from 55 to 103 per 1000 visits) despite no increase in the number of children presenting symptoms that might warrant such testing [14].

Haas and colleagues reported that a more substantial decline in use of hormone therapy by postmenopausal women was associated with wide media coverage of principal findings from the Women's Health Initiative (WHI) [21]. This was an observational cohort study (1997 to 2003). The proportion of women receiving hormone replacement therapy was decreased by about one third (from 40% to 28%) during that period.

Matthews et al. evaluated the impact of statin related media coverage on use of statins [22]. This was an ecological, interrupted time series study using prospectively collected primary care data from the UK. It showed that after a period of intense public discussion covered widely in the media (October 2013 to March 2014) over the risks and benefit balance of

statins, there was a transient rise of 11% and 12% in the proportion of people who stopped taking statins for primary and secondary prevention, respectively (*see figure 3)* [22]. Nevertheless, it did not show improvement in statin initiation among those with a recorded indication.
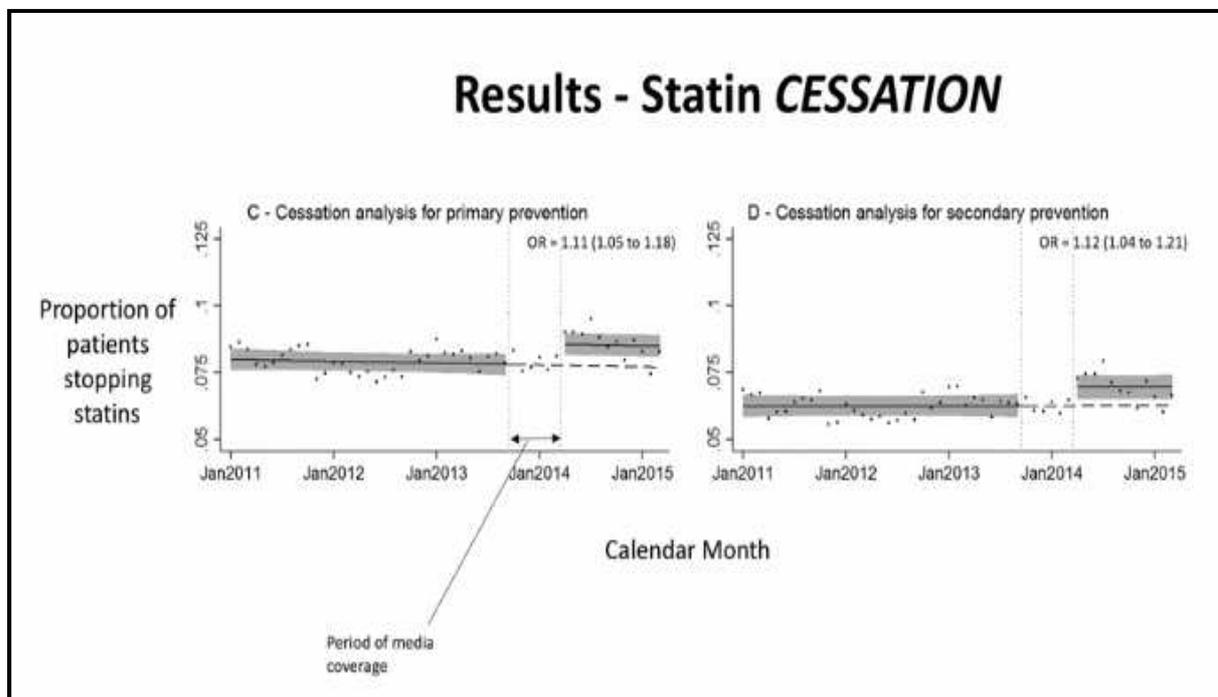
Figure 3: Primary analyses evaluating step change in proportion of patients stopping statins for primary and secondary prevention of cardiovascular diseases after exposure period (October 2013 to March 2014) [22].

(Figure 3 is extracted from the paper "Impact of statin related media coverage on use of statins: interrupted time series analysis with UK primary care data" published in BMJ in 2016).

These effects could result in more than 2000 additional cardiovascular events across the UK over a 10 year period.

An observational study of lithium evaluated how news reporting a beneficial effect of lithium on the course of ALS (Amyotrophic Lateral Sclerosis) was diffused and acquired by patients. In November 2007, a patient relayed an Italian news report about a promising result

of a human trial to an online community [23]. This single-blinded trial that included only 16 patients in the treatment group and 22 in the control group, reported on the potential efficacy of lithium carbonate to slow the progression of ALS [24]. The preliminary results of this trial were picked up in a news report, ahead of the formal scientific peer review and replication process [23].

The following is the first post by one patient who diffused it on an online social web:

"Hi everyone, I'm very enthusiastic about the news on the human ALS lithium trial coming out of Italy. I researched the literature and found that it has already been demonstrated that Lithium decreases glutamate excitotoxicity, upregulates HSP-70 (Heat shock protein), down-regulates the neuron-killing caspase-3, and has many other beneficial neural-protective effects. Plus, it clearly crosses the blood-brain boundary! I am a skeptic by nature, and this is the first time I've been truly hopeful about any ALS treatment."

Data from the PatientsLikeMe (www.patientslikeme.com/patients) plateform showed that before the announcement of this Italian study on the social web, only one patient reported taking Lithium. Four months later, there were 116 patients on this drug. *Figure 4* describes the frequency of Lithium Posts by week.

Figure 4: Frequency of Lithium Posts by week [23]

(Figure 4 is extracted from "How the social web supports patient experimentation with a new therapy: The demand for patient-controlled and patient-centered informatics", published in AMIA Annual Symposium Proceedings in 2008).

This study highlighted that sharing personal experience about a treatment on a social web may influence others behaviour who are taking the same treatment.

An observational study including patients from PatientsLikeMe later showed that Lithium had no effect on improving clinical outcomes of ALS at 12 months [25].

Finally, a Cochrane systematic review assessed the impact of the mass media on health services utilization by health care professionals, patients and the public [26]. This review concluded that media reports played an important role in influencing the use of health care interventions.

2.2. Choice of studies highlighted in news

Not all research articles are highlighted in the news, blogs, and social media. In theory, studies with high level of evidence should be more likely to be highlighted in the mass media. However, several other factors such as positive results, novelty of the treatment, etc, could influence the dissemination of an article. Some research has evaluated factors associated with news coverage.

In a longitudinal study, Bartlett et al. assessed the characteristics of medical research published in general medical journals that was press released and reported in two British newspapers [27]. They analyzed 1193 original articles; 517 (43%) were highlighted in a press release and 81 (7%) were reported in one or both newspapers. They found that coverage in newspapers was less likely for RCTs than observational studies (odds ratio 0.15, 95% CI [0.06 to 0.37][27] .

Selvaraj et al. showed that observational studies received more media attention than randomized controlled trials (RCTs) [28]. They compared 75 published articles that received coverage in top five newspapers by circulation against 75 published articles in top five high impact factor journals. They found that articles receiving coverage from newspapers were less likely to be RCTs (17% vs. 35%, p=0.016) and more likely to be observational studies (75% vs. 47%, p<0.001) [28].

On the other hand, research exploring the impact of higher methodological quality on citation rate has generated conflicting findings.

Patsopoulos et al. determined that research articles with higher methodological quality receive more citations than other study designs [29]. They evaluated a sample of 2646 articles with various study designs including meta-analyses, RCTs, cohort studies, case-control studies, case reports, non-systematic reviews, and decision analysis or cost-effectiveness analysis, published in 1991 and in 2001 [29]. They found that meta-analysis received more citations in both years than any other study designs [29].

In contrast, the work by Berghmans et al. found no convincing evidence that citation factors can be used to assess the higher methodological quality of published scientific work [30]. The authors evaluated 181 RCTs in lung cancer clinical research that were included in nine systematic reviews. They used two quality scales to assess methodological quality (Chalmers and ELCWP). A weak correlation between citation factors and quality scores was found using both scales [30].

2.3. Quality of reporting research results in news items

Theoretically, health news reporting of the results of published studies should be an accurate and transparent reflection of the research findings and should not be misleading, especially when it includes health advice for readers. Several studies have evaluated the quality of reporting of medical research in news items:

1. A cross-sectional analysis of 180 news articles and 27 television reports on three drugs used for disease prevention that appeared between 1994 and 1998, showed that 40% of these stories did not report benefits quantitatively and 53% did not report potential harm to patients [31].

2. In an analysis of 500 US health news stories over 22 months, between 62% -77% of stories failed to address adequately the harms and benefits of drugs, medical devices and other interventions [9].

3. In another analysis of 356 Canadian news articles on five prescription drugs, of 193 news articles mentioning at least one benefit, 68% (132/193) made no mention of possible side effects or harms [32].

3.   Distortion of research results

Distortion of research results is not a recent issue in medical literature.

3.1.   Definition of "spin"

"Spin can be defined as a specific reporting that fails to faithfully reflect the nature and range of findings and that could impact the impression the results produce in readers; a way to distort science reporting without actually lying" [33].

Spin has been highlighted in the medical literature using various terms or synonyms such as distorted presentation [33, 34], misrepresentation [35, 36], exaggeration of research results [37-39], boasting [38], misleading or inadequate reporting [31, 40], biased interpretation [41], over-interpretation [34], or misinterpretation and inappropriate extrapolation [35].

Spin is a classical concept in public relations and politics. It is "a form of propaganda that is aimed to influence the attitude of public or persuade their opinion in favor of or against some cause or position by presenting only one side of an argument" [42]. "Spin doctors" could attempt to conceal potentially negative information or selectively "cherry-pick" specific information or quotes, which modify public opinion. The use of spin in scientific writing can result from ignorance of the scientific issues, unconscious bias or authors' personal agendas such as financial, personal, and intellectual conflicts of interest, and can influence how research results are described [43].

3.2.   Prevalence and classification of "spin" in published articles

Previous studies have highlighted high prevalence of spin in published articles of RCTs [33, 35, 44, 45], diagnostic test accuracy studies [34, 46], non-randomized studies [41, 47-49], epidemiological studies [50] and systematic reviews and meta-analyses [51].

Boutron et al. evaluated the interpretation of RCTs with statistically non-significant results for primary outcomes [33]. They identified 616 RCTs published in December 2006 and 72 were eligible for analysis. The authors identified a number of spin strategies and found that more than 40% of the 72 trials have some form of spin [33]. They found 37.5% spin in the results and 58.3% in the conclusion section of the abstracts [33].

Vera-Badillo et al. evaluated bias in the reporting of efficacy and toxicity outcomes in RCTs of cancer therapy [52]. They reviewed articles published from July 2010 to December 2012 in six high impact factor journals, and identified 200 articles. Among 107 RCTs, they found no statistically significant difference in the primary outcome between two arms. Almost 47% of the RCTs implied benefit of the experimental treatment and 18.5% did not report the toxicity of the treatment [52].

We performed a literature review to identify all the reported spin strategies in published articles and to develop a classification of spin for non-randomized studies [53] and for systematic reviews and meta-analyses [51]. Spin can be classified into three main categories: 1. misleading reporting, 2. misleading interpretation and 3. misleading extrapolation [51, 53].

A cohort study of 128 non-randomized articles assessed the prevalence of spin and identified different strategies of spin used [53]. We found that 84% had at least one type of spin. The most prevalent strategy was the use of causal language which was identified in 53% of abstracts [53]. Other frequent strategies used in non-randomized studies were linguistic spin, inadequate implications for clinical practice and lack of focus on harm.

3.3. Dissemination of spin from published articles to health news

A cohort study of RCTs showed that distortion of results in an abstract conclusion is associated with spin in press releases and related health news items [35]. The authors of this study systematically analyzed a sample of 41 press releases which referred to RCTs and had

evaluated the presence of spin in RCTs and shift of spin in related press releases and news items.

The results of this study showed that 17 (41%) abstracts, 19 (46%) press releases, and 21 (51%) news items had spin [35]. For 17 abstracts with spin, the authors found the same spin in 16 press releases and 16 related news items. The multivariate analysis showed that spin in press release was associated with spin in the article abstract conclusion (Relative Risk = 5.6, 95% CI 2.8 – 11.0, p <0.001).

The following *figure 5* [35] describes the shift of misrepresentation of research results from published articles to the related press releases and health news. This study further reported that the research results based on press releases could be misinterpreted in media coverage [35].
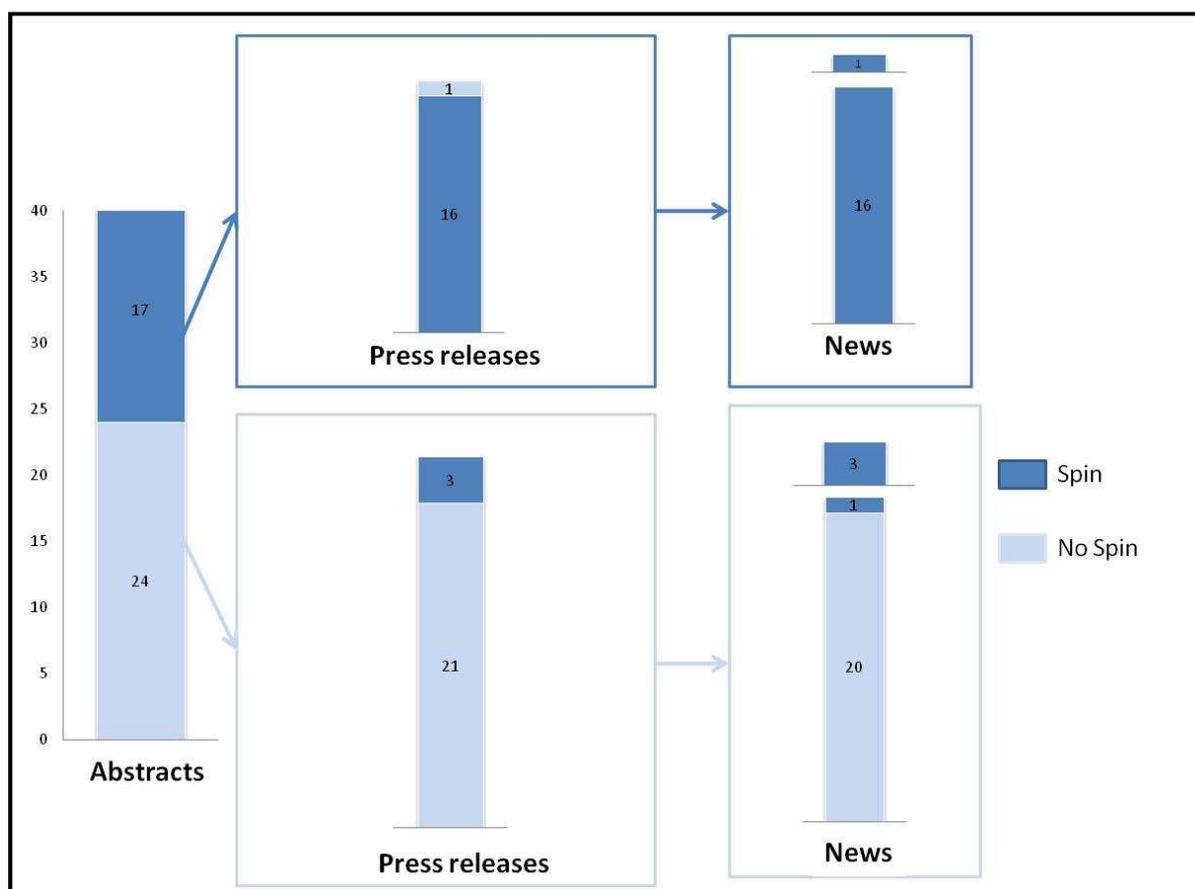
Figure 5: Shift of misinterpretation of research results from published articles to health news [35]

(Figure 5 is extracted from "Misrepresentation of Randomized Controlled Trials in Press-Releases and News Coverage: A cohort study", published in PLOS Medicine in 2012).

These results highlight an important responsibility of researchers in the dissemination of spin in press releases and related news items.

3.4. Spin in health news

Previous studies related to media coverage have highlighted the distorted presentation of study results in press releases and related news stories. Here we described a brief overview of those studies:

Schwartz et al. assessed the quality of press releases issued by medical journals and its influence on the quality of associated newspaper stories [12]. The authors performed a cohort study of medical journal press releases and associated news stories. They analyzed 343 stories, 243 (71%) of which reported on articles for which the medical journals had issued press releases, and evaluated these using specific quality measures (i.e., basic study facts, main result, harms and study limitations). They showed that 68% of news stories mentioned harms when it was mentioned in the press release (Relative risk = 2.8, 95% CI [1.1 to 7.4]), 36% when no press release was issued (Relative risk = 1.5, 95% CI [0.49 to 4.4]) [12] and 24% when harm was not mentioned in the press release. They found that high quality press releases issued by medical journals seem to associate with better quality of newspapers stories.

Downing et al. evaluated the interpretation of ACCORD-Lipid trial in health news and biomedical journal articles [54]. ACCORD-Lipid (Action to Control Cardiovascular Risk in Diabetes) was a landmark trial which demonstrated that fenofibrate, when added to statin

therapy, was not associated with improved cardiovascular outcomes among patients with diabetes mellitus [55]. The authors performed a cross-sectional study of all articles describing the results of ACCORD-Lipid in the news and biomedical literature in the 15 months after its publication [54]. They identified 67 news articles and 141 biomedical journal articles discussing the ACCORD-Lipid trial. Nearly 20% of the news articles concluded it was effective and approximately half of these made recommendations for continued use of fibrate [54].

Sumner et al. assessed how exaggerations or distortions in news were associated with press releases [39]. This was a retrospective quantitative content analysis of journal articles, press releases and related news items. They identified 462 press releases with 668 related news stories. The authors found that 40% of the press releases contained exaggerated advice, 33% contained exaggerated causal claims, and 36% exaggerated inference to human application from animal research [39]. When press releases contained such exaggeration, 58%, 81% and 86% of news stories, respectively, contained similar exaggeration [39]. These results showed exaggeration in news is strongly associated with exaggeration in press releases.

Gonon et al. described how newspapers preferentially report on initial studies but failed to inform the lay public if initial scientific claims were later refuted or strongly attenuated [56]. In a retrospective analysis, the authors identified 47 scientific publications on ADHD (Attention Deficit Hyperactivity Disorder) published in 1990 and echoed by 347 newspapers. They selected the top 10 most echoed publications and collected all subsequent studies until 2011. They checked whether the findings reported in "top 10" publications were consistent with previous and subsequent observations and also compared the newspaper coverage of the "top 10" publications to that of related studies. They found that seven of the "top 10" publications were initial studies and the conclusions in six of these

were either refuted or strongly attenuated in subsequent studies. They concluded that newspaper articles reporting on "top 10" publications repeatedly claimed that these findings might soon results in improved pharmacological treatments and in commercially available biomarkers to confirm the ADHD diagnosis [56].

Dumas-Mallet et al. also investigated that newspapers poorly covered the replication validity studies and preferentially covered initial studies [57].

To our knowledge, no systematic study has estimated the prevalence of spin in highly disseminated samples of health news and no classification of spin had been developed for health news.

4. Metrics to measure the research impact

Researchers, scientists, research institutes and funding agencies require metrics to measure the impact of their research. The most widely-used indicators are the number of citations received for each published article [29], and the impact factor of the journal where this article is published. Citations provide an objective assessment of how often scientists cite a specific published work and this is viewed as an indicator of the importance of the research [58]. Highly cited papers are nodes in the network of the dissemination and discussion of scientific information [59]. The rate of citations is also a surrogate marker for the impact of the journal publishing the article [60]. Journal impact factor is calculated as the ratio of the number of citations for articles published in the current year to articles published in the two preceding years, divided by the number of citable items published in the same two years [61].

However, this metric has some disadvantages. Firstly, citations only measure the impact of research in the scientific community but not among knowledge users (policy makers,

patients and the general public) [59]. Secondly, research impact can only be assessed after a delay, often months, before the published work is used by other scientists [19, 59].

New metrics have been developed to measure the impact of research not only in media but also in the scientific community. For example, Altmetric has been developed to measure the media attention an article receives online [62]. It was founded by a researcher, Euan Adie, in 2011 [63]. Altmetric is a portfolio company of Digital Science [64, 65], which is owned by Holtzbrinck Publishing Group. This metric tracks online attention to a specific research article published in a journal and linked to a digital object identifier (DOI). Each article receives an Altmetric score measuring the number of mentions the article has garnered in online news outlets, science blogs and social media (Twitter, Facebook, Google+, etc.) to provide an indicator of the amount of online public attention [66]. The score is derived from an automated algorithm and represents a weighted count of the amount of attention received for a research output to reflect the relative reach of each type of source [67].

An Altmetric score is represented by a donut with different colors (*see figure 6*). Each color shows the source where the published article is mentioned.

Figure 6: Presentation of Altmetric score [68].

(Figure 6 is extracted from Altmetric website).

It is a standardized score and is calculated based on three criteria: first is *Volume;* that how many people are mentioning that article. The score for an article rises as more people mention it and it counts only 1 mention from each person per source. Second is *Source;* each source contributes a different base amount to the final score, e.g. a newspaper article contributes more than a blog post which contributes more than a tweet. Third is the *Author* of each mention who mentioned the published articles, whether or not there is any bias towards a particular journal or publisher and who the audience is; for example a doctor sharing a link with other doctors counts more than a journal account pushing the same link out automatically [62]. If an Altmetric score is zero, it means the article did not receive any public attention. If a research article is mentioned in a news item, it is more likely to bring attention to the research output than the tweet. By default weightings, the research article mentioned in a news item will contribute 8 to the Altmetric score, and research article tweeted will give 1 to the score *(appendix 2: page 142)* [67]. Each mention of an article on online sources affects the Altmetric score. Six months after publication, the article typically has receives maximum attention and the score is stabilized.

This metric is widely used by journal editors, academic institutions, libraries and researchers to analyse the effect of the research within days of publication [18, 19, 69-71]. The main advantage of this metric is to have an immediate impact in online media and it provides a rapid indication of data dissemination, effect of research and discussion around that article across the global community.

RESEARCH OBJECTIVES

My PhD thesis had three main objectives:

1. To determine whether and how the interpretation of research results was distorted by the use of "spin" in a sample of highly disseminated Google health news, and to classify different strategies of spin

2. To describe online media attention of articles and identify the factors associated with online media attention, focusing on cancer treatments

3. To explore how the results of a trial reported with spin were disseminated to the scientific community and online media, using the 2014 DAPT as a case study

Project 1

Interpretation of Results of Studies Evaluating an Intervention Highlighted in Google Health News: A Cross-Sectional Study of News

1.   Summary

Google News, which has one billion people a week using its news content, is one of the largest and most up-to-date online news services around the world [72]. Google News "watches" more than 4500 news sources worldwide. This service covers news articles appearing in the previous 30 days on various news websites. Google News aggregates content from more than 25,000 publishers. The health section of Google News includes online news citing new scientific research. Distortion of research results has been mainly addressed in case studies but also in some systematic assessments of cohorts of articles and press releases. However, to our knowledge, no critical assessment of contents of news items highlighted in the health section of Google News has been performed. Our hypothesis was that research results were frequently distorted in different ways in the health section of Google News. The objective of this study was to determine whether and how the interpretation of research results were distorted by the use of "spin" in a sample of highly disseminated Google health news, as well as identify and classify different strategies of spin. We screened 4,020 news items highlighted in the health section of US, UK and Canada editions of Google News between July 2013 and January 2014. We searched for news items for 3 days a week (i.e., Monday, Wednesday, and Friday) and selected a sample of 130 health news items reporting a scientific article evaluating the effect of an intervention on human health. We estimated the prevalence of spin and expressed it with frequencies and percentages (%).

Since there was no classification of spin developed, we identified all the strategies of spin which have been reported in published articles, press releases and media on spin. Further, we selected a random sample of 30 news items to enrich this classification. After discussion among authors, we classified all the identified strategies of spin into three categories: misleading reporting, misleading interpretation and misleading extrapolation. Based on different types of spin strategies, each category was defined as follows: misleading reporting

as an incomplete or inadequate reporting of any important information in context of that research reported in health news, misleading interpretation as an interpretation of the study results in news not consistent with the results reported in the scientific articles and overstating the beneficial effect of the treatment, and misleading extrapolation as overgeneralization of study results in news to different populations, interventions or outcomes that were not assessed by the study.

Among 130 news items, we found that 45% of news headlines and 88% of the news text had at least one type of spin. Further, we identified 18 different types of spin strategies. These spin strategies were mainly related to misleading reporting (59%) such as not reporting adverse events that were reported in the scientific articles (25%), misleading interpretation (69%) such as claiming a causal effect despite non-randomized study design (49%) and misleading extrapolation (41%) such as extrapolating a beneficial effect from an animal study to humans (21%). News items were often reported with quoted comments by authors, experts or patients. We also identified that 115 (89%) news items were reported with at least one quoted comment and 44% (51/115) contained at least one type of spin. We also compared the frequency of distortions in Google News among three country editions: among 75 news items for the United States, 60 (80%) had at least one type of spin; among 28 news items for the United Kingdom, 27 had at least one type of spin; and among 27 news items for Canada, all contained at least one type of spin. These results support the hypothesis that research results are frequently distorted in the health section of Google News.

The approach which we adopted has some limitations: first the assessment of spin involves some subjectivity. Consequently, all reports were evaluated independently by 2 researchers. Second, we did not evaluate to what extent the spin was misleading for readers. Third, our arbitrary selection of 3 country editions for Google News might limit the extrapolation of results to other country editions. Finally, we did not evaluate the origin of spin in news,

whether it was due to journalists' lack of scientific knowledge or from the published article by study authors.

ARTICLE

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"Interpretation of Results of Studies Evaluating an Intervention Highlighted in Google Health News: A Cross-Sectional Study of News"

Interpretation of Results of Studies Evaluating an Intervention Highlighted in Google Health News: A Cross-Sectional Study of News

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Abstract

Background

Mass media through the Internet is a powerful means of disseminating medical research. We aimed to determine whether and how the interpretation of research results is misrepresented by the use of "spin" in the health section of Google News. Spin was defined as specific way of reporting, from whatever motive (intentional or unintentional), to emphasize that the beneficial effect of the intervention is greater than that shown by the results.

Methods

We conducted a cross-sectional study of news highlighted in the health section of US, UK and Canada editions of Google News between July 2013 and January 2014. We searched for news items for 3 days a week (i.e., Monday, Wednesday, and Friday) during 6 months and selected a sample of 130 news items reporting a scientific article evaluating the effect of an intervention on human health.

Results

In total, 78% of the news did not provide a full reference or electronic link to the scientific article. We found at least one spin in 114 (88%) news items and 18 different types of spin in news. These spin were mainly related to misleading reporting (59%) such as not reporting adverse events that were reported in the scientific article (25%), misleading interpretation (69%) such as claiming a causal effect despite non-randomized study design (49%) and overgeneralization/misleading extrapolation (41%) of the results such as extrapolating a beneficial effect from an animal study to humans (21%). We also identified some new types

of spin such as highlighting a single patient experience for the success of a new treatment instead of focusing on the group results.

Conclusions

Interpretation of research results was frequently misrepresented in the health section of Google News. However, we do not know whether these spin were from the scientific articles themselves or added in the news.

Background

Mass media through the Internet is an important and powerful means of disseminating and communicating medical research [1]. Especially, health news attracts large audiences and affects the behavior of healthcare providers and patients [2]. According to a report by Canadian Institute of Health Research, nearly 9 in 10 Canadians make decisions affecting their health as a direct result of media reports [3]. Such impacts may be beneficial, but high media coverage may have adverse effects. For example, a peak in media attention regarding group A streptococcal (GAS) disease and its testing in pediatric emergency departments was associated with an increase in the prescription of rapid tests for GAS despite no increase in the number of children presenting symptoms that might warrant such testing [2].

Undistorted dissemination of results of medical research is important to physicians, the scientific community and the public [4]. In theory, health news should be an accurate reflection of the research findings. Misrepresentation of study results to intentionally or unintentionally highlight that the beneficial effect of the intervention in terms of efficacy and safety is higher than that shown by the results is called "spin" [5]. Spin has been highlighted in the medical literature using various terms or synonyms such as distorted presentation [5, 6], misrepresentation [7, 8], exaggeration of research results [9–11], boasting [10], misleading or inadequate reporting [12, 13], biased interpretation [14], overinterpretation [6], or misinterpretation and inappropriate extrapolation [7]. This issue has been mainly addressed in case studies but also in some systematic assessments of cohorts of articles and press releases.

Previous studies have shown that spin is frequent in articles published in scientific journals, particularly in abstract conclusions [5], and that the presence of spin has an impact on readers' interpretation [8]. Furthermore, spin in press releases and news items is related to the presence of spin in the abstract conclusions of published articles, and the findings of randomized controlled trials (RCTs) based on press releases and media coverage could be misinterpreted [7, 11].

Google News, which has one billion people a week using its news content, is one of the largest and most up-to-date online news services around the world [15]. Google News "watches" more than 4500 news sources worldwide. This service covers news articles appearing in the previous 30 days on various news websites. Google News aggregates content from more than 25,000 publishers. The health section of Google News includes online news citing new scientific research. However, to our knowledge, no critical assessment of the content of news items highlighted in the health section of Google News has been published.

We aimed to describe and assess the frequency of spin in news items reporting the results of studies evaluating an intervention that are highlighted in the health section of Google News.

Methods

We conducted a cross-sectional study of news highlighted in the health section of Google News.

Selection of health news referring to scientific articles

We systematically searched the health section of Google News (http://news.google.com/) for US, UK and Canada editions, 3 times a week (i.e., Monday, Wednesday and Friday) at the same time (14:00–17:00 Paris time) from July 19, 2013 to January 19, 2014. We arbitrarily selected these 3 country editions and working days. The duration of a given study highlighted in the health section of Google News varied from 30 min to 3 hours depending on the number of hits it received. Because of this "rapidly varying process" and lack of news archives of the front page, we systematically selected the news highlighted at a specific time.

In a first step, one researcher (RH) screened all the headlines of news appearing in the health section of Google News. News appearing in the health section has "real-time coverage" (i.e., all news reporting the same study at that time by different news sources but not highlighted on the front page). We included news that referred to a published study evaluating the effect of a treatment (pharmacological or non-pharmacological treatment) on human health regardless of study design. We also included any article published in any non-medical journal. We excluded news that reported 1) studies of correlation, screening, diagnostic, prognostic, case reports, guidelines and vaccine development; 2) highlighted the results of studies reported as an abstract or a poster presented in a scientific meeting or were unpublished; and 3) reported 2 or more scientific studies in one news item. If news dedicated to the same study appeared on the front page of more than one country edition by same or different news sources, only one of the news items was randomly selected.

In a second step, for previously selected news, the full text of the scientific articles was retrieved by using the reference of the article highlighted in the selected news or in "real-time coverage" of that news. If no reference was reported in the selected news, the name of the study author and the scientific journal that published the original study was searched in "real-time coverage" of the news. If the name of the scientific journal was mentioned, the author's name was used to systematically search the current scientific journal issue or Google scholar, PubMed and Google. All retrieved articles were screened by 2 researchers (RH, CL).

Classification of spin (misrepresentation of study results)

We defined "spin" as a specific way of reporting, from whatever motive (intentional or unintentional), to emphasize that the beneficial effect of the intervention is higher than that shown by the results [5].

We developed the classification of spin in 3 steps. First, we identified spin from a literature review on spin in published articles [5, 6, 12, 14, 16–27] and on reporting of scientific results in media and press releases [2, 4, 7, 9, 13, 28–38]. Second, we randomly selected a sample of 30 news items with or without spin to enrich our preliminary classification of spin. Third, the authors discussed the different types of spin retrieved and developed a classification of spin in 3 main categories: misleading reporting, misleading interpretation, and inadequate extrapolation.

Misleading reporting. Misleading reporting was defined as an incomplete or inadequate reporting of any important information in context of that research and that could be misleading for the reader. This category includes 1) not reporting adverse events; 2) misleading reporting of study design; 3) selective reporting of outcomes favoring the beneficial effect of the treatment (e.g., statistically significant results for efficacy outcomes or statistically non-significant results for safety outcomes); 4) linguistic spin (i.e., any word or expression emphasizing the beneficial effect of the treatment [10]); and 5) any other type of misleading reporting not classified under the above section.

Misleading interpretation.   Misleading interpretation was defined as an interpretation of the study results in news not consistent with the results reported in the scientific articles and overestimating the beneficial effect of the treatment. This category includes 1) claiming a beneficial effect of the treatment despite statistically non-significant results; 2) claiming an equivalent effect of the treatment for statistically non-significant results; 3) claiming that the treatment is safe for statistically non-significant results despite lack of power; 4) claiming safety of the treatment despite adverse events reported in the scientific articles; 5) claiming a causal effect (i.e., implies a cause and effect relationship between the intervention being assessed and the outcome of interest [12]) despite non-randomized study design; 6) concluding a beneficial effect despite lack of a comparator; 7) focus on p-value instead of clinical importance; 8) interpretation of relative risk as absolute risk; and 9) any other type of misleading interpretation not classified under the above section.

Overgeneralization/misleading extrapolation.   Overgeneralization/misleading extrapolation was defined as overgeneralization of study results in news to different populations, interventions or outcomes that were not assessed by the study. This category includes 1) extrapolation of animal study results to human application; 2) extrapolation of preliminary study results to clinical application; 3) extrapolating the effect of study outcomes to other outcomes for the disease; 4) extrapolation of the beneficial effect of the study intervention to a different intervention (e.g., broccoli, which contains sulphoraphane, was claimed as beneficial by health news, but the study evaluated the benefit of a sulphoraphane compound only); 5) extrapolation from the study participants to a larger or different population; 6) inappropriate implication for clinical or daily use (i.e., an improper recommendation or advice to use the intervention in clinical practice or daily use not supported by study results); and 7) any other types of extrapolation not classified under the above section.

All other spin that could not be classified with this scheme were systematically recorded and secondarily classified.

Data extraction

Two researchers (RH, CL) with expertise in clinical epidemiology systematically read the abstract, methods and results sections of the scientific article and independently extracted data from the news using a preliminarily tested data extraction form. Two researchers (RH, IB) tested the form on a randomly selected sample of 10 news items by reading the referenced article and the content of the selected news items to extract specific information for spin. We evaluated the spin only in the health news. Discrepancies were resolved by discussion until consensus. If needed, a third researcher (IB) appraised the news and related article. The concordance between 2 reviewers for the assessment of spin is reported in S1 Table; the overall kappa coefficient was 0.65 [95% 0.48–0.82].

The following data were collected:

1. **General characteristics of health news:** we recorded the type of online news outlet (general news outlet dedicated to several domains including health such as BBC or health-specific news outlet dedicated to health only such as Medscape). We evaluated whether the following information were reported in the news: study population, study design, sample size, study limitations and funding source. We considered that the study design was reported in the news if it mentioned how the intervention was assigned to the study sample. We also assessed whether the news cited a full reference or an electronic link to the published article.

2. **General characteristics of published articles:** we recorded the journal type (i.e., specialized or general medical journal), study population (human and animal), study design (RCT, observational study, etc.), sample size, and funding source (non-profit, profit, both).

3. **Prevalence of spin in news**

We assessed the presence of spin in 1) headlines and 2) the text of the news, which may include quotations by study authors, experts or patients, when available in news. We identified the spin in these 2 sections of the news according to our classification in 3 main categories.

Statistical analysis

We calculated frequencies and percentages (%) for qualitative variables. Data with quantitative variables are expressed with medians and inter-quartile range (IQR).

Results

Selection of health news

We screened 4,020 news items, of which 130 met our inclusion criteria and were included in this study are reported in Fig 1. The list of selected news items with referenced scientific articles is in S2 Table.

General characteristics of health news

Overall, 98 (75%) of the news items were reported by a general news outlet (Table 1). The study population was reported in 90% of news items, the study design in 75% and the sample size in 68%. Some study limitations were reported in 44% of news items. Only 25% of items
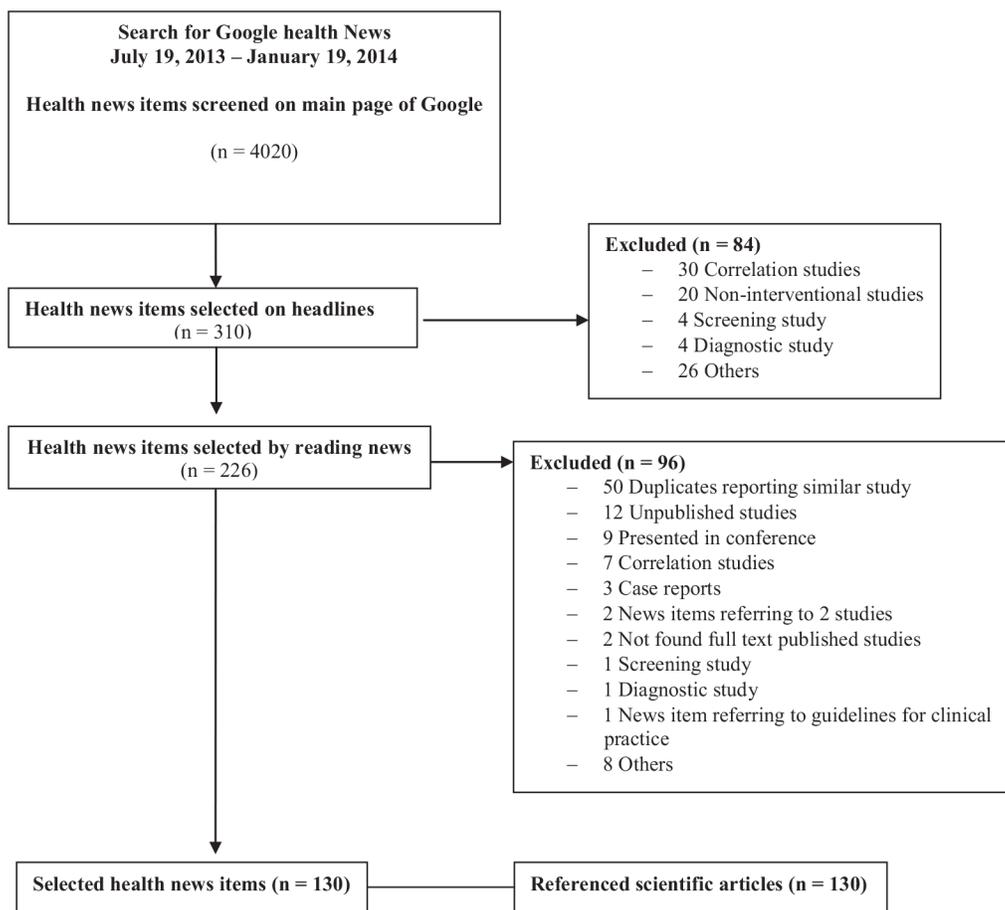
Fig 1. Flow diagram of selected Google health News with referenced scientific articles.

Table 1. General characteristics of health news and scientific articles.

Category	
Health news characteristics n = 130	
Type of online news outlet, n (%)	
– General news outlet	75.4)
– *Medical news outlet*	32 (24.6)
Reporting of	
– Study population, n (%)	0.0)
– Study design, n (%)	75.4)
– Sample size, n (%)	67.7)
– Study limitations, n (%)	43.8)
– Funding source, n (%)	33 (25.4)
– Full reference or electronic link to the published article, n (%)	29 (22.3)
Scientific article characteristics n = 130	
Type of journal, n (%)	
– Specialized medical	58 (44.6)
– General medical	40.0)
– Life sciences	20 (15.4)
Funding source, n (%)	
– Non-profit	66.1)
– Profit	34 (24.1)
– Not reported	10 (7.7)
Study population, n (%)	
– Human	7.7)
– Animal	29 (22.3)
Study design (if human study), n (%),	**n = 101**
– Meta-analysis/ Systematic reviews	13.9)
– Randomized controlled trial	38.6)
– Cohort studies	32.7)
– Case–control	(5.1)
– Cross-sectional	(2.0)
– Before and after the intervention	8 (7.9)
Sample size, median [IQR]* (human studies)	634.5 [52–5208]

*[IQR], interquartile range

doi:10.1371/journal.pone.0140889.t001

reported a funding source. In total, 78% of the news items did not report a full reference or electronic link to the published article.

General characteristics of scientific articles

Of the 130 scientific articles, 58 (45%) were published in specialized medical journals, 52 (40%) in general medical journals and 20 (15%) in life sciences journals ([Table 1](#)). The funding source was non-profit for 86 (66%). The study population was humans in 101 articles (78%) and animals in 29 (22%). Of the 101 articles of human studies, 14 (14%) were of meta-analysis and systematic reviews, 39 (39%) RCTs and 48 (48%) observational studies.

Prevalence of spin in news headlines

We identified 58 (45%) news headlines with at least one spin ([Table 2](#)). Among news items reporting animal studies (n = 29), 48% (14/29) of headlines implied overgeneralization/

misleading extrapolation from animals to humans. For example, in an animal study of rats evaluating a new treatment, the headline was "*Big breakthrough in cure for blindness*" with a picture of a human eye. This example contains 2 types of spin: first, the use of linguistic spin (i.e., "Big breakthrough") and second, overgeneralization/misleading extrapolation from animals to humans. For news items reporting a non-randomized study design (n = 77), 22% (20/77) of headlines claimed a causal effect. For example, for a news item with the headline "*Vitamin D boosts strength of children*," the study found only an association between maternal plasma 25 (OH) D statuses at 34 weeks' gestation and children's muscle strength at age 4 years in a non-randomized study design.

Prevalence of spin in the text of news items

We identified 114 (88%) news items with at least one spin in the text ([Table 2](#)). The news items contained a median [IQR] of 3 [1.0–4.0] types of spin. We identified 18 types of spin in our sample of news ([Table 3](#)).

Overall, 76 (59%) news items had at least one misleading reporting. One third of news items did not report adverse events, even though these were reported in the scientific articles. Use of linguistic spin or "hype" was identified in almost half of news items. For example, a news item stated "*A radical drug which lowers cholesterol by silencing a key gene [. . .]. The medication has been hailed as a Wonder drug, bringing down deaths from cardiac problems*".

A total of 90 (69%) news items had at least one misleading interpretation. Almost 49% of these items incorrectly claimed a causal effect of the intervention despite non-randomized study design (observational studies). For example, a news item reported that "*Daytime naps help improve learning in pre-school children by significantly enhancing their memories*". Use of "improve" and "enhancing" implied a causal link between the intervention (daytime naps) and outcome (learning). This claim was inappropriate because the study was not randomized and the study design was a before-and-after study without a control group.

Finally, 53 (41%) news items had at least one overgeneralization/misleading extrapolation such as extrapolating a beneficial effect from an animal study to humans (21%). A news item reported that "*Researchers have shown that contact lenses [. . .] are an effective way of treating glaucoma patients*"; the published study was on white rabbits. This item was reported with a photo of a woman holding a lens.

We also identified some new spin such as highlighting a single patient experience for the success of a new treatment. The interpretation should focus on group results. For example, to highlight the success of a new treatment for prostate cancer, the news item reported that "*PROSTATE cancer patient Bob McGregor is living proof that a new treatment regime for the disease is as good as gold*". Other types of spin implied that the treatment is available but that it was at a very early stage of development; for example, one news item announced, "*Here is good news for cancer patients [. . .]*,"about a study performed on 3 mice, and the treatment will not available for current cancer patients.

Spin in quotations. We identified 115 (89%) news items reported with at least one quoted comment, 44% (51/115) with at least one example of spin. Of the 167 quoted comments reported, 59% (99/167) were by the study authors, 37% (62/167) experts and 4% (6/167) patients. Spin was identified in 43% (43/99) of quoted comments by authors, 19% (12/62) experts and 83% (5/6) patients. For example, in a study with statistically non-significant results, the author's quote was "*To me it's one of the best things that have happened in my medical practice. It's rare to see something that works so dramatically. We didn't realize it was going to produce such a massive reduction in side effects. It's very solid step forward. It enables new technology to be used properly. It's well on the way to becoming the norm*".

Table 2. Prevalence of spin in health news (n = 130).

Spin location	Spin, n/total news (%), n = 130
Spin in headline, n (%)	**58 (44.6)**
Spin in text, n (%)	
– No. of news reporting at least one spin	7.7)
– No. of spin, median; [IQR]; (min-max)	3 [1.0–4.0] (0–9.0)
News with at least one misleading reporting*	**(58.5)**
– Not reporting of adverse events‡	13/52 (25.0)
– Selective reporting of outcomes favoring statistically significant results	8.5)
– Misleading reporting of study design¥	2/48 (4.2)
– Linguistic spin or hype	63 (48.5)
News with at least one misleading interpretation*	**90 (69.2)**
– Claiming a beneficial effect of intervention despite statistically non-significant results	7 (5.4)
– Claiming the treatment is safe despite statistically non-significant results in treatment and comparison groups	(0.7)
– Claiming safety despite adverse events	4/52 (7.7)
– Claiming a causal effect despite non-randomized study design§	38/77 (49.3)
– Claiming a beneficial effect despite small sample size not reported ψ	5/101 (5.0)
– Concluding a beneficial effect despite lack of comparator§	20/77 (25.9)
News with at least one overgeneralization/misleading extrapolation*	**40.8)**
– Results of animal study to human application‡	6/29 (20.7)
– Preliminary study results to clinical application	12.3)
– Study outcomes to different outcomes	14.6)
– Study intervention to different interventions	10.0)
– Study participants to larger or different population	(6.9)
– Inappropriate implication for clinical/daily use	25 (19.2)
– Others	4 (3.1)
Other spin	**24 (18.5)**

*Several types are possible

‡ Only including human studies where adverse events were reported in scientific articles (n = 52)

¥ Applicable to observational studies (n = 48)

§ Applicable to observational & animal studies (n = 77)

Ψ Applicable to human studies (n = 101)

‡ Applicable to animal studies (n = 29)

doi:10.1371/journal.pone.0140889.t002

The prevalence of spin by type of news outlet (panel A), study design (panel B) and funding source (panel C) are described in Fig 2.

Discussion

Our evaluation of 130 news items that reported studies evaluating an intervention highlighted in the health section of Google News during a 6-month period showed a substantial misrepresentation of results. Among 130 news items, 88% contained at least one spin. These spin were mainly related to misleading reporting (59%), misleading interpretation (69%) and overgeneralization/misleading extrapolation (41%) of study results. However, we did not determine the source of the spin – scientific articles or added by journalists.

Table 3. Examples of 18 types of spin in health news.

Spin Categories	Spin type with *examples*	Explanation
Misleading reporting	Not reporting of adverse events‡: **"_Study uses stem cells to help treat drug-resistant TB_"**	The study objective was to assess the safety of autologous mesenchymal stromal cell infusion as an adjunct treatment in patients with tuberculosis. In total, 217 adverse events were reported among all study subjects (i.e., 30) in a before-and-after study. However, the news did not report any adverse events.
	Selective reporting of study outcomes favoring statistically significant results: **"_Aspirin may reduce colon cancer in women_"**	The study assessed the cancer incidence of breast, colon and lung cancer with low-dose aspirin. The study showed a statistically significant association between aspirin use and colon cancer (hazard ratio [HR] 0.80 [95% confidence interval (95% CI) 0.67–0.97]; $p = 0.021$) and a statistically non-significant association for breast cancer (HR 0.98 [95% CI 0.90–1.07]; $p = 0.65$) and lung cancer (HR 1.04 [95% CI 0.86–1.26]; $p = 0.67$). The news reported a significant association between only colon cancer and aspirin use.
	Misleading reporting of study design¥: "*The findings of **our trial** indicate that a good night's sleep may be critical for maintain brain health*".	The study design was not a trial but a before-and-after study of 15 healthy young study participants.
	Linguistic spin or hype: "**_Massive reduction_** *in side effects*". "**_A radical drug_** *which lowers cholesterol by silencing a key gene could work just as well as statins but **without side-effects** and in just one dose, a study found. The medication has been hailed as a **Wonder drug**, bringing down deaths from cardiac problems*". "**_Big breakthrough_** *in cure for blindness*".	Use of massive reduction, a radical drug, without side effects, wonder drug and big breakthrough are linguistic spins or hype.
Misleading interpretation	Claiming a beneficial effect of intervention despite statistically non-significant results: *"Participants in the study played games that were designed to train visual and spatial memory and quick decision making. Following the games, **older adults were able to stand up from being seated and walk faster than individuals who placed in a comparison group**".*	The study results did not show a statistically significant effect on gait (walk) speed ($p = 0.124$).
	Claiming the treatment is safe when results are statistically non-significant**: "_Gold injection did not alter urinary symptoms_".**	The study reported similar dysfunctional symptoms in both groups in the study. No statistically test was performed to test the significance and data were provided in a figure.
	Claiming safety despite adverse events: *"**Our new approach using the patients' own bone marrow stromal cells is safe** and could help overcome the body's excessive inflammatory response, repair and regenerate inflammation-induced damage to lung tissue and lead to improved cure rates".*	The study aimed to assess the safety of autologous mesenchymal stromal cell infusion as adjunct treatment in patients with tuberculosis. In total, 217 adverse events were reported among all subjects (i.e., 30) in a before-and-after study design.
	Claiming a causal effect despite non-randomized study design§: *"Breastfeeding **boosts** smarts as babies grow, the **longer babies are nursed**, the **greater their intelligence**".*	The study assessed the association between breastfeeding duration and intelligence in a cohort design.
	Claiming a beneficial effect despite a small sample size not reported Ψ: **"_Sleep protects your brain_"**: *study*	The study assessed the effect of sleep intervention among 15 health young men in a before-and-after study design.
	Concluding a beneficial effect despite lack of comparator§: *"A new study has found that **watermelon juice can help post-exercise muscle soreness**".*	The study assessed the *in vitro* L-citrulline bioavailability from a synthetic standard or natural watermelon juice and determined the effect of a potential functional watermelon juice *in vivo* without a comparator group in a before-and-after study of 7 athletes.
Overgeneralization/ misleading extrapolation	Results of animal study to human application‡: *"Researchers have shown that contact lenses laced with medicines are an effective way of **treating glaucoma patients**".*	The rabbit study showed the effect only in rabbit eyes.

(Continued)

Table 3. (Continued)

Spin Categories	Spin type with *examples*	Explanation
	Preliminary study results to clinical application: *"It could __treat phobias__ and perhaps even __post-traumatic stress disorders"__*	The study participants were healthy without any phobia and it was a very small sample of 15 subjects in a before-and-after study.
	Study outcomes to different outcomes: 1. *__"Tomatoes may help fight breast cancer"__*. 2. *"A radical drug which lowers cholesterol by silencing a key gene could work just as well as statins but without side-effects and in just one dose, a study found. The medication has been hailed as a Wonder drug, __bringing down deaths from cardiac problems"__*.	1. The study examined the effects of diets rich in lycopene (tomato based) and isoflavone (soy based) on serum adipokine levels only. 2. The study did not assess effect of tomatoes based diet on decreasing the risk of breast cancer. The study did not assess the decrease in mortality with the ALN-PCS compound, which has not yet been developed as a drug.
	Study intervention to different interventions: *__"Broccoli slows arthritis"__*.	The study did not evaluate the use of broccoli but rather, sulphoraphane compound present in cruciferous vegetables, including broccoli, in a mouse study.
	Study participants to a larger or different population: *"The results of the trial-the first in humans-could offer hope to __one in five people who are resistant to statins. It could also be offered to patients who suffer ill-effects from the drugs, or those whose cholesterol remains high even after statins are prescribed"__*.	The study participants were healthy with low-density lipoprotein cholesterol levels > 3.00 mmol/L and had received no lipid-lowering treatment in the 30 days before screening. The effect of the drug on participants with statin resistance was not evaluated in this study.
	Inappropriate implication for clinical/daily use: *__"Everyone should have at least 10–15 minutes of exposure to the sun every day to ensure that vitamin D levels are adequate"__*.	The rat study assessed dietary vitamin D deficiency leading to elevated tyrosine nitration in brain that may promote cognitive decline. The study did not assess the vitamin D level by exposure to sunlight.
	Other types of inappropriate extrapolations: *__"A new drug known as ALN-PCS__, performed just as well, reducing cholesterol up to 57 per cent"*.	The study investigated the safety and efficacy of ALN-PCS, a small interfering RNA that is not yet developed as a drug. It was a randomized, single-blind, placebo-controlled, phase I trial.
Others spin	Highlighting a single patient experience for the success of a new treatment instead of focusing on the group results: *__"PROSTATE cancer patient Bob McGregor is living proof that a new treatment regime for the disease is as good as gold"__*.	The study compared a 3-D conformal radiation therapy with and without image guidance using implanted fiducial markers in a cohort of 282 patients with prostate cancer with similar dysfunctional symptoms in both groups.

‡ Only including human studies where adverse events were reported in scientific articles (n = 52)

¥ Applicable to observational studies (n = 48)

§ Applicable to observational & animal studies (n = 77)

Ψ Applicable to human studies (n = 101)

‡ Applicable to animal studies (n = 29)

doi:10.1371/journal.pone.0140889.t003

Research on spin in biomedical research is recent. Previous studies have focused on spin in RCTs [5, 7, 39, 40], diagnostic test accuracy studies [6, 41], non-randomized studies [14, 16, 42] and epidemiologic studies [43] and demonstrated a high prevalence of spin in published articles. A recently published RCT demonstrated that the presence of spin in abstract conclusions could have an impact on readers' interpretation. [8] Other studies showed misrepresentation of research results in press releases [9, 28, 29, 31] and how it could have an impact on news [11] [31]. Furthermore, Yavchitz et al. showed that the presence of spin was associated with an overestimation of the beneficial effect of the treatment from research articles to press releases and the news [7]. Some studies have specifically assessed the contents of news and showed that the quality of reporting was poor, with important information missing [33] and a lack of reporting of the study limitations [44]. For example, in the United States [13] and in Canada [45], 53% and 68% of news stories, respectively, failed to mention the potential harms related to drug treatments for patients and failed to quantify the benefits.

Prevalence of spin by:

A. Online news outlet

General news outlet (n=98)
28 (29%) | 59 (60%) | 11 (11%)

Medical news outlet (n=32)
3 (9%) | 21 (66%) | 8 (25%)

B. Study design

Systematic reviews/Meta- analysis (n=14)
9 (64%) | 5 (36%)

Randomized controlled trials (n=39)
5 (13%) | 26 (67%) | 8 (20%)

Observational studies (n=48)
15 (31%) | 32 (67%) | 1 (2%)

Animal studies (n=29)
11 (38%) | 16 (55%) | 2 (7%)

C. Funding source

Non profit (n=86)
19 (22%) | 57 (66%) | 10 (12%)

Profit* (n=34)
4 (23,5%) | 18 (53%) | 8 (23,5%)

Not reported (n=10)
4 (40%) | 5 (50%) | 1 (10%)
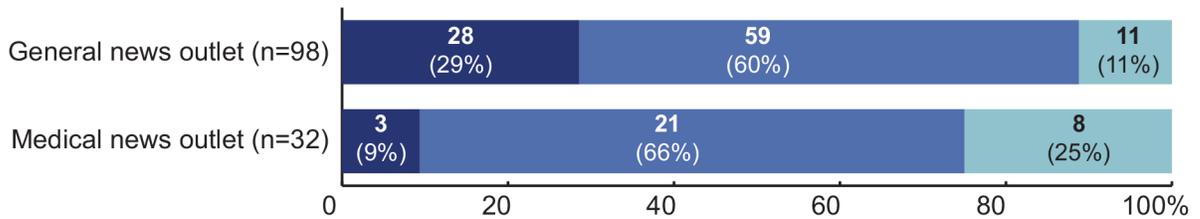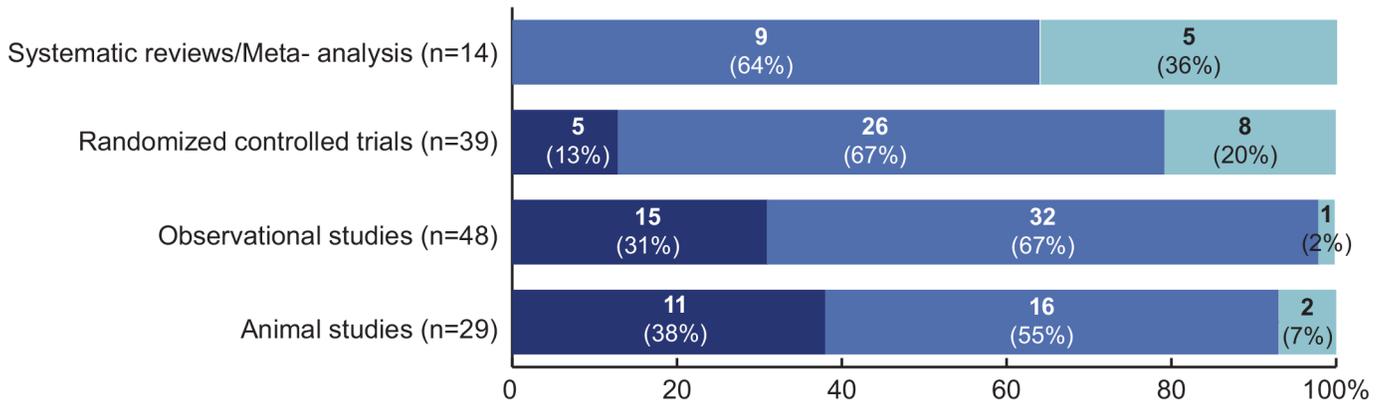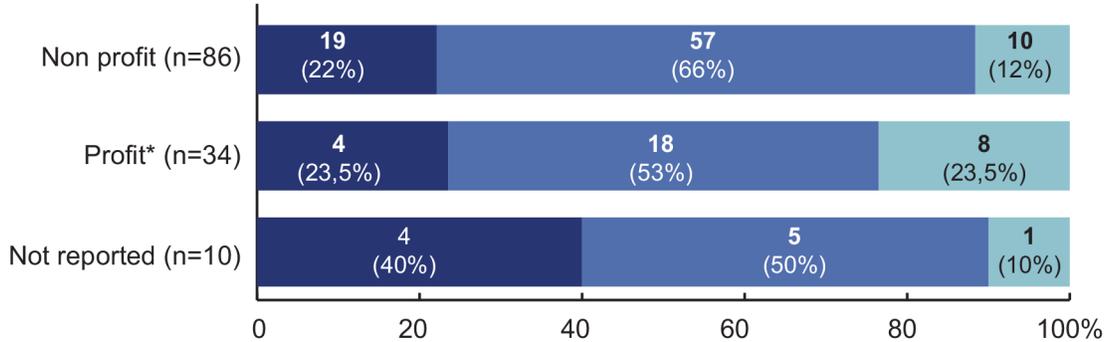
*Funding source:
Profit (includes 5% complete profit and 21% partial profit).

Legend: 5-9 spin per news | 1-4 spin per news | 0 spin per news

Fig 2. Prevalence of spin in online health news (n = 130).

doi:10.1371/journal.pone.0140889.g002

To our knowledge, our study is the first to systematically assess the misrepresentation of research results highlighted in the health section of Google News, which has one billion users of its news content each week worldwide [15]. Our study provides a comprehensive evaluation and classification of spin in a highly disseminated sample of news reporting the results of scientific studies. We developed a classification of spin that could be applied equally to scientific research, press releases and news. Nevertheless, we cannot provide conclusions on the origin of the spin; indeed, the presence of spin in news could be related to the presence of spin in the published articles.

Limitations

The first limitation is that the assessment of spin necessarily involves some subjectivity. Consequently, all reports were evaluated independently by 2 researchers. Second, we did not evaluate to what extent the spin was misleading for readers. The possible impact of spin on public perception about new treatments reported in health news should be studied. Third, our arbitrary selection of 3 country editions for Google News may limit the extrapolation of results to other country editions. Finally, we did not evaluate the origin of spin in news, whether it was due to journalists' lack of scientific knowledge or from the published article.

Implications

Misrepresentation of results can have serious consequences such as raising false hope among patients, distrust about new treatments, misguided choices that may put people's health at risk or influence policy makers to adopt inadequate or harmful laws, regulations, or policies.

The implication of this study is to define strategic interventions to reduce the spin and the impact of spin on readers' interpretation. These interventions could focus on researchers, journalists and the public. In fact, previous studies showed that spin in press releases and news items frequently came from the scientific articles [7, 11]. Consequently, to reduce the spin in news, the occurrence of spin should first be reduced in articles and then press releases. Second, we should train journalists to identify spin in scientific articles and avoid the dissemination of spin in the news. Finally, we should develop a users' guide for the public to critically appraise news items and teach the public how to appraise health news critically. Some interesting initiatives [46, 47] such as "Behind the Headlines" [46], provide a critical analysis of health news stories.

Further research is recommended to assess the impact of spin on reader's interpretation and public behaviour and which type of spin has high impact.

Conclusions

In this sample of highly disseminated Google health news, the interpretation of research results was frequently misrepresented. However, we do not know whether these spin were from the scientific articles themselves or added in the news.

Supporting Information

S1 Table. Kappa coefficients for concordance on spin in Google health news items.
(DOCX)

S2 Table. List of the selected news items with referenced scientific articles and relevant news outlets.
(XLSX)

Acknowledgments

Author Contributions

Conceived and designed the experiments: RH PR IB. Performed the experiments: RH CL. Analyzed the data: RH CL. Contributed reagents/materials/analysis tools: RH CL AY. Wrote the paper: RH CL PR AY IB.

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Project 2

Factors associated with online media attention to research: A cohort study of articles evaluating cancer treatment

2. Summary

Global oncology spending reached $100 billion in 2014 [73] and more than 100,000 research articles are published every year in the field of cancer. It is important to evaluate the impact of cancer research evaluating treatments because it interests to scientific community and important stakeholders such as policy makers, health care professionals, patients and caregivers. One of the new metrics developed called "Altmetric" is used to measure the media attention an article received online through online news, science blogs, and social media [68]. To our knowledge, no study had evaluated online media attention to published articles in the field of cancer and identified factors associated with it. Our hypothesis was that studies with high level of evidence might receive more online media attention. The objective of this study was to describe online media attention of articles evaluating cancer treatments and identify the factors associated with it. Particularly, we aimed to determine whether more attention was received by studies with a high level of evidence [74-77].

We systematically screened highest impact factor journals in the following categories: 50 in "Oncology", 25 in "Medicine, General and Internal", and 25 in "Medicine, Research and Experimental" and selected 47 journals with a diverse range of impact factors, from 3.9 to 54.4 that were publishing clinical studies, systematic reviews of clinical studies and observational studies evaluating the effect of interventions on humans. We searched MEDLINE via PubMed on March 1, 2015 for articles published during the first 6 months of 2014 in selected journals. We retrieved 4,038 citations and selected a sample of 792 articles evaluating cancer treatments regardless of study design. To obtain the media attention of selected articles, we applied PubMed unique identifier (PMID) on Altmetric Explorer and downloaded the Altmetric score, number of news items, science blogs, tweets, Facebook posts, Google + and some other sources where published article was mentioned.

The primary outcome was the media attention an article received online as measured by Altmetric score. We pre-specified following explanatory variables: 1) journal impact factor, 2) study design in 4 classes (i.e., SR/MA, RCT, phase I/II (non-randomized) trial and observational study [as a referent group], 3) abstract conclusion (in favour of study treatment(yes vs no [not in favour of study treatment and neutral]), 4) funding source (for profit [profit, both (profit and non-profit)] vs non-profit [non-profit, none, not reported]), 5) open access to the article (yes vs no), and presence of press release (yes vs no). These variables were entered in the multivariate model to assess the association of each variable with media attention (controlling for other variables in the model). We estimated the logarithm of ratio of mean (RoM), representing the values of Altmetric score per unit change in the covariate, to investigate the factors associated with media attention (i.e., Altmetric score).

Among 792 articles, we found that 512 (64.7%) received a score between 1 and 50, 32 (4.0%) a score between 51 and 100, 21 (2.7%) a score between 101 and 200 and only 9 (1.1%) a score >200.On multivariate analysis, we found following factors associated with a high Altmetric score: presence of a press release (RoM=10.14, 95%CI [4.91-20.96]; $P<0.0001$), open access to the article (RoM=1.48, 95%CI [1.02-2.16]; $P=0.041$), non-profit funding (RoM=1.45, 95%CI [1.08-1.94]; $P=0.012$) and journal impact factor (RoM=1.10, 95% [1.07-1.12]; $P<0.0001$). As compared with observational studies, systematic reviews and meta-analysis [SR/MA] were not associated with high Altmetric score (RoM=1.46, 95%CI [0.74-2.86]; $P=0.27$), nor were RCTs (RoM=0.65, 95%CI [0.41-1.02]; $P=0.059$) and phase I/II, non-RCTs (RoM=0.58, 95%CI [0.33-1.05]; $P=0.07$). The articles with abstract conclusions favoring study treatments were not associated with high Altmetric score (RoM=0.97, 95%CI [0.60-1.58]; $P=0.91$). These results do not support the hypothesis that studies with high level of evidence receive more online media attention.

Our study has following limitations: First was the sheer amount of social media (Facebook posts/tweets) where the chance of missing information is possible and might not all be captured by Altmetric. Second, the association between study design with high level of evidence and media attention was not statistically significant which might be due to limited power. Third, the search strategy used in this project was simple, relying on only the term "cancer" in all fields, but was very large and unspecific. Fourth, the search was performed with MEDLINE only because it is the most frequently used database, and we did not aim to perform a comprehensive search. Fifth, date extraction was limited to one reviewer for 75% articles. However, the quality of data extracted was assessed and did not involve any subjective outcome, therefore a second reviewer independently extracted the data for 25% articles and the reproducibility was very good, with kappa coefficient > 0.9. Sixth, the Altmetric score, which was registered at a fixed point, may have influenced the results. However, a major part of this influence was corrected by adjustment on post-publication exposure periods even if cumulation of Altmetric score over time is probably non-linear. Seventh, the search period was focused on the first 6 months of 2014 because we wanted to have sufficient delay since the launch of Altmetric, in 2012, and aimed to have a post-publication exposure period (i.e., period from last publication date [June 30, 2014] to the Altmetric search date [May 1, 2015] of at least 10 months to ensure that the Altmetric score would be stabilized for most articles. Finally, the RoM value for press releases had wide confidence intervals because there were very few studies which have press releases; therefore the results should be interpreted with caution.

ARTICLE

DETAIL

Haneef R, Ravaud P, Gabriel B, Lina G, Boutron I

"Factors associated with online media attention to research: A cohort study of articles evaluating cancer treatments"

METHODOLOGY   **Open Access**

CrossMark

Factors associated with online media attention to research: a cohort study of articles evaluating cancer treatments

Romana Haneef[1,2,3*], Philippe Ravaud[1,2,3,4,5], Gabriel Baron[3], Lina Ghosn[2] and Isabelle Boutron[1,2,3,4]

Abstract

Background: New metrics have been developed to assess the impact of research and provide an indication of online media attention and data dissemination. We aimed to describe online media attention of articles evaluating cancer treatments and identify the factors associated with high online media attention.

Methods: We systematically searched MEDLINE via PubMed on March 1, 2015 for articles published during the first 6 months of 2014 in oncology and medical journals with a diverse range of impact factors, from 3.9 to 54.4, and selected a sample of articles evaluating a cancer treatment regardless of study design. Altmetric Explorer was used to identify online media attention of selected articles. The primary outcome was media attention an article received online as measured by Altmetric score (i.e., number of mentions in online news outlets, science blogs and social media). Regression analysis was performed to investigate the factors associated with high media attention, and regression coefficients represent the logarithm of ratio of mean (RoM) values of Altmetric score per unit change in the covariate.

Results: Among 792 articles, 218 (27.5%) received no online media attention (Altmetric score = 0). The median [Q1–Q3] Altmetric score was 2.0 [0.0–8.0], range 0.0–428.0. On multivariate analysis, factors associated with high Altmetric score were presence of a press release (RoM = 10.14, 95%CI [4.91–20.96]), open access to the article (RoM = 1.48, 95%CI [1.02–2.16]), and journal impact factor (RoM = 1.10, 95%CI [1.07–1.12]). As compared with observational studies, systematic reviews were not associated with high Altmetric score (RoM = 1.46, 95%CI [0.74–2.86]; $P = 0.27$), nor were RCTs (RoM = 0.65, 95%CI [0.41–1.02]; $P = 0.059$) and phase I/II non-RCTs (RoM = 0.58, 95%CI [0.33–1.05]; $P = 0.07$). The articles with abstract conclusions favouring study treatments were not associated with high Altmetric score (RoM = 0.97, 95%CI [0.60–1.58]; $P = 0.91$).

Conclusions: Most important factors associated with high online media attention were the presence of a press release and the journal impact factor. There was no evidence that study design with high level of evidence and type of abstract conclusion were associated with high online media attention.

Keywords: Cancer treatment, Media attention, Altmetric score, Journal impact factor, Press release, Open access

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Background

Global oncology spending reached $100 billion in 2014 [1], and more than 100,000 research articles are published every year in the field of cancer. It is important to evaluate the impact of this research. The most widely used indicator to measure the impact of research is the number of citations received for each published article [2, 3]. However, citations only measure the impact in the scientific community [4] but not on other important stakeholders such as policy makers, patients, and the general public [2]. Furthermore, this impact can be assessed only after a wait of months [5, 6].

New metrics have been developed to assess the impact of research and provide an indication of online media attention, data dissemination and effect of research across global community. For example, Altmetric was developed to measure the media attention an article receives online [7]. These metrics track online attention for a specific research through an output (e.g., journal article), an identifier linked to the output (e.g., digital object identifier (DOI)) and mentions in a source (e.g., online news outlets). Each article receives an Altmetric score measuring the number of mentions the article has received in online news outlets, science blogs and social media (Twitter, Facebook, Google+, etc.) to provide an indicator of the amount of online media attention [8]. The score is derived from an automated algorithm and represents a weighted count of the amount of attention received for a research output [9]. However, the Altmetric score is not the only factor of scholarly impact. This score is widely used by journal editors and researchers to analyze the effect of the research they publish within days after their publication [2, 10–13].

To our knowledge, no study has evaluated online media attention in the field of cancer. Therefore, we aimed to describe and identify the factors associated with online media attention of articles evaluating cancer treatments. Particularly, we aimed to determine whether more attention was received by studies with a high level of evidence [14–17]. We focused on studies evaluating treatments because they interest the scientific community and are important to healthcare professionals, policy makers, patients and caregivers.

Methods

Study design

We conducted a cohort study of articles reporting studies evaluating treatments in the field of cancer and published in high-impact-factor journals.

Identification of articles

Search strategy

We screened the highest impact factor journals in the following categories: 50 in "Oncology", 25 in "Medicine,

General and Internal" and 25 in "Medicine, Research and Experimental" (Journal citation report 2013, Thomson Reuters). We selected the journals that were publishing clinical studies or systematic reviews of clinical studies or observational studies evaluating the effect of interventions on humans and identified 24 journals from "Oncology", 17 from "Medicine, General and Internal" and 6 from "Medicine, Research and Experimental". We then searched MEDLINE via PubMed on March 1, 2015 for articles published from January 1, 2014 to June 30, 2014 in the selected journals by using the following search strategy: "name of the journal" in the journal search field; "cancer" in title and abstract field; article type "randomized controlled trials", "clinical trials", "observational studies", "meta-analysis" or "systematic reviews" and text availability "abstract".

Eligibility criteria

We included all studies evaluating an intervention to improve the health of patients with any type of cancer, regardless of study design. These interventions could concern chemotherapy, targeted therapy, radiotherapy, surgery, hormone therapy, immunotherapy and supportive care (e.g., analgesics, antibiotics, antiretroviral, dietary supplements, multivitamins, vaccination). We excluded studies of diagnostics, screening, prognostic factors, biomarkers, correlation and gene, molecular and protein expression that did not evaluate any treatment. We also excluded animal studies and narrative reviews.

Data extraction

An online data extraction form was developed and preliminarily tested on a sample of 30 articles. The following data were collected: journal type (i.e., cancer or general medical), study design (systematic reviews/meta-analyses (SRs/MAs), randomized controlled trials (RCTs), phase I/II non-randomized trials and observational studies), sample size and funding source (i.e., for profit, non-profit, both and not reported). The types of cancer and type of cancer treatments were classified according to the US National Cancer Institute" [18].

We determined whether the abstract conclusion favoured the study treatment, did not favour the study treatment or was neutral [19]. We checked whether there was an open access to the article on PubMed and recorded the online publication date on PubMed. Finally, we also checked whether the published article had issued a press release or not. For this purpose, we searched EurekAlert (online free database for science press releases: http://www.eurekalert.org/) using keywords from PubMed, online or journal publication date, journal name, authors' first and last names and title.

Two researchers (RH, LG) with expertise in clinical epidemiology independently screened the titles and abstracts for 25% of the citations retrieved and extracted specific

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information. The reproducibility was very good (kappa > 0.9 for all items) (Additional file 1). Then, the remaining citations were divided among the two researchers for further screening and data extraction. The full text was retrieved to record the funding source when not reported in the abstract.

Online media attention measured by Altmetric score

The primary outcome was the online media attention measured by the Altmetric score. The Altmetric Web-based application tracks the attention scholarly articles receive online by using data from three main categories of sources: social media (i.e., Twitter, Facebook, Google +, Pinterest and blogs); traditional media (i.e., mainstream, such as *The Guardian*, *New York Times*, and science-specific, such as *New Scientist* and *Scientific American*) and online reference managers (i.e., Mendeley and CiteULike) [20]. This score, providing a quantitative measure of attention a scholarly article receives online, is derived from an automated algorithm. The score is weighted by the relative coverage of each published research article in each type of source (e.g., news, Twitter) [9]. For example, an average newspaper story is more likely to bring attention to the research article than an average tweet [9]. Additional file 2 provides details on how the Altmetric score is calculated.

The effect of time is important in exposure of media attention to the article [11]. In general, the published article receives maximum online attention within 6 months of its publication. Each mention of an article on online sources affects the Altmetric score. Therefore, we chose a delay of at least 10 months from the last publication date (June 30, 2014) to the Altmetric search date (May 1, 2015) to allow for sufficient exposure for a stable Altmetric score.

We searched Altmetric Explorer [7] by using the PubMed unique identifier (PMID) for the selected articles (Altmetric search date: May 1, 2015). Then, we downloaded the Altmetric score and number of news items, science blogs, tweets, Facebook posts, Google+ posts, Mendeley readers, CiteULike and some other sources where the published article was mentioned.

Statistical analysis

Qualitative variables are described with frequencies and percentages (%). Quantitative variables are described with medians [Q1–Q3]. We used the negative binomial GEE model to study the association of explanatory variables and Altmetric score. Regression coefficients represent the logarithm of the ratio of mean (RoM) values of the Altmetric score per unit change in the covariate. We chose this model to explain the wide dispersion of Altmetric score (greater variance than the mean). Using a function "offset", we adjusted for the duration between online publication dates of articles (or journal publication date if the online publication date was greater than journal publication date) and the search date for Altmetric score (May 1, 2015) to account for the same post-publication exposure period. Clustering due to journals was accounted for by adding an exchangeable correlation structure to the model.

Univariate and multivariate analyses involved the following pre-specified explanatory variables: (1) journal impact factor, (2) study design in four classes (i.e., SR/MA, RCT, phase I/II non-randomized trial and observational study[as a referent group]), (3) abstract conclusion (in favour of study treatment (yes vs no [not in favour of study treatment and neutral]), (4) funding source (for profit [profit, both (profit and non-profit)] vs non-profit [non-profit, none and not reported]), (5) open access to the article (yes vs no) and

Fig. 1 Flow diagram of articles evaluating cancer treatments

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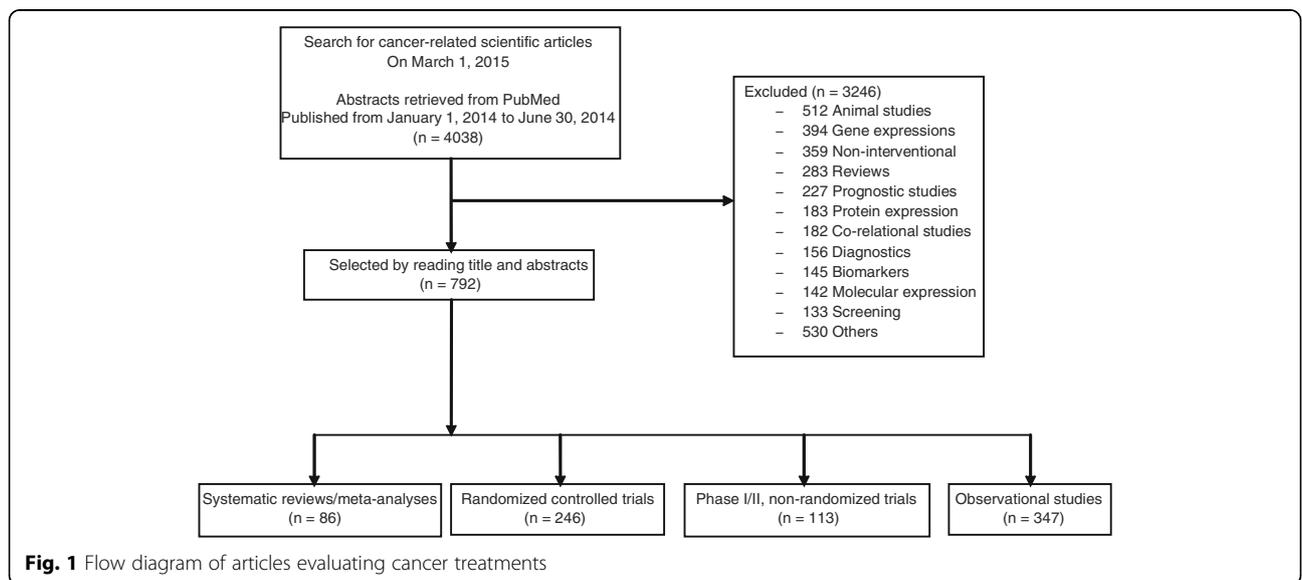
(6) presence of a press release (yes vs no). All these variables were entered in the multivariate model to assess the association of each variable with high Altmetric score (controlling for the other variables in the model). Results are expressed as RoMs with 95% confidence intervals (95%CIs) for both univariate and multivariate analysis. Statistical analysis involved use of SAS for Windows 9.4 (SAS Inst., Cary, NC).

Results

General characteristics of selected articles

Among 47 selected journals, 4038 citations were retrieved. The 792 articles identified were published in 31 journals with a diverse range of impact factors, from 3.9 to 54.4 (Fig. 1). At least one article was selected among the 31 journals; the median [Q1–Q3] of included articles per journal was 10.0 [3.0–42.0]. Selected journals with the included number of articles are detailed in Additional file 3. The general characteristics of the articles selected are in Table 1. The median [Q1–Q3] of the journal impact factor of selected articles was 5.3[4.8–16.4]. Overall, 347 articles (44%) described observational studies, 246 (31%) RCTs, 113 (14%) phase I/II, non-randomized trials and 86 (11%) SRs/MAs. Most were published in cancer journals ($n = 739$, 93%). Among the 792 articles, in 523 (66%), the abstract conclusion was in favour of the study treatment, the funding source was for profit for 268 (34%), and 462 (58%) had open access to the article. Overall, only 56 (7%) of the articles had a press release.

Description of online media attention measured by Altmetric score

The median [Q1–Q3] Altmetric score was 2.0 [0.0–8.0], range 0.0–428.0; 218 articles (27.5%) received no media attention (Altmetric score = 0). Figure 2 describes the overall distribution of Altmetric score of 792 articles.

Among 792 articles, 512 (64.7%) received a score between 1 and 50, 32 (4.0%) a score between 51 and 100, 21 (2.7%) a score between 101 and 200 and only 9 (1.1%) a score >200.

Figure 3 describes the amount of attention that studies received in different online media sources. Overall, there were 756 news outlets, 143 science blogs, 1285 facebook posts, 6467 tweets and 3449 Mendeley readers. In this figure, each bar represents the proportion of studies with no mention or attention (sky blue), 1–5 mentions per study (dark green), 6–10 mentions per study (jade green), 11–15 mentions per study (yellow), 16–20 mentions per study (orange) and 20 mentions per study (red). For example, in news media, 83% studies (657/792) received no attention, 11% (87/792) were mentioned 1–5 times, 3.1% (25/792) were mentioned 6–10 times, 1.4% (11/792) were mentioned 11–15 times, 0.5% (4/792) were mentioned 16–20 times, and only 1% (8/792) were mentioned 20 times.

Table 1 General characteristics of articles

Category	Total ($n = 792$)
Type of journal, *n* (%)	
– Cancer	739 (93.3)
– General medical	53 (6.7)
Journal impact factor, median [Q1–Q3]	5.3 [4.8–16.4]
Study design	
– Systematic review/meta-analysis	86 (10.9)
– Randomized controlled trial	246 (31.1)
– Phase I/II, non-randomized trial	113 (14.3)
– Observational study	347 (43.8)
Cancer type by organ, *n* (%)	
– Digestive system	168 (21.2)
– Breast	135 (17.0)
– Lungs	82 (10.4)
– Blood	71 (8.9)
– Prostate	53 (6.7)
– Female reproductive organ	44 (5.6)
– Others	239 (30.2)
Type of cancer treatment, *n* (%)	
– Chemotherapy	212 (26.7)
– Targeted therapy	88 (11.1)
– Radiotherapy	69 (8.7)
– Surgery	44 (5.5)
– Hormone therapy	28 (3.5)
– Immunotherapy	4 (0.5)
– Supportive care	197 (25.0)
– Others	150 (19.0)
Sample size, median [Q1–Q3][a]	181.0 [48.5–1010.5]
Type of abstract conclusion	
– In favour of study treatment	523 (66.0)
– Not in favour of study treatment	269 (34.0)
Funding source, *n* (%)	
– Non-profit	418 (52.8)
– Profit[b]	268 (33.8)
– Not reported	106 (13.4)
Altmetric score, median [Q1–Q3]	2.0 [0.0–8.0]
Open access	
– Yes	462(58)
– No	330(42)
Press-release	
– Yes	56(7)
– No	736(93)

[a]Excluding the sample size of systematic reviews/meta-analyses
[b]12.2% is partially profit and non-profit

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Fig. 2 Distribution of Altmetric score for articles (*n* = 792) [Inset graph limited to articles with an Altmetric score ≤50]
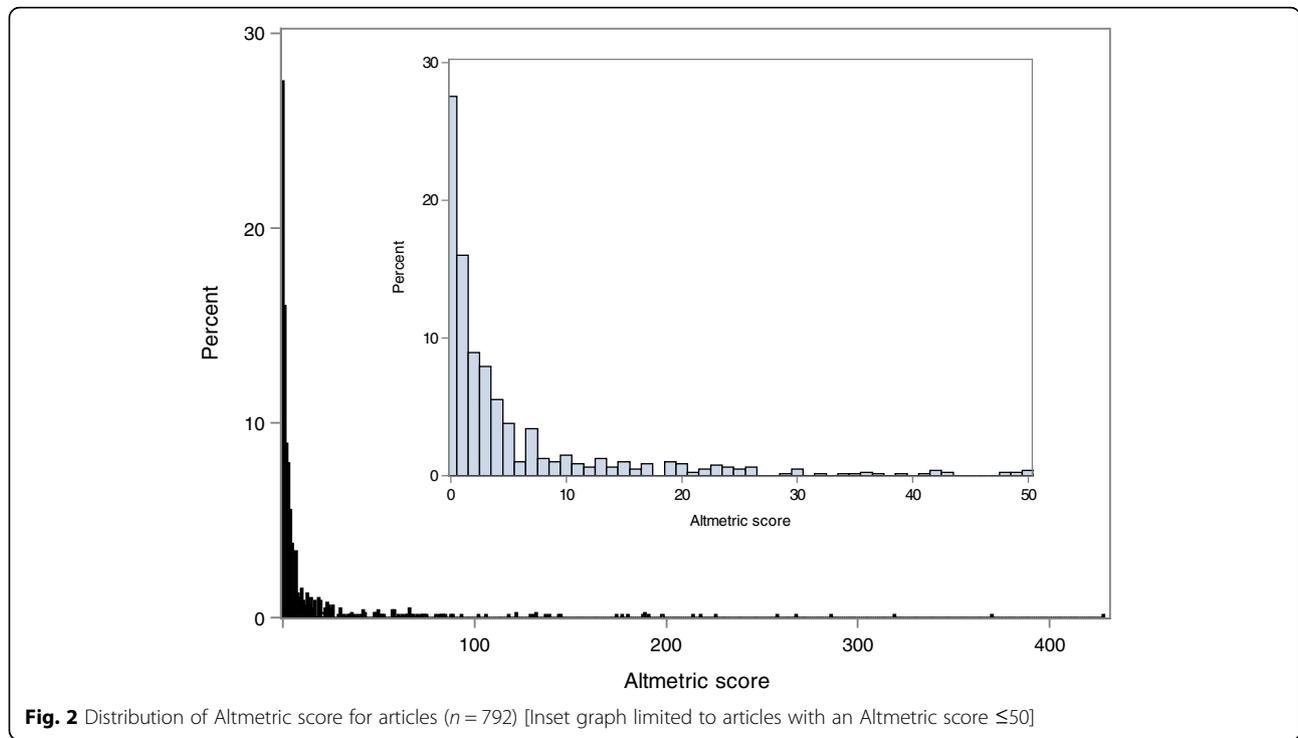
Factors associated with online media attention

On multivariate analysis, the factors associated with a high Altmetric score were presence of a press release (RoM = 10.14, 95%CI [4.91–20.96]; *P* 0.0001), i.e., articles with press-release seemed to have 10.1 times increase in mean Altmetric score), open access to the article (RoM = 1.48, 95%CI [1.02–2.16]; *P* = 0.041), non-profit funding (RoM = 1.45, 95%CI [1.08–1.94]; *P* = 0.012) and journal impact factor (RoM = 1.10, 95% [1.07–1.12]; *P* 0.0001), i.e., 1-point increase in impact factor has a 10% increase in mean Altmetric score (for instance a journal with an impact

factor equal to 2), and a journal with an impact factor equal to 12 with a difference of 10 point in impact factor have an expected Altmetric score multiplied by 2.5 (150% increase for 10 points) (Table 2).

Systematic reviews (SR/MA) were not associated with high Altmetric score (RoM = 1.46, 95%CI [0.74–2.86]; *P* = 0.27) as compared with observational studies, nor were RCTs (RoM = 0.65, 95%CI [0.41–1.02]; *P* = 0.059) and phase I/II, non-RCTs (RoM = 0.58, 95%CI [0.33–1.05]; *P* = 0.07) as compared with observational studies. The articles with abstract conclusions favouring study treatments

Fig. 3 Online media attention of articles by sources (*n* = 792)

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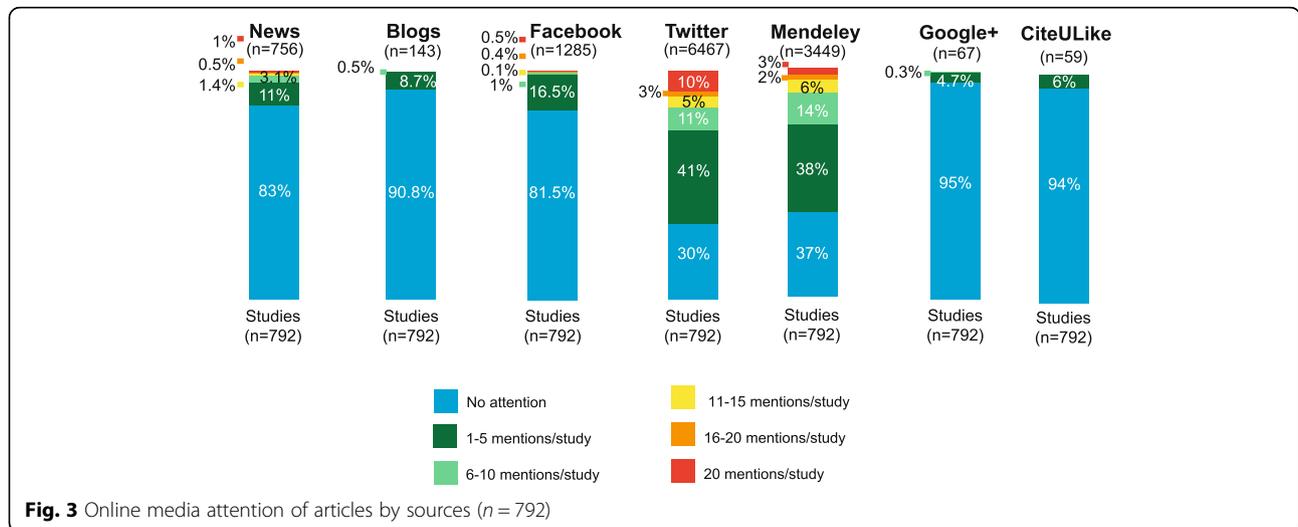
Table 2 Factors associated with online media attention (i.e., Altmetric score) of articles (*n* = 792)

		Univariate analysis			Multivariate analysis		
		RoM	95%CI	*P* value	RoM	95%CI	*P* value
Journal impact factor	(One unit)	1.11	[1.07–1.14]	<0.0001	1.10	[1.07–1.12]	<0.0001
Study design	• RCT vs observational study	1.02	[0.78–1.32]	0.9259	0.65	[0.41–1.02]	0.0593
	• Phase I/II, non-randomized trial vs observational study	0.46	[0.34–0.62]	<0.0001	0.58	[0.33–1.05]	0.0715
	• SR/MA vs observational study	0.97	[0.70–1.34]	0.8381	1.46	[0.74–2.86]	0.2724
Abstract conclusion	In favour of study treatment (yes vs no)	1.34	[1.04–1.74]	0.0254	0.97	[0.60–1.58]	0.9134
Funding source	Non-profit vs for profit	1.30	[0.97–1.73]	0.0773	1.45	[1.08–1.94]	0.0126
Open access	Yes vs no	1.72	[1.27–2.33]	0.0005	1.48	[1.02–2.16]	0.0418
Press release	Yes vs no	11.61	[6.78–19.87]	<0.0001	10.14	[4.91–20.96]	<0.0001

RoM ratio of mean

were not associated with high Altmetric score (RoM = 0.97, 95%CI [0.60–1.58]; *P* = 0.91).

Further details of means and medians for each explanatory variable associated with Altmetric score are in Table 3.

Discussion

This study describes the online media attention of 792 articles evaluating cancer treatments and identified associated factors. Almost one third of these studies received no media attention in terms of Altmetric score. The presence of a press release, open access to the article, non-profit funding source and journal impact factor were associated with high online media attention. There was no evidence that study design with a high level of evidence and type of abstract conclusion were associated with high online media attention.

To our knowledge, this is the first study describing the online media attention to articles evaluating cancer treatments and systematically determining the associated factors. Previous studies have mainly focussed on citation analysis to determine research impact within a speciality such as oncology [21], gastric cancer [22], general surgery [23], obstetrics and gynaecology [24] and urology [25].

Our results are consistent with previous studies showing that press releases are associated with the subsequent publication of newspaper stories [26, 27] and open access to the article increases the citation counts [28]. For example, Altmetric issued a list of 100 articles published in 2015 which received the highest media attention; 42% had open access [29]. Research articles exploring the impact of the study design and quality on citations are conflicting. Patsopoulos et al showed that articles with a study design with a high level of evidence received relatively more citations than other study designs [3]. In contrast, other work found no convincing evidence that journals with higher citation publish trials of higher methodological quality [30].

Implications

Our study has some important implications. First, it shows that online media attention does not warrant the high

Table 3 Mean, median and [min–max] for explanatory variables associated with Altmetric score (*n* = 792)

Explanatory variables	Sub-categories	Mean (SD)	Median [Q1–Q3]	[Min–max]
Study design	SR/MA	14.9 (37.0)	3.5 [1.0–10.0]	[0.0–268.0]
	RCT	20.7 (50.5)	3.0 [0.0–16.0]	[0.0–428.0]
	Phase I/II, non-RCT	6.5 (17.2)	2.0 [0.0–4.0]	[0.0–139.0]
	Observational study	13.4 (39.7)	2.0 [0.0–7.0]	[0.0–319.0]
Abstract conclusion	In favour of study treatment	16.6 (44.8)	2.0 [0.0–9.0]	[0.0–428.0]
	Not in favour of study treatment	11.5 (32.5)	2.0 [0.0–7.0]	[0.0–319.0]
Funding source	Profit	13.9 (41.1)	2.0 [0.0–9.0]	[0.0–370.0]
	Non-profit	15.4 (41.1)	2.0 [0.0–8.0]	[0.0–428.0]
Open access	Yes	17.9 (49.3)	3.0 [1.0–8.0]	[0.0–428.0]
	No	10.6 (24.8)	1.5 [0.0–8.0]	[0.0–258.0]
Press release	Yes	118.6 (87.5)	84.5 [58.0–144.5]	[29.0–428.0]
	No	7.0 (19.0)	2.0 [0.0–5.0]	[0.0–268.0]

SR/MA systematic review/meta-analysis, *RCT* randomized controlled trial

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quality of research. In fact, news, blogs and social media may highlight research on the basis of perceptions of their potential appeal to patients and the public, not because of their rigorous methodology. Indeed, previous studies showed that the media is more likely to cover observational studies and less likely to report RCTs [31]. A high level of evidence may interest the scientific and medical community more than the public.

Second, factors related to the publication process such as the presence of press release, open access are strongly associated with online media attention and the subsequent publication of newspaper stories [26, 27]. This is important information for researchers when planning the dissemination of their results. To enhance the impact of their research, they should favour open access and disseminate press releases.

Third, there is some evidence showing that high online media attention is highly correlated with access to the scientific article and the number of scholarly citations the scientific article will receive [2]. Some studies from the fields of clinical pain [10], urology [32], neurointerventional surgery [33] and cardiovascular [34] and emergency medicine [35] have shown that disseminating research on social media will increase their access or views to their readers. Highly cited articles can be predicted by tweets occurring within the first 3 days of article publication [2]. Open access to the article increases the citation counts [28].

Finally, high online media attention to articles evaluating treatments can have an impact on public health. Previous studies have shown that dissemination of medical research in the mass media can affect patients, public, researchers, physicians and healthcare providers and their behaviours [36]. For example, a peak in media attention regarding group A streptococcal (GAS) disease and its testing in paediatric emergency departments was associated with an increase in the prescription of rapid tests for GAS despite no increase in number of children presenting symptoms that might warrant such testing [37]. In another example, wide media coverage resulted in striking changes in the use of hormone therapy by postmenopausal women [38]. A Cochrane systematic review highlighted the impact of the mass media on health services utilization, with a consistent effect after planned campaigns and unplanned coverage [39]. A recent study of statins use highlighted the potential effect of widely covered health stories in the media on real-world behaviour related to healthcare [40].

Limitations

This study has some limitations. First, the sheer amount of social media (Facebook posts/tweets) where the chance of missing information is possible and may not all be captured by Altmetric. Second, the power may be limited to detect a relationship between the study design and online media attention. Third, our search strategy was simple, relying on only the term "cancer" in all fields, but was very large and unspecific. Fourth, the search was performed with MEDLINE only because it is the most frequently used database, and we did not aim to perform a comprehensive search. Fifth, date extraction was limited to one reviewer for 75% articles. However, we assessed the quality of data extracted because a second reviewer independently extracted the data for 25% articles and the reproducibility was very good, with kappa coefficient >0.9. Sixth, the Altmetric score, which was registered at a fixed point, may have influenced the results. However, a major part of this influence is corrected by adjustment on post-publication exposure periods even if cumulation of Altmetric score over time is probably no linear. Seventh, our search period focused on the first 6 months of 2014 because we wanted to have sufficient delay since the launch of Altmetric, in 2012, and we aimed to have a post-publication exposure period (i.e., period from last publication date [June 30, 2014] to the Altmetric search date [May 1, 2015]) of at least 10 months to ensure that the Altmetric score would be stabilized for most articles. Finally, the results should be interpreted with caution because the RoM value for press releases had wide confidence intervals.

Further research is needed to measure the impact of cancer research on individual components of media such as news and social media.

Conclusions

There is a large variability in online media coverage of articles evaluating cancer treatments. Most important factors associated with high online media attention are presence of a press release and journal impact factor. There was no evidence that study design with high level of evidence and type of abstract conclusion were associated with high online media attention.

Additional files

Additional file 1: Kappa coefficients for concordance in screening titles and abstracts of articles. This word file gives the individual estimates of Kappa coefficients for concordance between two researchers in screening title and abstracts to include articles in the study (11.5 Ko). (DOCX 22 Kb)

Additional file 2: Criteria to calculate the Altmetric score. This word file provides the information that how Altmetric score is calculated and weighted (14.5 Ko). (DOCX 29 Kb)

Additional file 3: Journals including the selected articles. This word file gives the detail of included journals, selected number of articles in each journal and description of some articles which received high Altmetric score in related journal (30.0 Ko). (DOCX 39 kb)

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Project 3

Dissemination of 2014 Dual Anti-Platelet Therapy (DAPT) trial results: A systematic review of scholarly and media attention over 7 months

3. Summary

Dual anti-platelet therapy (DAPT) (i.e., P2Y12-receptor inhibitor combined with aspirin) is recommended after the placement of coronary stents to prevent thrombotic complications [78]. The optimal duration of DAPT has been debated [79-83]. In December 2014, the Harvard Clinical research Institute (HCRI) released the results of the DAPT study and published in the *New England Journal of Medicine (NEJM)* [84]. The trial aimed to determine the benefits and risks of continuing DAPT beyond 1 year after the placement of a coronary stent [84]. A total of 9,961 adult patients were randomly assigned to continue thienopyridine treatment or to receive a placebo for 30 months. Continued therapy reduced the rate of stent thrombosis (0.4% vs.1.4%; $p < 0.001$) and major adverse cardiovascular and cerebrovascular events (MACCEs) (2.1% vs. 4.1%; $p < 0.001$), with an expected increase in the rate of moderate or severe bleeding (2.5% vs. 1.6%; $p = 0.001$). Continued therapy was also associated with an increase of 36% in all-cause mortality (2.0% vs. 1.5%; hazard ratio 1.36 [95% CI 1.00 to 1.85]; $P = 0.05$) [84].

However, the reporting of the results raised some concerns [85, 86]. Particularly, the abstract conclusions did not mention the increased risk of mortality. Furthermore, the discussion included explanations based on post-hoc analyses to clear the role of prolonged thienopyridine treatment in this increased risk of mortality. For this purpose, the authors had split the analysis by cause of death, which was not powered to show a statistically significant difference. They focused on the increase in cancer-related death (0.62% vs 0.28%, $p = 0.02$). The results were interpreted as being related to an imbalance at baseline in patients with a history of cancer before enrolment (9.8% vs 9.5%). To confirm, the authors performed a post-hoc analysis excluding all deaths that could be related to cancer diagnosed before enrolment. Consequently, the results became statistically non-significant (0.50% vs 0.28%, $p = 0.11$). This post-hoc exclusion of patients with an event is questionable.

The objective of this study was to explore how the results of a trial reported with spin were disseminated to the scientific community and online media, using the 2014 DAPT trial as a case studyand to assess whether this interpretation was criticized or not. Our aim was not to resolve the controversy about DAPT duration and this debate is still ongoing.

This was systematic review of scholarly and public attention surrounding the DAPT study. We searched and collected the data from the ISI Web of Knowledge, Google Scholar, PubMed Commons, EurekAlert, the DAPT study website (www.daptstudy.org), and the NEJM website *(for scholarly attention)* and Altmetric Explorer [68], Snap Bird, YouTube *(for public attention)* citing DAPT study results appearing from November 16, 2014 to June 10, 2015.

We evaluated the text of contents and classified them as follows: text favouring the prolonged treatment; text uncertain (about the benefit of prolonged treatment) with inappropriate mention of mortality; text neutral/uncertain (about the benefit of prolonged treatment) with no mention of mortality; electronic link or referenced with no message; text uncertain (about the benefit of prolonged treatment) with appropriate mention of mortality; text not favouring the prolonged treatment and text not favouring the prolonged treatment and critical of the authors' interpretation. The main outcome was the proportion of contents highlighting the increased risk of mortality and critical to the author's interpretation of the results. We calculated frequencies and percentages (%) for qualitative variables and median [IQR] (interquartile range) for quantitative variables.

We identified 425 items reported by 7 sources; 164 (39%) disseminated the authors' interpretation via an electronic link or a reference, with no additional text. Among 81 items (19%), the message favoured prolonged treatment and overstated the article conclusions. Among 119 items (28%), the text was uncertain about the benefit of prolonged treatment but was reported with no or inappropriate mention of increased risk of mortality. Only 34 items (8%) were uncertain about the benefit of prolonged treatment and mentioned increased risk

of mortality. In all, 27 items (6%) did not favour prolonged treatment, and only 12 of these (3%) clearly raised some concerns about the reporting of increased risk of death.

This study has following limitations: First, this study focused on only one specific trial publication and results are not generalizable to other studies. However, the article we focused on was among the top 5 of all research outputs and within the 99th percentile of articles on Altmetric. Second, the data extraction involved some subjectivity and we tried to address this by using a standardized data extraction form and an independent assessment as well as consensus among 2 researchers. Third, despite our best efforts, we cannot ensure that our search strategy was all-encompassing because of the breadth of social media. Finally, we did not explore the balance between efficacy and safety outcomes with DAPT treatment.

ARTICLE

DETAIL

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*These authors contributed equally to this work as a first author.

"Dissemination of 2014 Dual Anti-Platelet Therapy (DAPT) trial results: A systematic

review of scholarly and media attention over 7 months"

Dissemination of 2014 Dual Anti-platelet Therapy (DAPT) trial results: A systematic review of scholarly and media attention over 7 months

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Abstract

Objective: To explore how the results from the 2014 DAPT trial were disseminated to the scientific community and online media.

Design: A systematic review of scholarly and public attention surrounding the DAPT study.

Settings: Data were collected from the ISI Web of Knowledge, Google Scholar, PubMed Commons, EurekAlert, the DAPT study website (www.daptstudy.org), and the *New England Journal of Medicine* website *(for scholarly attention)* and Altmetric Explorer, Snap Bird, YouTube *(for public attention)* citing DAPT study results appearing from November 16, 2014 to June 10, 2015.

Participants: No participants were involved in this study.

Main outcome measure: Proportion of contents highlighting the increased risk of mortality and critical to the author's interpretation of the results.

Results: We identified 425 items reported by 7 sources; 164 (39%) disseminated the authors' interpretation via an electronic link or a reference, with no additional text. Among 81 items (19%), the message favoured prolonged treatment and consequently overstated the article conclusions. Among 119 items (28%), the text was uncertain about the benefit of prolonged treatment but was reported with no or inappropriate mention of increased risk of mortality. Only 34 items (8%) were uncertain about the benefit of prolonged treatment and mentioned increased risk of mortality. In all, 27 items (6%) did not favour prolonged treatment, and only 12 of these (3%) clearly raised some concerns about the reporting of increased risk of death.

Conclusion: Dissemination of the DAPT study results to the scientific community and on different media sources rarely criticized the interpretation of the study results.

Strengths and limitation of this study

- Our method involved a broad search strategy, ensured to capture an extensive and representative sample of contents citing the 2014 DAPT trial for both scholarly and public attention.

- Our systematic approach to analyze the text of contents provides a comprehensive overview of dissemination of the study results.

- This study focused on only a specific trial publication and results are not generalizable to other studies.

INTRODUCTION

The development of optimal coronary stent replacement has progressed rapidly over recent years [1]. In the United States, almost 700,000 stents are placed every year and there is an increasing trend for its use in Europe [2]. Dual antiplatelet therapy (DAPT) (i.e., P2Y12-receptor inhibitor combined with aspirin) is recommended after placement of coronary stents to prevent thrombotic complications [3]. The optimal duration of DAPT has been debated [4-8].

In December 2014, the Harvard Clinical Research Institute (HCRI) released the results of the DAPT study, the largest international randomized controlled trial to date [9]. The trial aimed to determine the benefits and risks of continuing DAPT beyond 1 year after placement of a coronary stent [9]. A total of 9,961 adult patients were randomly assigned to continue thienopyridine treatment or to receive a placebo for 30 months. Continued therapy reduced the rate of stent thrombosis (0.4% vs.1.4%; p<0.001) and major adverse cardiovascular and cerebrovascular events (MACCEs) (2.1% vs. 4.1%; p<0.001), with an expected increase in the rate of moderate or severe bleeding (2.5% vs. 1.6%; p=0.001) [9]. However, continued therapy was also associated with an increase of 36% in all-cause mortality (2.0% vs. 1.5%; hazard ratio 1.36 [95% CI 1.00 to 1.85]; P=0.05).

The results of the DAPT study were published in the *New England Journal of Medicine* (*NEJM*) [9] after their presentation at the American Health Association Conference, in November 2014. However, the reporting of the results raised some concerns [10, 11]. Particularly, the abstract conclusions did not mention the increased risk of mortality. Furthermore, the discussion included explanations based on post-hoc analyses to clear the role of prolonged thienopyridine treatment in this increased risk of mortality. For this purpose, the authors had split the analysis by cause of death, which was not powered to show a statistically significant difference. They focused on the increase in cancer-related death (0.62% vs 0.28%,

p = 0.02). The results were interpreted as being related to an imbalance at baseline in patients with a history of cancer before enrolment (9.8% vs 9.5%). To confirm, the authors performed a post-hoc analysis excluding all deaths that could be related to cancer diagnosed before enrolment. Consequently, the results became statistically non-significant (0.50% vs 0.28%, p=0.11). This post-hoc exclusion of patients with an event is questionable.

We aimed to explore how the authors' interpretation of results from the DAPT trial was disseminated to the scientific community and online media and to assess whether this interpretation was criticized or not.

METHODS

We performed a systematic review of scholarly and public attention surrounding the DAPT study.

Identification of scholarly and public attention surrounding the DAPT study

Scholarly attention

On June 2015, we searched the following electronic databases to identify responses to the DAPT study: ISI Web of Knowledge, Google Scholar, and PubMed Commons. We also searched the comments and citing articles on the *NEJM* website for the original article [9].

Public attention

We searched Altmetric Explorer [12-15] to identify all online attention (news, blogs, Twitter, Facebook, Google+, Mendeley, CiteULike) given to the DAPT study. Each identified social media source was then systematically evaluated to determine whether other posts were not captured by Altmetric Explorer. In addition, each original tweet was reviewed to find retweets, replies and favourites. Since Altmetric.com captures only tweets attached to the DOI (Digital Object Identifier) of the original DAPT article, we also used snapbird.org, a search engine that can search an individual Twitter account by using the *NEJM*'s Twitter account and the search terms "DAPT" and "dual antiplatelet therapy". We also searched EurekAlert! (a free online database for science press releases, www.eurekalert.org) for press releases dedicated to the DAPT study; YouTube (search terms "DAPT" and "dual antiplatelet therapy"); and pages dedicated to patients, clinicians and media at the DAPT study website (http://www.daptstudy.org).

Eligibility criteria

Two researchers (MS, RH) screened all items retrieved and selected all English-language items that cited the DAPT study and were released from November 16, 2014 to June 10, 2015. Any disagreements were resolved by discussion to reach consensus.

Content of scholarly and public attention surrounding the DAPT study

Two researchers (MS, RH) read the items from each source independently and evaluated them by using a preliminarily tested extraction form. Disagreements were resolved by discussion to reach consensus. If needed, a third researcher (IB) appraised the content.

We determined whether the source consisted of a reference or a link to the *NEJM* article reporting the DAPT study only or was a text commenting on the DAPT study. For a text commenting on the DAPT study, we checked whether the original study authors were involved in writing the text or not. Our main outcome of interest was the proportion of contents highlighting the increased risk of mortality and critical to the author's interpretation of the results. We determined whether

- the primary efficacy outcomes (i.e., stent thrombosis and MACCE) were reported

- the safety outcomes related to moderate or severe bleeding were reported

- the increased risk of mortality with prolonged treatment was reported

- the authors' explanation clearing the responsibility of prolonged treatment in the increased risk of mortality was reported or criticized

- the content of the text was 1) favouring the prolonged treatment and consequently overstating the article conclusion, 2) uncertain about the benefit of the prolonged treatment (i.e., statement of both the beneficial effect, and increased risk of bleeding, text ending with a question mark, use of "may or might" or reporting that the study needs further research), or 3) not favouring the prolonged treatment [16].

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Overall, we classified the sources based on the text of contents as follows:

1. Text favouring the prolonged treatment

2. Text uncertain (about the benefit of prolonged treatment) with inappropriate mention of mortality

3. Text neutral/uncertain (about the benefit of prolonged treatment) with no mention of mortality

4. Electronic link or referenced with no message

5. Text uncertain (about the benefit of prolonged treatment) with appropriate mention of mortality

6. Text not favouring the prolonged treatment

7. Text not favouring the prolonged treatment and critical of the authors' interpretation

Statistical analysis

We calculated frequencies and percentages (%) for qualitative variables and median (interquartile range) for quantitative variables.

RESULTS

Identification of scholarly and public attention surrounding the DAPT study

From all sources, we selected and appraised 425 items: 118 scientific communications, 12 news items, 3 blogs, 189 Facebook posts or comments, 75 tweets or replies, 8 videos on YouTube, 14 DAPT media pages, 5 DAPT website pages and 1 video on the DAPT website (Figure 1). The original study authors were directly involved in 35 items. Details of 118 scientific communications are in *Appendix 1*.

Reporting of the content

The texts of contents are described in Figure 2 (overall) and Figure 3 (by source). Overall, 164 items (39%) involved disseminating the authors' reporting and interpretation via an electronic link (n=151, 36%) or reference (n=13; 3%), with no additional text or message. Among 81 items (19%), the message favoured the prolonged treatment and therefore overstated the article conclusions. For example, the DAPT study website dedicated to patients reported that "*It is important that patients who currently take a thienopyridine anti-clotting medication (clopidogrel or prasugrel) do not stop taking their medication. […] The benefits of continuing dual antiplatelet therapy for one year, according to current guidelines, far outweigh the risks.*" Among 153 items (36%), the text was uncertain about the benefit of prolonged treatment but was reported with no mention of the increased risk of mortality (n=100, 24%) or the authors' explanation clearing the responsibility of prolonged treatment (n=19; 4.5%). Overall, 34 items (8%) were uncertain about the benefit of prolonged treatment but mentioned the increased risk of mortality. Only 27 (6%) did not favour prolonged treatment and only 12 of these (3%) clearly raised some concerns about the reporting of the increased risk of death. Further information on items by source is in *Appendix 2.*

Overall, 136 items (32%) reported efficacy outcomes (i.e., stent thrombosis and MACCEs), 127 (30%) safety outcomes and 113 (27%) both efficacy and safety outcomes.

A total of 100 items (24%) did not mention mortality, but when mortality was mentioned, in 19 items (5%), it was reported with the authors' justification for prolonged treatment.

DISCUSSION

We describe the dissemination of the 2014 DAPT study findings in scientific community and to the public via different sources such as news, blogs, and social media. Our assessment of 425 items disseminating the DAPT study results showed that only 8% of the items mentioned some uncertainty about the benefit of prolonged treatment and included a mention of the increased risk of mortality. Furthermore, only 12 items (3%) clearly raised some concerns about the reporting of the increased risk of death. This study adds to the burgeoning literature on the biased dissemination of research results. Previous studies have focused on publication bias [17], selective reporting of outcomes [17-22], and spin [19, 23, 24].

However, this is the first study to our knowledge to focus on both scholarly and public dissemination of study results. Our study highlighted an unmet need of scientific communication in the media, whose importance in dissemination of scientific data is becoming increasingly relevant. These findings could be helpful for the entire community of better understanding how scientific knowledge is disseminated.

Our approach involved a broad search strategy and multiple search engines, which ensured the capture of an extensive and representative sample of contents discussing the DAPT study results. Each social media item from Altmetric was systematically reviewed for additional content that may have been missed, and several different search engines were used. We captured items that were published over the course of many months, which highlighted the perpetuation and continuation of the dissemination of the authors' interpretations. The inclusion period for sources seemed to be more than sufficient because tweets linked to scientific articles have been shown to taper off well before our cut-off point (7 months) [25]. In addition, 2 independent researchers assessed each source by using a standardized data extraction form and disagreements were resolved by consensus.

However, our study has some limitations. First, this study focused on only a specific trial publication and results are not generalizable to other studies. However, the article we focused on was among the top 5 of all research outputs and within the 99th percentile of articles on Altmetric. Second, the data extraction involved some subjectivity; however, we tried to address this by using a standardized data extraction form and independent assessment as well as consensus among 2 researchers. Third, despite our best efforts, we cannot ensure that our search strategy was all-encompassing because of the breadth of social media. Finally, we did not explore the balance between efficacy and safety outcomes with DAPT treatment.

Our aim was not to resolve the controversy about DAPT duration and this debate is still ongoing. The OPTIDUAL (Optimal Duration of Dual Anti-platelet Therapy after Drug Eluting Stent implantation) trial did not find an increased risk of death with the prolonged treatment; on the contrary, the risk of death was lower with the prolonged treatment [26]. Several meta-analyses found conflicting results [4, 5, 8, 27, 28]. The researchers involved in the DAPT trial concluded in a meta-analysis published in *The Lancet* that prolonged DAPT duration was not associated with a difference in risk of all-cause mortality [29]. Three meta-analyses, published later by different teams, showed prolonged DAPT associated with increased risk of all-cause mortality [4, 5, 8]. More recently, other meta-analyses did not find a statistically significant increase in all-cause mortality [27, 28]. Most of these meta-analyses warranted further research with extended DAPT.

However, these results are difficult to interpret because of different definitions of short (1, 3, 6, or 12 months) and extended (6, 12, 24 or > 24 months) durations, which varied across studies. Furthermore, different durations of follow-up and types of stents could also influence the results.

CONCLUSIONS

Dissemination of the DAPT study results to the scientific community and on different media sources rarely criticized the interpretation of the study results.

Supplementary Data

Appendix 1: Detail of 118 scientific communications

Appendix 2: Content of scholarly and public attention surrounding the DAPT study by source.

Data sharing

All relevant data are included in this manuscript. Details of text content are available upon request for academic researchers.

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Figure 1: Flow diagram of identified scholarly and public attention surrounding the DAPT study

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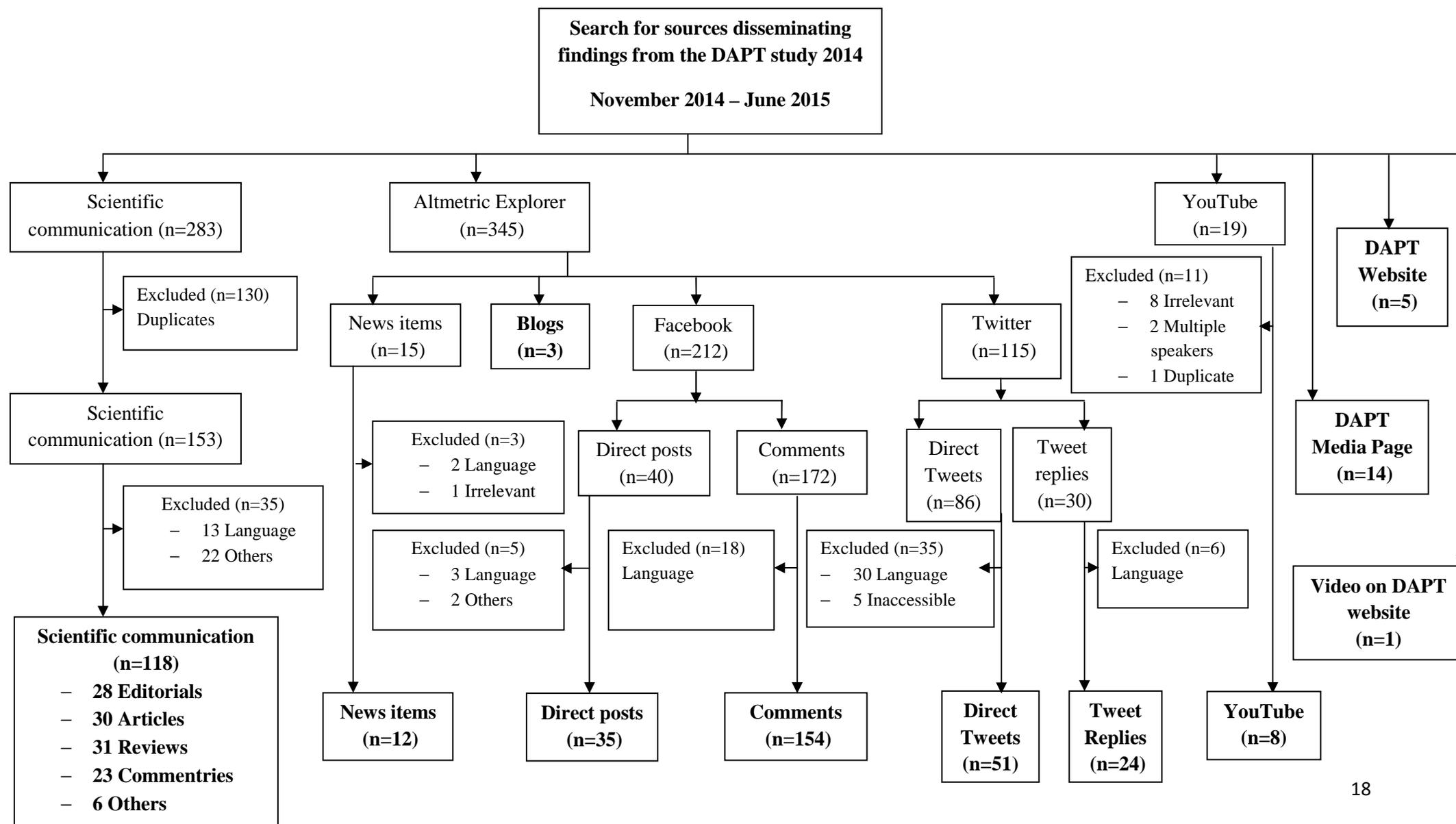
Figure 2: Content of the scholarly and public attention surrounding the DAPT study (n = 425)
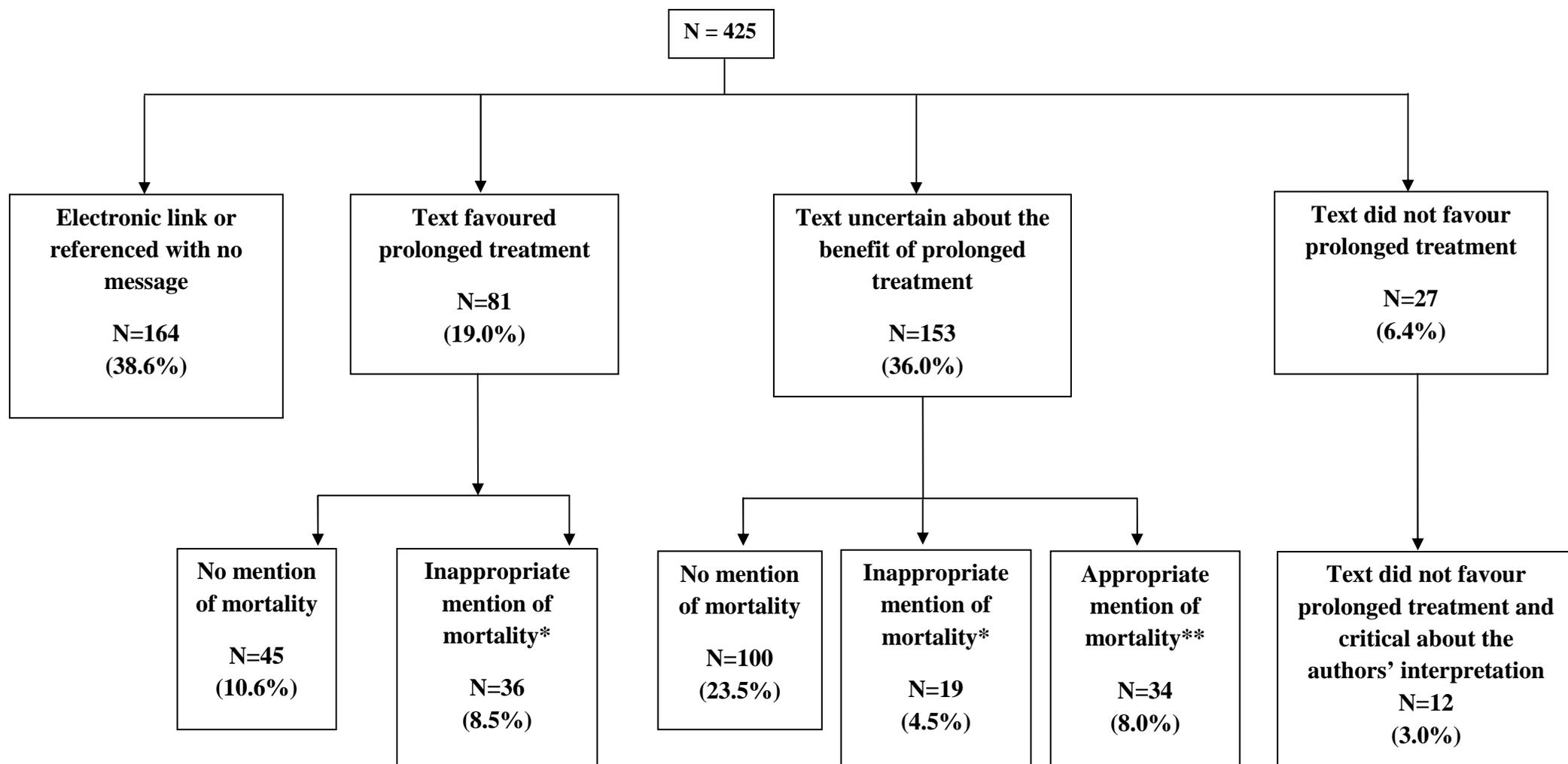
*Increased risk of mortality reported with the authors' questionable explanation clearing the responsibility of prolonged treatment in the increased risk

** Increased risk of mortality reported without any explanation

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Figure 3: Content of the scholarly and public attention surrounding the DAPT study by source
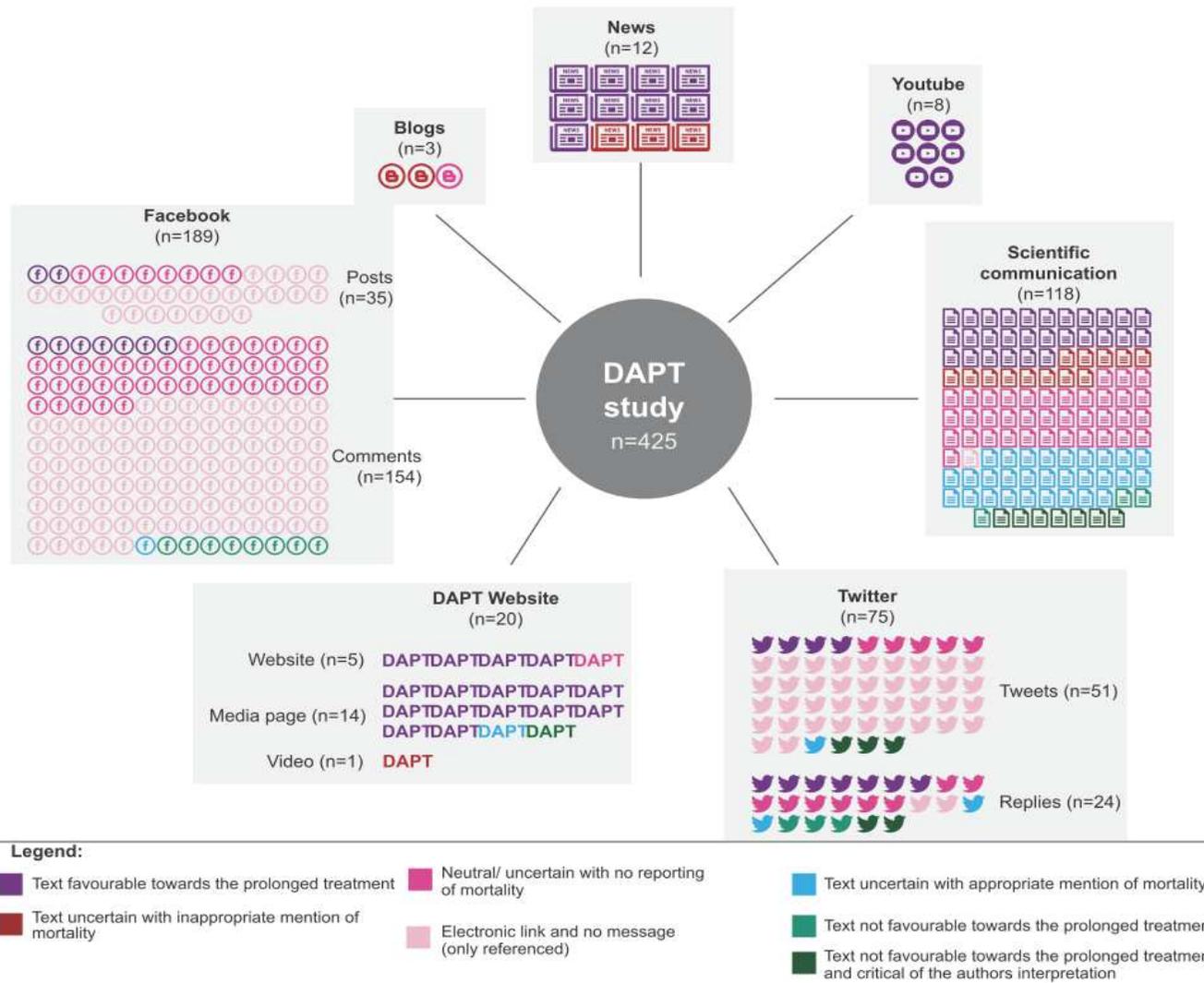
GENERAL DISCUSSION

1.1. Main Results

In this PhD thesis, _first_ we described how research results are distorted in a sample of 130 news items that reported studies evaluating an intervention highlighted in the health section of Google News during a period of six months and developed a classification of spin in health news. Our results showed a substantial distortion of results (i.e., spin) in the headline and the text of a highly disseminated sample of Google health news. We identified 18 different strategies of spin and classified them into three categories: 1. misleading reporting, 2. misleading interpretation, 3. misleading extrapolation. Further, our results highlighted the most commonly used strategies to distort research results in health news were claiming a causal effect despite a non-randomized study, use of linguistic spin or hype, and extrapolation of results from animals to humans. These results showed a huge gap in translation of results from published articles to health news.

Distortion of research results in health news is not a recent issue and had been addressed in some case studies and methodological reviews of articles and their related press releases and news items [9, 31, 32, 35, 39, 54, 87]. Our results are consistent with the evaluation of these studies. It is the first time that all strategies of spin which have been reported in published articles, related press releases and health news, were analyzed and classified to develop a classification of spin for health news.

Secondly, we described the dissemination of 792 articles evaluating cancer treatments published in oncology and medical journals with a diverse range of impact factors from 54.4 to 3.9 and identified factors associated with online media attention. Our results showed that almost one third of these studies received no media attention (i.e., Altmetric score = 0) and only one percent received a high media attention (i.e., Altmetric score > 200). Our results highlighted that there are three principal factors related to publication process associated with high online media attention: journal impact factor, open access and presence of a press-release. The journal impact factor and presence of press release seem to be closely

interdependent to each other. We reran the analysis without entering the press release (because the press release is correlated with journal impact factor) and obtained similar results as with our original model. Our results confirm that these two variables are highly correlated (p<0.001). The mean (SD) impact factor of the journals for articles with and without a press release was 22.7 (14.9) and 8.9 (6.6) respectively. High-impact-factor journals may issue press releases to disseminate the results of published articles more widely to the scientific community and the media. We found no evidence that study design with high level of evidence and type of abstract conclusion were associated with high online media attention.

Previous studies have shown that dissemination of research results through press release is associated with the subsequent publication of newspaper stories [10, 11] and open access to the articles increases the citation counts [88]. For example, a list of 100 articles published in 2015 was issued by Altmetric which received the highest media attention: 42% of these articles had open access [89]. Published articles which are highly disseminated and received most media attention may not be the most scientifically rigorous [60]. Our results are consistent with these studies.

Finally, we described the dissemination of the 2014 DAPT study findings in the scientific community and to the public via different sources such as news, blogs, and social media as a case study. We focused on this trial because the results were reported with spin. Our assessment of 425 items disseminating the DAPT study results showed that only 8% of the items mentioned some uncertainty about the benefit of prolonged treatment and included a mention of the increased risk of mortality which was understated in the article. Furthermore, only 12 items (3%) clearly raised some concerns about the reporting of the increased risk of death.

Our study adds to the burgeoning literature on the biased dissemination of research results and consistent with previous studies which have focused on publication bias [90], selective

reporting of outcomes [33, 90-94], and spin [33, 35, 53]. To our knowledge, this is the

first study to focus on both scholarly and public dissemination of study results.

1.2. Implications

Our results have important implications.

Distortion or misrepresentation of results can have serious consequences on public health such as raising false hope among patients, distrust about new treatments, misguided choices that may put people's health at risk or influence policy makers to adopt inadequate or harmful laws, regulations, or policies.

Our results provide a framework (i.e., classification of spin) to identify and avoid the occurrence of spin in three different forms: misleading reporting (i.e., incomplete or inadequate reporting of any important information in the context of the research that could be misleading for the readers), misleading interpretation (i.e., an interpretation of study results in news stories that is no consistent with the results reported in the scientific articles) and misleading extrapolation (i.e., overgeneralization of study results in news stories to different populations, interventions or outcomes that were not assessed in the study) of results in health news.

This framework has three following implications:

1. Our results raise awareness about how study results are distorted in Google health news and may help lay person to be more vigilant and critical about the reporting of results in health news.

2. This framework may guide researchers and medical journalists to write press releases and health news without spin respectively. As previous studies have shown that spin in press releases is strongly associated with spin in news items [12, 35, 39]. Therefore, to reduce the spin in news, the occurrence of spin should first be reduced in press releases issued by the study authors and editors of medical journals. This framework may help medical journalists to avoid the dissemination of different types of spin in health news.

3. Our framework could be used to develop users' guide and teaching modules for the general public and medical journalists. The users' guide may help the general public to

appraise health news critically. Teaching modules would help journalists for how to appraise scientific articles critically, to translate their results in a balanced language and to avoid disseminating spin in health news.

Our study identified the factors associated with high online media attention and these results have the following implications:

1. Our results showed that study design with high level of evidence is not associated with online media attention; hence online media attention to research does not warrant the high quality of research.

2. We found that factors related to the publication process such as the presence of press release and open access were strongly associated with online media attention. This could have an impact on researchers and academic institutions strategy to enhance the dissemination of their research. Authors should favor open access and may disseminate press releases, to enhance the impact of their research. Previous studies showed that press releases and open access are associated with the subsequent publication of newspaper stories [10, 11].

3. Further, online media attention may influence to increase the citation counts to that research. Gargouri et al. showed that open access to the article increases the citation counts [88]. There is some evidence showing that high online media attention is highly correlated with access to the scientific article and the number of scholarly citations the scientific article will receive [19]. Some studies from the fields of clinical pain [18], urology [15], neurointerventional surgery [2], cardiovascular [95] and emergency medicine [96] have shown that disseminating research on social media will increase their access or views to their readers. Highly cited articles can be predicted by tweets occurring within the first 3 days of article publication [19].

Finally using the 2014 DAPT trials as a case study, we showed that critical opinion on misrepresentation of research results was rare which may raise the need to improve critical thinking about reporting medical research not only in scientific community but also in general public. Further, this study also highlighted an unmet need of scientific communication in the media, whose importance in dissemination of scientific data is becoming increasingly relevant.

In this thesis, we did not explore the causes of spin. Spin in news items arises from a very complex interaction between different stakeholders interacting and sharing important responsibilities. Researchers are responsible for the content of the scientific publication and its communication (interviews etc.); peer-reviewers and editors of scientific journals are responsible for the manuscript evaluation, the identification, deletion or addition of spin; editors and academic institutions are responsible for selecting the articles that will have a press release and the content of the press release; and journalists are responsible for the choice and critical appraisal of the scientific report and the content of news items.

Distortions in scientific literature may arise from ignorance of scientific standards, imitating previous practice, unconscious prejudice, or willful intent to influence readers [43]. Several studies have highlighted that pre-existing conflict of interest (COI) could also motivate researchers to spin their results, which could arise due to financial interests [97-102] or non-financial or private interests [103].

Distortion in the media particularly depends on how the scientific community interacts with the media. Some researchers explored the concept of "medialization of science" to describe an increase in the orientation of science toward the mass media, with the consequence that news factors (i.e., factors guiding journalistic selection) become relevant within the science [104].

There is an adaptation of scientific knowledge to media communication, with the selection of science events for news coverage being based on "news factors". A web-based survey performed in 2005-2006 showed that science–media interactions have changed considerably over time [105]. In this survey, 1354 researchers from epidemiology and stem cell fields were recruited from the United States, Japan, Germany, United Kingdom and France to compare scientists' public communication attitudes and activities [105]. Although 82% of scientists perceived a risk of incorrect quotation in news items, they were mainly neutral when assessing the quality of media coverage of scientific topics in terms of four aspects (accuracy, use of credible sources, presence of a hostile tone and comprehensiveness) [105]. Moreover, scientists most involved in media interactions tend to be scientifically productive, have leadership roles and perceive that interactions with the media have more positive than negative outcomes [105]. Institutions encourage scientists to contact the media to disseminate scientific information and they enhance the visibility of their scientists to journalists. Indeed, it is presumed that a media presence is a universally effective indicator of social relevance. Finally, it is well accepted that media communication is a separate domain with specific rules different from those of the scientific community.

Distortions in news stories may be due to the following constraints on journalists: newspapers have limited space, and because of no reserved slots on news pages for health stories, articles about medical research compete with other stories [13]. This is judged by editors, whose decisions reflect established news values such as the size and impact of an event, its relevance to readers, and the strength of the human interest [106, 107]. Furthermore, journalists are working to tight deadlines and have little time to identify and develop news stories from wide range of potential stories available to them, so they value conveniently packaged information [13]. The most important constraint could be their inability to evaluate the quality of evidence and arguments presented in scientific articles [13].

PERSPECTIVES

Dissemination and communication of research results in media is an important domain and some areas deserve further exploration. Based on the results of our projects, we propose the following prospective projects to explore reporting of results in health news:

1.1. Prospective meta-analysis (MA)

One important question is whether spin matters and may influence readers' interpretation. Our aim is to compare the interpretation of health news items reported with or without spin by different types of population. Our hypothesis is that spin can influence the interpretation of health news items by patients and the public. The objective of this study is to compare the interpretation of health news items reported with or without spin.

We will design a prospective meta-analysis (MA) including a series of 16 randomized controlled trials (RCTs) to perform a MA. Each RCT will be two arms, parallel group and will explore the interpretation of news items reporting one of 4 study designs: 1) pre-clinical studies, 2) phase I/II trials (non-randomized), 3) RCTs, and 4) observational studies. We will focus on news items reporting studies evaluating the effect of a pharmacological treatment that will contain highest number of spin in the headline and text and will receive high online media attention. We will remove the spin, rewrite the selected news items according to spin classification described in project 1 and will report cautions according to the study design reported in the news item. The interventions will include original news items (with spin=active comparator) and rewritten news items (without spin=experimental group) reporting 4 study designs. 4 different targeted populations will be recruited: 1) French-speaking patients, 2) French-speaking general public, 3) English-speaking patients, and 4) English-speaking general public to appraise health news items reported with or without spin *(see below figure 1)*.
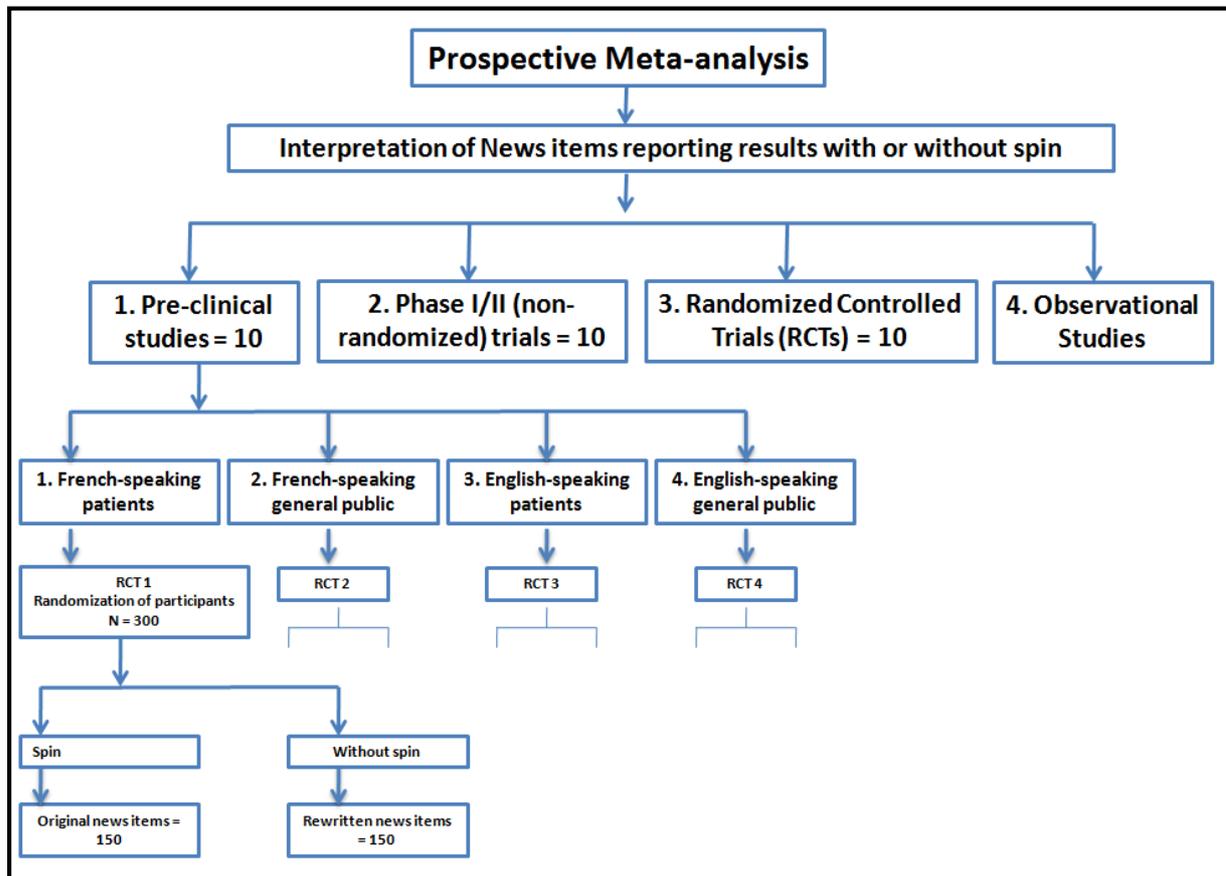
Figure 1: Flow chart of prospective meta-analysis

The primary outcome will be participants' interpretation of benefit of treatment after reading the news items: *(What do you think is the probability that treatment X would be beneficial to the patients?) (Scale, 0[very unlikely] to 10 [very likely])*

This study will evaluate the impact of spin on the interpretation of news items reporting results of studies evaluating pharmacological treatments. This will be the first prospective meta-analysis of randomized controlled trials for interpretation of health news items reporting the results of studies with or without spin. The concept of prospective meta-analysis allows comparing the interpretation of health news reporting results of studies with or without spin by 4 types of populations. This form of synthesis of evidence wills answers the question that whether spin can influence the readers' interpretation of health news.

The protocol is accepted at BMJ Open (see appendix: page 158).

1.2. Mechanisms of spin (i.e., why scientific community generate these distortions?)

Another important question is why authors of the scientific literature and medical journalists add distortions when reporting scientific results and why they ignore them. Our aim will be to explore the motives for adding spin in scientific publications and in news stories. This work will help to understand the mechanism of spin (i.e., causes of spin). For this, we will perform a web-based online survey among researchers, peer-reviewers, editors of press releases and medical journalists. A questionnaire with specific scenarios will be developed to assess motivations for adding spin in the scientific literature, press releases and health news.

1.3. Development of a users' guide and training module

Second, our aim will be to develop a users' guide and training module helping laypersons and medical journalists to improve their knowledge about how medical research is misrepresented in the media such as inadequate reporting of adverse events, use of causal language and overgeneralization of results. This guide will help the general public not get mislead from distorted presentation of research result in media and adopt a cautious attitude in making decisions based on media reports. This guide should be dedicated to patients, care givers, the general public, journalists and public health policy makers.

More training programs for medical journalist to train them how to appraise a scientific article critically should be encouraged. Our classification of spin can help to develop that training program. One could assess that whether medical journalists with training of critical appraisal of scientific articles can write news stories without spin than those without training.

CONCLUSIONS

My PhD thesis explored the dissemination and communication of clinical research results in mass media.

In a sample of highly disseminated health news, we found that the interpretation of research results of studies evaluating an intervention highlighted in health section of Google News was frequently distorted. We developed the classification of spin for health news which can be used as strategic interventions to avoid the occurrence of spin in terms of reporting, interpretation and extrapolation of results.

For dissemination of articles evaluating cancer treatments in media, we found a large variability in online media coverage. We showed that the factors related to publication process such as presence of a press release, open access and journal impact factor were associated with high online media attention. The factors related to study characteristics including study design with high level of evidence and the type of abstract conclusionwere not associated with high online media attention.

Using a case study for the dissemination of the 2014 DAPT study results to the scientific community and on different media sources, we found that the interpretation of the study results was rarely criticized.

These results highlighted the importance of spin in mass media and provided a tool (classification of spin) to improve the dissemination of research results. Further, these results are important not only for the scientific community but also to inform users about how research results are reported and disseminated in mass media.

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Appendix 1: Kappa coefficient for concordance on spin in Google Health News items

Variables	Agreement Percentage	kappa [95%CI]
News with at least one spin (Overall)	89.2	0.653 [0.48 - 0.82]
Misleading Reporting	77.7	0.552 [0.38 - 0.72]
Misleading Interpretation	92.2	0.365 [0.19 -0.53]
Overgeneralization/Misleading Extrapolation	81.5	0.567 [0.39 - 0.73]

Appendix 2: List of the selected news items with referenced scientific articles and relevant news outlets

	Selected Health News and referenced scientific articles				
Studynumber	**Headlines for the news appearing on the main page**	**Titles of interventional study published**	**News outlets**	**Type of news outlet**	**Country**
1	MS damage repair treatment looked by Edinburgh researchers	M2 microglia and macrophages drive oligodendrocyte differentiation during CNS remyelination	BBC	General	UK
2	Big leap' towards curing blindness in stem cell study	Photoreceptor precursors derived from three-dimensional embryonic stem cell cultures integrate and mature within adult degenerate retina	BBC	General	UK
3	Aspirin may reduce colon cancer risk in women	Alternate- Day, Low-Dose Aspirin and Cancer Risk: Long-Term Observational Follow-up of a Randomized Trial	Digital Journal	General	USA
4	ACE Inhibitor drug offer dementia treatment hope	Effects of centrally acting ACE inhibitors on rate of cognitive decline in dementia	The Independent	General	UK
5	Breastfeeding Boosts Smarts as Babies Grow, Study Finds	Infant Feeding and Childhood Cognition at Ages 3 and 7 Years: Effect of Breastfeeding Duration and Exclusivity	Bloomberg	General	USA
6	Pill linked to long life in mice	Metformin improves healthspan and lifespan in mice	BBC	General	UK
7	Eatingbroccoli retunes metabolism	A diet rich in high-glucoraphanin broccoli interacts with genotype to reduce discordance in plasma metabolite profiles by modulating mitochondrial function	Health Canal	Medical	USA

	Cutting off sugar could stop cancer growth	A cyclic peptide inhibitor of C-terminal binding protein dimerization links metabolism with mitotic fidelity in breast cancer cells	The Scotsman	General	UK
8					
9	Face-lifts have minimal effects, according to new study	Objective Assessment of Perceived Age Reversal and Improvement in Attractiveness After Aging Face Surgery	Los Angeles Times	General	USA
10	Big breakfast may aid weight loss	High Caloric Intake at Breakfast vs. Dinner Differentially Influences Weight Loss of Overweight and Obese Women	Spire Healthcare	Medical	UK
11	Choclate may help keep brainhealth, sharp in old age, study says	Neurovascular coupling, cerebral white matter integrity, and response to cocoa in older people	Los Angeles Times	General	USA
12	Breastfeeding for six months can delay breast cancer onset by a decade	Breastfeeding and the prevention of breast cancer: A Retrospective review of clinical histories	The Guardian	General	UK
13	Drink watermelon juice to ease post-exercise muscle soreness	Watermelon Juice: Potential Functional Drink for Sore Muscle Relief in Athletes	Deccan Chronicle	General	India
14	Short-term exercise may not help with insomnia	Exercise to Improve Sleep in Insomnia: Exploration of Bidirectional Effects	Healio	Medical	USA
15	Insulin pumps better than injections for diabetic children	Long-term outcome of Insulin pump therapy in children with type-1 diabetes assessed in a large population-based case-control study	Onmedica	Medical	UK
16	Fish consumption 'linked with reduced risk of rheumatoid arthritis	Long-term intake of dietary long-chain n-3 polyunsaturated fatty acids and risk of rheumatoid arthritis: A prospective cohort study of women	Pulse Today	Medical	UK

17	Quit smoking program helps psychiatric patients, too	Efficacy of Initiating Tobacco Dependence Treatment in Inpatient Psychiatry: A Randomized Controlled Trial	Chicago Tribune	General	**USA**
18	Broccoli slows arthritis, researchers think	Sulphoraphane repress matrix-degrading proteases and protects cartilage from destruction in vitro and in vivo	BBC	General	**UK**
19	Eating fruit significantly cuts diabetes risk-but drinking juice INCREASES it, says study	Fruit consumption and risk of type 2 diabetes: results from three prospective longitudinal cohort studies	The Independent	General	**UK**
20	Glass of wine a day 'lowers depression risk'	Alcohol intake, wine consumption and the development of depression: the PREDIMED Study	The Telegraph	General	**UK**
21	Prostate cancer gold treatment	Treatment-Related Morbidity in Prostate Cancer: A Comparison of 3-Dimentional Conformal Radiation Therapy With and Without Image Guidance Using Implanted Fiducial Markers	NEWCASTLE Herald	General	**Australia**
22	PARIS trial find mode of DAPT cessation plays pivotal role	Cessation of dual antiplatelet treatment and cardiac events after percutaneous coronary intervention(PARIS): 2year results from a prospective observational study	Healio	Medical	**USA**
23	Novartis heart failure drug effective across patient groups	Effects of Serelaxin in subgroups of patients with acute heart failure: results from RELAX-AHF Trial	Reuters	General	**USA**
24	Parents' Goal Guide ADHD Treatment Choice	Parental Preferences and Goals regarding ADHD Treatment	HealthDay	Medical	**USA**
25	Daiichi Sankyo's edoxaban will 'shake things up'	Enoxaban versus Warfarin for the Treatment of Symptomatic Venous Thromboembolism: The Hokusai-VTE Trial	PharmaTimes	Medical	**UK**

26	Simple operation could help millions with high blood pressure	The carotid body as a putative therapeutic target for the treatment of neurogenic hypertension	The Telegraph	General	**UK**
27	For Polypill, Adherence Better Than Outcomes	Effects of a Fixed-Dose Combination Strategy on Adherence and Risk Factors in Patients With or at High Risk of CVD: The UMPIRE Randomized Clinical Trial	MedpageToday	Medical	**USA**
28	U.S. Anti-smoking ads tied to 1.6 million quit attempts	Effect of the first federally funded US antismoking national media campaign	Reuters	General	**USA**
29	E-Cigarette Might Help Smokers Quit	Electronic cigarettes for smoking cessation: A randomized controlled trial	MedpageToday	Medical	**USA**
30	Middle-aged men can blame estrogen for decline in libido	Gonadal Steroids and Body Composition, Strength, and Sexual Function in Men	National Monitor	General	**USA**
31	Diabetics fare better with bypass than stents, review suggests	Comparison of coronary artery bypass surgery and percutaneous coronary intervention in patients with diabetes: a meta-analysis of randomized controlled trials	CBC News	General	**Canada**
32	Exercise has modest effect on depression, study finds	Excercise for Depression (Review)	National Monitor	General	**USA**
33	Health kick 'reverses cell ageing'	Effect of comprehensive lifestyle changes on telomerase activity and telomerase length in men with biopsy-proven low-risk prostate cancer: 5-year follow-up of a descriptive pilot study	BBC	General	**UK**
34	Cattle vaccine could cut human E.coli O157 infections by 85 per cent: study	Predicting the public health benefit of vaccinating cattle against Escherichia Coli 0157	The Vancouver Sun	General	**Canada**

35	New class of drugs targets heart disease	Loss of Apelin Exacerbates Myocardial Infarction Adverse Remodeling and Ischemia-reperfusion Injury: Therapeutic Potential of Synthetic Apelin Analogues	The Indian EXPRESS	General	**India**
36	Money can motivate people to exercise: Study	Financial Incentives for Exercise Adherence in Adults: Systematic Review and Meta-Analysis	Edmonton Sun	General	**UK**
37	E-Readers Makes Reading Easier for Students with Dyslexia	E-Readers Are More Effective than Paper for Some with Dyslexia	Science World Report	General	**USA**
38	Vitamin B supplements might reduce your risk of stroke	Vitamin B supplementation, homocysteine levels, and the risk of cerebrovascular disease: A meta-analysis	CBC News	General	**Canada**
39	Study Affirms Benefit of Back Braces as Scoliosis Treatment	Effect of Bracing in Adolescents with Idiopathic Scoliosis	New York Times	General	**USA**
40	Heart diseases drug statins 'raise the risk of developing cataract by 27%	Association of Statin Use With Cataracts: A Propensity Score-Matched Analysis	Daily Mail Online	General	**UK**
41	Skin drug shows 'promising' results on type 1 diabetes	Targeting of memory T-cells with Alefacept in new-onset type-1 diabetes (T1DAL Study): 12 month results of a randomized, double-blind, placebo-controlled phase 2 trial	BBC	General	**UK**
42	Commonly-prescribed statin may impair memory	Chronic Pravastatin but not Atorvastatin Treatment Impairs Cognitive Function in Two Rodent Models of Learning and Memory	The Telegraph	General	**UK**
43	Antidepressants may up diabetes risk	Antidepressant Medication as a Risk Factor for Type 2 Diabetes and Impaired Glucose Regulation: A Systematic Review	Irish Health	Medical	**Irland**

	Weight loss can help reduce knee pain from arthritis	Effect of Intensive Diet and Exercise on Knee Joint Loads, Inflammation, and Clinical Outcomes Among Overweight and Obese Adults With Knee Osteoarthritis: The IDEA Randomized Clinical Trial	USA Today	General	**USA**
44					
45	Auto-Off Insulin Pump Helps in High-Risk T1D	Effect of Sensor-Augmented Insulin Pump Therapy and Automated Insulin Suspension vs Standard Insulin Pump Therapy on Hypoglycemia in Patients With Type 1 Diabetes: A Randomized Clinical Trial	MedpageToday	Medical	**USA**
46	Daytime Naps Enhance Prescholers' Memory	Sleep spindles in midday naps enhance learning in preschool children	US News	General	**USA**
47	Tackling fears 'while you sleep'	Stimulus-specific enhancement of fear extinction during slow-wave sleep	BBC	General	**UK**
48	Girls who eat peanut butter may improve breast health later in life	Vegetable protein and vegetable fat intakes in pre-adolescent and adolescent girls, and risk for benign breast cancer disease in young women	Washington University in St. Louis News	General	**USA**
49	Stem Cell-Enriched Fat May Improve Plastic Surgery, Study Finds	Enrichment of autologous fat grafts with ex-vivo expanded adipose tissue-derived stem cells for graft survival: a randomized placebo-controlled trial	Bloomberg Business	General	**USA**
50	Eating fish may not help with memory, thinking skills	Omega-3 fatty acids and domain-specific cognitive aging: Secondary analysis of data from WHISCA	USA Today	General	**USA**
51	Study of Hormone Use in Menopause Reaffirms Complex Mix of Risks and Benefits	Menopausal Hormone Therapy and Health Outcomes During the Intervention and Extended Poststopping Phases of the Women's Health Initiative Randomized Trials	The New York Times	General	**USA**

52	Exercise 'can be as good as pills'	Comparative effectiveness of exercise and drug interventions on mortality outcomes: metaepidemiological study	BBC	General	**UK**
53	Blood pressure drug 'fights cancer'	Angiotensin inhibition enhances drug delivery and potentiates chemotherapy by decompressing tumour blood vessels	BBC	General	**UK**
54	Leisure-Time Exercise Could Lower Your Risk of High Blood Pressure	Physical Activity and risk of Hypertension	Science Daily	General	**USA**
55	Walking cuts risk of breast cancer, says new study	Recreational Physical Activity and Leisure-Time Sitting in Relation to Postmenopausal Breast Cancer Risk	Independent.ie	General	**Irland**
56	High-dose statin may reduce gum inflammation	High Dose Atorvastatin Reduces Periodontal Inflammation: A Novel Pleiotropic Effect of Statins	Medical News Today	Medical	**UK**
57	New cholesterol drug without the side-effects	Effect of an RNA interference drug on the synthesis of proprotein convertase subtilisin/kexin type 9(PCSK9) and the concentration of serum LDL cholesterol in healthy volunteers: a randomized, single-blind, placebo-controlled, phase 1 trial	South Asia Mail	General	**India**
58	Gloves and gowns use in ICU not completely effective against infection, says study	Universal Gloves and Gown Use and Acquisition of Antibiotics-Resistant Bacteria in the ICU: A Randomized Trial	Pentagon Post	General	**USA**
59	Probiotics may help combat colic, but evidence mixed	Probiotics to Prevent or Treat Excessive Infant Crying: Systematic Review and Meta-analysis	Reuters	General	**USA**
60	No Signs That Vitamin D Supplements Help Aging Bones: Study	Effect of vitamin D supplements on bone mineral density: a systematic review and meta-analysis	HealthDay	Medical	**USA**

61	Scientists Hail Major Breakthrough in Treating Alzheimers's in Mice	Oral Treatment Targeting the Unfolded Protein Response Prevents Neurodegeneration and Clinical Disease in Prion-Infected Mice	Health-TIME	General	**USA**
62	Is Sprite the cure for your hangover woes?	Effect of Herbal Infusion, Tea and Carbonated Beverage on Alcohol Dehydrogenase and Aldehyde Dehydrogenase Activities	CBS News	General	**USA**
63	Exercise may ward off Alzheimer'sand Parkinson's	Exercise Induces Hippocampal BDNF through a PGC-1α/FNDC5 Pathway	Medical News Today	Medical	**UK**
64	Red Wine Compound Makes Tumor Cells More Susceptible to Radiation Treatment	A potential role for resveratrol as a radiation sensitizer for melanoma treatment	RTT News	General	**USA**
65	Cabbage compound protects health tissues from radiation damage	DIM (3,3'-diindolymethane) confers protection against ionizing radiation by a unique mechanism	Medical News Today	Medical	**UK**
66	Popular Morning Sickness Drug Safe in Pregnancy: Study	Metoclopramide in Pregnancy and Risk of Major Congenital Malformation and Fetal Death	WebMD	Medical	**USA**
67	Bypass May Beat Angioplasty for Diabetics With Heart Disease	Quality of Life After PCI vs CABG Among Patients With Diabetes and Multivessel Coronary Artery Disease: A Randomized Clinical Trial	HealthDay	Medical	**USA**
68	Study: Vitamin D Supplements May Not Raise Risk for Kidney Stones	25-Hydroxyvitamin D in the Range of 20 - 100ng/ml and Incidence of Kidney Stone	WebMD	Medical	**USA**
69	Sleep 'Detoxes' The Brain, New Research Suggests	Sleep Drives Metabolite Clearance from the Adult Brain	Forbes News	General	**USA**
70	Delaying baby's first measles shot may afford greater protection, study finds	Measles in Children Vaccinated With 2 Doses of MMR	Thestar.com	General	**Canada**

71	Cognitive behavioral therapy 'effective' for health anxiety	Clinical and cost-effectiveness of cognitive behaviour therapy for health anxiety in medical patients: a multicentre randomized controlled trial	Medical News Today	Medical	**UK**
72	Flu shot lessens chance of heart attack, stroke	Association Between Influenza Vaccination and Cardiovascular Outcomes in High- Risk Patients : A Meta-analysis	Thestar.com	General	**Canada**
73	Weight-Loss Surgery Beats Obesity Better Than Diet, Exercise	Bariatric surgery versus non-surgical treatment for obesity: a systematic review and meta-analysis of randomized controlled trials	Bloomberg Business	General	**USA**
74	New Technique Holds Promise for Hair Growth	Microenviromental reprogramming by three-dimensional culture enables dermal papilla cells to induce de novo human hair-follicle growth	The New York Times	General	**USA**
75	Love Hormone' May Mediate Placebo Effect	Effect of Oxytocin on Placebo Analgesia: A Randomized Study	MedpageToday	Medical	**USA**
76	Mindfulness therapy doesn't lower blood pressure, Canadian study finds	Hypertension Analysis of Stress Reduction Using Mindfulness Meditation and Yoga: Results From the Harmony Randomized Controlled Trial	Calgary Herald	General	**Canada**
77	Verona Pharma says RPL554 Drug Trial Positive	Efficacy and safety of RPL554, a dual PDE3 and PDE4 inhibitor, in healthy volunteers and in patients with asthma or chronic obstructive pulmonary disease: finding from four clinical trials	London South East News	General	**UK**
78	Buprenorphine Works in Initial Opiod Detox	A Randomized, Double-blind Evaluation of Buprenorphine Taper Duration in Primary Prescription Opioid Abusers	MedpageToday	Medical	**USA**

79	UBC study shows drug may reduce compulsive gambling	A Selective Role for Dopamine D4 Receptors in Modulating Reward Expectancy in a Rodent Slot Machine Task	The Vancouver Sun	General	**Canada**
80	Gardening as good as exercise in cutting heart attack risk, study shows	The importance of non-exercise physical activity for cardiovascular health and longevity	The Guardian	General	**UK**
81	Improving gum health may reduce heart attack	Changes in Clinical and Microbiological Periodontal Profiles Relate to Progression of Carotid Intima-Media Thickness: The Oral Infections and Vascular Disease Epidemiology Study	Medical News Today	Medical	**UK**
82	HPV Vaccine: One Dose May Be Enough	Durable Antibody Responses Following One Dose of the Bivalent Human Papillomavirus L1 Virus-Like Particle Vaccine in the Costa Rica Vaccine Trial	Live Science	General	**USA**
83	Testosterone medication may boost risk of heart attack, stroke, death	Association of Testosterone Therapy With Mortality, Myocardial Infarction, and Stroke in Men With Low Testosterone Levels	Los Angeles Times	General	**USA**
84	Mediterranean-diet-style eating may improve health in later life	The Association Between Dietary Patterns at Midlife and Health in Aging	Washington Post	General	**USA**
85	Kids Who Add Sleep Can Subtract Pounds, Study Suggests	Changes in Children's Sleep Duration on Food Intake, Weight, and Leptin	U.S.News	General	**USA**
86	Bio patch regenerates missing or damaged bone	The enhancement of bone regeneration by gene activated matrix encoding for platelet derived growth factor	Medical News Today	Medical	**UK**
87	Exercise boosts memory in adults 50 and older	Shorter term aerobic exercise improves brain, cognition, and cardiovascular fitness in aging	CBC News	General	**Canada**
88	Zinc helps reduce bacterial infection	Imperfect coordination chemistry facilitates metal ion release in the Psa permease	Digital Journal	General	**Canada**

89	Take long walks to reduce your risk of stroke	Protective Effect of Time Spent Walking on Risk of Stroke in Older Men	Saga	General	**UK**
90	Go nuts: Study ties nuts to a lower risk of death, including from heart disease or cancer	Association of Nut Consumption with Total and Cause-Specific Mortality	CTV News	General	**Canada**
91	Exercise helps pregnant women quit smoking-study	The effects of acute exercise on tobacco cravings and withdrawal symptoms in temporarily abstinent pregnant smokers	Eyewintness News	General	**South Africa**
92	Telemedicines May Reduce Doctor Errors for Kids in Rural EDs	Telemedicine Consultations and Medication Errors in Rural Emergency Departments	Medscape	Medical	**USA**
93	Exercise later in life can significantly increase healthy ageing	Taking up physical activity in later life and healthy ageing: the English longitudinal study of ageing	WalesOnline	General	**UK**
94	Higher clot risk seen with Thoratec heart pump: study	Unexpected Abrupt Increase in Left Ventricular Assist Device Thrombosis	Reuters	General	**UK**
95	Corals could hold key to future bone grafting procedures	Characterization of a biodegradable coralline hydroxyapatite/calcium carbonate composite and its clinical implementation	Zee News	General	**India**
96	Oxygen deprivation could help improve mobility for patients with spinal injuries: study	Daily intermittent hypoxia enhances walking after chronic spinal cord injury: A randomized trial	CTV News	General	**Canada**
97	Low vitamin D levels may damage brain	Dietary vitamin D deficiency in rats from middle to old age leads to elevated tyrosine nitration and proteomics changes in levels of key proteins in brain: Implication for low vitamin D-dependent age-related cognitive decline	Health Central	Medical	**USA**
98	Exercise can help demential patients	Exercise programs for people with dementia (Review)	THE TIMES OF INDIA	General	**India**

99	Love hormone' could help autistic children: study	Oxytocin enhances brain function in children with autism	NEW YORK POST	General	**USA**
100	Certain diabetes drugs reduce cancer risk in women, study finds	Gender-specific effects of oral hypoglycaemic agents on cancer risk in type 2 diabetes mellitus	Los Angeles Times	General	**USA**
101	Doubt cast on vitamin D's role against disease	Vitamin D status and ill health: a systematic review	BBC	General	**UK**
102	New study suggests computer games may help older adults with walking	Impact of Cognitive Training on Balance and Gait in Older Adults	Justice News Flash	General	**USA**
103	Menstrual cramps relieved by erectile dysfunction drug	Sildenafil citrate in the treatment of pain in primary dysmenorrhea: a randomized controlled trial	Medical News Today	Medical	**UK**
104	Contact lenses can deliver glaucoma drugs for a month	In vivo performance of a drug-eluting contact lens to treat glaucoma for a month	Medical News Today	Medical	**UK**
105	Brain cancer treatment may lie in reactivating immune cells	Therapeutic activation of macrophages and microglia to suppress brain tumor-initiating cells	Medical News Today	Medical	**UK**
106	Exercise 'significant role' o, reducing risk of dementia, long-term study finds	Healthy Lifestyles Reduce the Incidence of Chronic Diseases and Dementia: Evidence from the Caerphilly Cohort Study	BBC	General	**UK**
107	Stomach acid drugs may increase vitamin deficiency risk	Proton Pump Inhibitor and Histamine 2 Receptor Antagonist Use and Vitamin B12 Deficiency	Reuters	General	**UK**
108	Australian researchers find drug to prevent breast cancer	Anastrozole for prevention of breast cancer in high-risk postmenopausal women (IBIS-II): an international, double-blind, randomized placebo-controlled trial	Business Standard	General	**India**

109	Protein Could Help in Prostate Cancer Treatment	A novel prostate acid phosphatase-based peptide vaccination strategy induces antigen-specific T-cell responses and limits tumour growth in mice	News TonightAfrica	General	**South Africa**
110	Study: Exercise For Better Sex	Exercise Improves Sexual Function in Women Taking Antidepressants: Results From A Randomized Crossover Trial	LATIN POST	General	**USA**
111	Big breakthrough in cure for blindness	Adult rat retinal ganglion cells and glia can be printed by piezoelectric inkjet printing	THE TIMES OF INDIA	General	**India**
112	An Apple A Day Keeps Heart Attacks And StrokesAt Bay, Study Finds	A statin a day keeps the doctor away: comparative proverb assessment modelling study	HEALINES & GLOBAL NEWS	General	**USA**
113	Extra quarter ounce of fibre could be the secret to avoiding heart attack	Dietary fibre intake and risk of cardiovascular disease: systematic review and meta-analysis	The Telegraph	General	**UK**
114	Tomatoes may help fight breast cancer	Effects of Tomato and Soy on Serum Adipokine Concentrations in Postmenopausal Women at Increased Breast Cancer Risk: A Cross-Over Dietary Interventional Trial	iol Lifestyle	General	**South Africa**
115	Sleep protects your brain: study	Sleep Deprivation increases serum levels of NSE and S-100B in healthy young men	Geo News	General	**Pakistan**
116	Fibre rich diet may ward off asthma	Gut microbiota metabolism of dietary fiber influences allergic airway disease and hematopoiesis	THE FINANCIAL EXPRESS	General	**India**
117	Vitamin D boots strength of children	Maternal Antenatal Vitamin D Status and Offspring Muscle Development: Findings from the Southampton Women's Survey	heraldscotland	General	**UK**
118	Expectorant mom regularly eating nuts may lower baby's nut allergy risk	Prospective study of Peripregnancy Consumption of Peanuts or Tree Nuts by Mothers and the Risk of Peanut or Tree Nut Allergy in Their Offspring	English.News.cn	General	**China**

119	New 'sticky balls' treatment may help stop spread of cancer	Trail-coated leukocytes that kill cancer cells in the circulation	Zee News	General	**India**
120	Gene therapy might offer hope in Parkisnon's	Long-term safety and tolerability of ProSavin, a lentiviral vector-based gene therapy for Parkinson's disease: a dose escalation, open-label, phase 1/2 trial	Onmedica	Medical	**UK**
121	Avocado with lunch may help with weight management	A randomized 3x3 crossover study to evaluate the effect of Hass avocado intake on post-ingestive satiety, glucose and insulin levels, and subsequent energy intake in overweight adults	Medical News Today	Medical	**UK**
122	Study uses stem cells to help treat drug-resistant TB	Autologous mesenchymal stromal cell infusion as adjunct treatment in patients with multidrug and extensively drug-resistant tuberculosis: an open-label phase 1 safety trial	BusinessDay Live News	General	**South Africa**
123	Moderate Coffee Consumption does Not Cause Dehydration, Study	No Evidence of Dehydration with Moderation Daily Coffee Intake: A Counterbalanced Cross-Over Study in a Free-Living Population	Science World Report	General	**USA**
124	CaffeineEnhances Memory	Post-study caffeine administration enhances memory consolidation in humans	Laboratory EQUIPMENT News	General	**USA**
125	Alternative Treatments for Autism Patients Common	Utilization Patterns of Conventional and Complementary/Alternative Treatments in Children with Autism Spectrum Disorders and Developmental Disabilities in a Population-Based Study	Science World Report	General	**USA**
126	Brain training helped older adults stay sharp for years, study finds	Ten-Year Effects of the Advanced Cognitive Training for Independent and Vital Elderly Cognitive Trial on Cognition and Everyday Functioning in Older Adults	Fox NEWS	General	**USA**

127	Pump it up! Weightlifting 'cuts diabetes risk in women'	Muscle-Strengthening and Conditioning Activities and Risk of Type 2 Diabetes: A Prospective study in Two cohorts of US Women	BBC	General	**UK**
128	Radiation for prostate cancer may lead to more complications than surgery: study	Incidence of complications other than urinary incontinence or erectile dysfunction after prostatectomy or radiotherapy for prostate cancer: A population-based cohort study	CityNews	General	**Canada**
129	Gluten-Free Diet May Help Protect With Celiac Disease	Persistent Mucosal Damage and Risk of Fracture in Celiac Disease	WebMD	Medical	**USA**
130	Microparticles may reduce heart attack damage	Therapeutic Inflammatory Monocyte Modulation Using Immune-Modifying Microparticles	THE TIMES OF INDIA	General	**India**

Paper 2: Factors associated with online media attention to research: A cohort study of articles evaluating cancer treatments

Appendix 1: Kappa coefficients for concordance in screening title and abstracts of articles (n = 200)

Items	Kappa	95%CI
Study design	0.95	[0.91;0.98]
Cancer type by organ	0.98	[0.96;1.00]
Type of treatment	0.98	[0.96;1.00]
Sample size reported (Y/N)	0.89	[0.80;0.98]
Type of abstract conclusion	0.94	[0.90;0.98]
Funding source	0.93	[0.89;0.97]
Open access to the article (Y/N)	0.94	[0.90;0.99]

Appendix 2: Criteria to calculate the Altmetric score

It is a standardized score and is calculated based on three criteria: first is *Volume;* that how many people are mentioning that article. The score for an article rises as more people mention it and it counts only 1 mention from each person per source. Second is *Source;* each source contributes a different base amount to the final score, e.g. a newspaper article contributes more than a blog post which contributes more than a tweet. Third is the *Author* of each mention that who mentioned the published articles, at whether or not there is any bias towards a particular journal or publisher and who the audience is; for example a doctor sharing a link with other doctors counts for far more than a journal account pushing the same link out automatically [62]. If Altmetric score is zero, it means, the article did not receive any public attention.

The score is a weighted count.

The score is derived from an automated algorithm, and represents a weighted count of the amount of attention which have picked up for a research output. Why is it weighted? To reflect the relative reach of each type of source. It's easy to imagine that the average newspaper story is more likely to bring attention to the research output than the average tweet. This is reflected in the default weightings:

News	8
Blogs	5
Twitter	1
Facebook	0.25

Sina Weibo	1
Wikipedia	3
Policy Documents (per source)	3
Q&A	0.25
F1000/Publons/Pubpeer	1
YouTube	0.25
Reddit/Pinterest	0.25
LinkedIn	0.5

The Altmetric score always has to be a whole number. This means that mentions that contribute less than 1 to the score sometimes get rounded up to one. So, if we picked up one Facebook post for a paper, the score would increase by 1, but if we picked up 3 more Facebook posts for that same article, the score would still only increase by 1. (LinkedIn and Pinterest have deprecated as sources, as they started putting more of their content behind login pages, which made it more difficult for us to pick up mentions from them).

									Journals including the selected articles / Description of some selected articles with Altmetric score							
S/No	Type of Journal	Full Journal Title	Total Cites	Journal Impact Factor	Eigenfactor Score	Total No of Articles	Included articles	Excluded articles	Altmetric Score on May 1, 2015	PMIDs	Study design	Cancer type	Type of treatment	Type of conclusion	Fudning source	Open access to the article
1	Cancer	CA-A CANCER JOURNAL FOR CLINICIANS	16130	162,50	0,0603	18	0	18								
2	Medical	NEW ENGLAND JOURNAL OF MEDICINE	257469	54,42	0,65797	13	6	7	191	24597866	RCT	Prostate	Surgery	In favour	Non-profit	Yes
3	Medical	LANCET	176528	39,21	0,38061	24	9	15	370	24333009	RCT	Breast	Hormone therapy	In favour	Profit	Yes
4	Cancer	NATURE REVIEWS CANCER	36052	37,91	0,11207	39	0	39								
5	Medical	JAMA-JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION	124822	30,39	0,25083	14	3	11	89	24715074	SR/MA	Lungs	Chemotherapy	In favour	Non-profit	Yes
6	Medical	NATURE MEDICINE	60002	28,05	0,16292	9	0	9								
7	Cancer	The Lancet, Oncology	20565	24,73	0,09311	96	58	38	88	24332238	RCT	Digestive system	Chemotherapy	In favour	Non-profit	Yes
8	Cancer	JOURNAL OF CLINICAL ONCOLOGY	130991	17,96	0,37162	235	121	114	428	24470004	RCT	Breast	Supportive care	In favour	Non-profit	Yes
9	Medical	BMJ-British Medical Journal	85434	16,38	0,15994	20	7	13	286	24916719	Observationalstudy	Breast	Supportive care	In favour	Non-profit	Yes
10	Medical	ANNALS OF INTERNAL MEDICINE	47309	16,10	0,10256	15	0	15								
11	Cancer	Nature ReviewsClinicalOncology	3523	15,70	0,02285	42	0	42								
12	Medical	AnnualReview of Medicine	5560	15,48	0,0148	11	0	11								
13	Cancer	JNCI-Journal of the National Cancer Institute	37903	15,16	0,07242	96	10	86	319	24563519	Observationalstudy	Prostate	Supportive care	Against	Profit	Yes
14	Medical	Science TranslationalMedicine	9222	14,41	0,06994	22	1	21	131	24760190	Observationalstudy	Digestive system	Supportive care	In favour	Non-profit	Yes

#	Field	Journal							#	PMID	Study type	Site	Treatment	Direction	Funding	
15	Medical	PLOS MEDICINE	16975	14,00	0,07366	5	0	5								
16	Medical	JOURNAL OF EXPERIMENTAL MEDICINE	64191	13,91	0,13866	5	0	5								
17	Medical	JOURNAL OF CLINICAL INVESTIGATION	96908	13,77	0,19342	55	0	55								
18	Medical	ARCHIVES OF INTERNAL MEDICINE	39734	13,25	0,08546	0	0	0								
19	Cancer	CANCER RESEARCH	142970	9,28	0,25797	358	3	355	15	24795429	Observational study	Brain	Others	In favour	Non-profit	Yes
20	Cancer	CLINICAL CANCER RESEARCH	68311	9,14	0,01322	269	42	227	66	24443618	RCT	Breast	Others	In favour	Profit	Yes
21	Medical	BMC Medicine	4052	7,28	0,01736	9	2	7	5	24479409	RCT	Digestive system	Others	In favour	Non-profit	Yes
22	Cancer	ANNALS OF ONCOLOGY	24363	6,58	0,07518	143	57	86	25	24504442	Phase I/II, non-RCTs	Others	Chemotherapy	In favour	Non-profit	Yes
23	Cancer	CANCER TREATMENT REVIEWS	4867	6,47	0,01412	103	16	87	8	24268442	SR	Lungs	Supportive care	In favour	Not reported	No
24	Medical	Cochrane Database of Systematic Reviews	39856	5,94	0,13531	14	12	2	19	24414552	SR	Others	Supportive care	In favour	Non-profit	Yes
25	Cancer	Breast cancer research : BCR	8270	5,88	0,02823	27	3	24	5	24745601	SR/MA	Breast	Supportive care	In favour	Not reported	Yes
26	Medical	MAYO CLINIC PROCEEDINGS	9716	5,81	0,01906	16	1	15	129	24958698	Observational study	Others	Supportive care	In favour	Non-profit	Yes
27	Medical	CANADIAN MEDICAL ASSOCIATION JOURNAL	12130	5,81	0,02479	0	0	0								
28	Cancer	Journal of thoracic oncology : official publication of the International Association for the Study of Lung Cancer	8282	5,80	0,03949	113	37	76	74	24445595	Observational study	Lungs	Others	In favour	Non-profit	Yes
29	Medical	JOURNAL OF INTERNAL MEDICINE	8511	5,79	0,01698	4	0	4								
30	Medical	AMERICAN JOURNAL OF MEDICINE	22679	5,30	0,02806	8	3	5	11	24384102	SR	Others	Others	Neutral	Non-profit	No
31	Cancer	NEURO-ONCOLOGY	4478	5,29	0,01733	59	9	50	5	24627236	Observational study	Brain	Others	Neutral	Non-profit	Yes
32	Cancer	Cancer Prevention Research	4033	5,27	0,02136	0	0	0								

#	Category	Journal								PMID	Study type	Organ	Treatment	Result	Funding	
33	Cancer	INTERNATIONAL JOURNAL OF CANCER	46009	5,01	0,09896	586	73	513	226	24470442	Observationalstudy	Breast	Supportive care	In favour	Non-profit	Yes
34	Cancer	Journal of Hematology&Oncology	1124	4,93	0,00451	40	7	33	4	24642247	Phase I/II, non-RCTs	Blood	Chemotherapy	In favour	Profit	Yes
35	Cancer	ENDOCRINE-RELATED CANCER	4977	4,91	0,01333	82	6	76	1	24174370	Observationalstudy	Breast	Supportive care	In favour	Non-profit	Yes
36	Cancer	CANCER	62604	4,90	0,10396	319	79	240	214	24375332	RCT	Breast	Hormone therapy	In favour	Non-profit	Yes
37	Cancer	RADIOTHERAPY AND ONCOLOGY	12480	4,86	0,03161	48	15	33	7	24906626	Observationalstudy	Liver	Radiotherapy	In favour	Non-profit	No
38	Cancer	Gastric Cancer	2089	4,83	0,00434	75	25	50	3	24122094	Phase I/II, non-RCTs	Digestive system	Radiotherapy	In favour	Non-profit	Yes
39	Cancer	EUROPEAN JOURNAL OF CANCER	23038	4,82	0,05583	241	58	183	42	24613622	Meta-analysis	Breast	Supportive care	In favour	Non-profit	No
40	Cancer	BRITISH JOURNAL OF CANCER	39150	4,82	0,07834	441	84	357	180	24675385	Observationalstudy	Others	Supportive care	In favour	Non-profit	Yes
41	Medical	ANNALS OF MEDICINE	3825	4,73	0,0086	8	1	7	1	24491173	systematic Reviw	Others	Supportive care	Neutral	None	No
42	Medical	ANNALS OF FAMILY MEDICINE	2896	4,57	0,01042	2	0	2								
43	Cancer	CANCER EPIDEMIOLOGY BIOMARKERS & PREVENTION	20408	4,32	0,0506	91	14	77	13	24526287	Observationalstudy	Others	Supportive care	In favour	Non-profit	Yes
44	Medical	AMERICAN JOURNAL OF PREVENTIVE MEDICINE	14189	4,28	0,03661	25	0	25								
45	Cancer	BREAST CANCER RESEARCH AND TREATMENT	16303	4,20	0,05379	170	22	148	17	24554388	RCT	Breast	Supportive care	In favour	Non-profit	Yes
46	Medical	Journal of TranslationalMedicine	3947	3,99	0,01574	57	8	49	3	24708624	Phase I/II, non-RCTs	Digestive system	Others	In favour	Non-profit	Yes
47	Medical	JOURNAL OF GENERAL INTERNAL MEDICINE	13142	3,42	0,03268	11	0	11								
						4038	**792**	**3246**								

Paper 3: "Dissemination of 2014 Dual Anti-Platelet Therapy (DAPT) trial results: A systematic review of scholarly and media attention over 7 months"

Appendix 1: Detail of 118 Scientific communications

S/No	First Author	Year	Title	Journal	Type of scientific contribution
1	Abo-salem	2015	Optimal duration of dual antiplatelet therapy after drug eluting stents: Meta-analysis of randomized trials	CardiovascularTherapeutics	Article
2	Alfredsson	2015	Balancing the risks and benefits of long-term antiplatelet therapies for cardiovascular disease: clinical, research, and regulatory implications	J Am Heart Association	Editorial
3	AlJaroudi	2014	Review of CardiovascularLiterature	Journal of nuclearcardiology	Review
4	Angoulvant	2015	Dual antiplatelet therapy after acute coronary syndrome: a cardiologist-based optimal decision	Heart	Editorial
5	Aradi	2015	ATLANTIC: another reason to investigate the disconnect between stent thrombosis and mortality?	Thromosis&Haemostatis	Editorial
6	Auer	2015	Dual antiplatelet therapy duration and mortality	Lancet	Commentary
7	Becker	2015	Are at Least 12 Months of Dual Antiplatelet Therapy Needed for All Patients With Drug-Eluting Stents? Not All Patients With Drug-Eluting Stents Need at Least 12 Months of Dual Antiplatelet Therapy	Circulation	Editorial
8	Binder	2015	Duration of dual antiplatelet therapy after coronary artery stenting: where is the sweet spot between ischaemia and bleeding?	EuropeaonHeart Journal	Editorial
9	Biondi-Zoccai	2015	Noncompliance and Cessation of Dual Antiplatelet Therapy After Coronary Stenting Looking at the Speck Rather Than Noticing the Log?	JACC-Cardiovascular Interventions	Editorial
10	Bonaca	2015	Long-term use of ticagrelor in patients with prior myocardial infarction	NEJM	Article

11	Brener	2015	Are at Least 12 Months of Dual Antiplatelet Therapy Needed for All Patients With Drug-Eluting Stents? All Patients With Drug-Eluting Stents Need at Least 12 Months of Dual Antiplatelet Therapy	Circulation	Editorial
12	Byrne	2015	Bioresorbable Drug-Eluting Stents: An Immature Technology in Need of Mature Application	JACC: Cardiovascular Interventions	Editorial
13	Capodanno	2015	What about the risk of thrombosis with bioresorbable scaffolds?	Eurointervention	Review
14	Capodanno	2015	Triple antithrombotic therapy in atrial fibrillation patients with acute coronary syndromes or undergoing percutaneous coronary intervention or transcatheter aortic valve replacement	Eurointervention	Editorial
15	Capodanno	2015	Impact of bridging with perioperative low-molecular-weight heparin on cardiac and bleeding outcomes of stented patients undergoing non-cardiac surgery	Thrombosis and Haemostasis	Article
16	Cassese	2015	Prolonged dual antiplatelet therapy after drug-eluting stenting: meta-analysis of randomized trials	ClinicalResearch in Cardiology	Article
17	Chow	2015	Drug-coated balloons: a novel advance in the percutaneous treatment of coronary and peripheral artery disease	InterventionalCardiology	Review
18	Cohen	2015	Long-term outcomes in high-risk patients with non-ST-segment elevation myocardial infarction	Journal of thrombosis and thrombolysis	Review
19	Collet	2015	Dual antiplatelet treatment after stenting–Authors' reply	The Lancet	Commentary
20	Colombo	2014	Dual Antiplatelet Therapy after Drug-Eluting Stents — How Long to Treat?	NEJM	Editorial
21	Cortese	2015	Drug-Coated Balloon angioplasty: an intriguing alternative for the treatment of Coronary Chronic Total Occlusions	International journal of cardiology	Letter
22	Costa	2015	Perspectives on the 2014 ESC/EACTS Guidelines on Myocardial Revascularization	Journal of cardiovascular translational research	Review
23	Costa	2015	Impact of clinical presentation on ischaemic and bleeding outcomes in patients receiving 6-or 24-month duration of dual-antiplatelet therapy after stent implantation: a pre-specified analysis from the PRODIGY (Prolonging Dual-Antiplatelet Treatment After Grading Stent-Induced Intimal Hyperplasia) trial	EuropeanHeart Journal	Article

24	Crea	2015	Sex differences in mechanisms, presentation and management of ischaemic heart disease	Atherosclerosis	Review
25	Cutlip	2014	Antiplatelet therapy after coronary artery stenting	UpToDate, Waltham, MA	Review
26	Curzen	2015	Prolonged antiplatelet therapy after drug-eluting stents	The Lancet	Commentary
27	de la Torre Hernandez	2015	Dual Antiplatelet Therapy for 6 Months vs 12 Months After New-generation Drug-eluting Stent Implantation: Matched Analysis of ESTROFA-DAPT and ESTROFA-2	RevistaEspañola de Cardiología (English Edition)	Article
28	De Rango	2015	Dual Antiplatelet Therapy after Carotid Stenting: Lessons from'Big Brother'	European journal of vascular and endovascular surgery: the official journal of the European Society for Vascular Surgery	Editorial
29	Dhall	2014	Truth Vs hype	NEJM	Commentary
30	Dohan	2015	Duration of Dual Antiplatelet Therapy after Drug-Eluting Stents	NEJM	Commentary
31	Eisen	2015	Antiplatelet therapy: Defining the optimal duration of DAPT after PCI with DES	Nat RevCardiol	Others
32	Elmariah	2015	Extended duration dual antiplatelet therapy and mortality: a systematic review and meta-analysis	The Lancet	Article
33	Fanari	2015	Cost Effectiveness of Antiplatelet and Antithrombotic Therapy in The Setting of Acute Coronary Syndrome: current perspective and literature review	American Journal of Cardiovascular Drugs	Review
34	Fareed	2015	Antithrombotic therapy in 2014: Making headway in anticoagulant and antiplatelet therapy	Nature ReviewsCardiology	Review
35	Fiedler	2015	Duration of Triple Therapy in Patients Requiring Oral Anticoagulation After Drug-Eluting Stent Implantation The ISAR-TRIPLE Trial	Journal of the American College of Cardiology	Article
36	Genereux	2015	Stent Thrombosis and Dual Antiplatelet Therapy Interruption With Everolimus-Eluting Stents Insights From the Xience V Coronary Stent System Trials	Circulation: CardiovascularInterventions	Article

37	Gilard	2015	Double Antiplatelet Therapy Duration: Standardize or Personalize?	Journal of the American College of Cardiology	Editorial
38	Gilchrist	2015	Vignettes of DES Failure	Catheterization and Cardiovascular Interventions	Editorial
39	Giustino	2015	Duration of Dual Antiplatelet Therapy After Drug-Eluting Stent Implantation: A Systematic Review and Meta-Analysis of Randomized Controlled Trials	Journal of the American College of Cardiology	Article
40	Gupta	2014	Balancing ischemia vs. bleeding-- Jury still out.	NEJM	Commentary
41	Gupta	2014	Dual antiplatelets :Walking on a tight rope	NEJM	Commentary
42	Habib	2015	Endothelialization of drug eluting stents and its impact on dual anti-platelet therapy duration	PharmacolRes	Review
43	Henderson		Primecuts–This Week In The Journals	ClinicalCorrelations	Others
44	Hernandez	2015	2014 Update on InterventionalCardiology	RevistaEspañola de Cardiología	Review
45	Huang	2015	Is the Duration of Dual Antiplatelet Therapy after Implantation of Drug-Eluting Stents the Longer the Better	Medical Principles and Practice	Letter
46	Husted	2015	Antithrombotic therapy for long-term secondary prevention of acute coronary syndrome in high-risk patients	Therapeutics and clinical risk management	Review
47	Huynh	2015	Antiplatelet therapy: Risks and benefits of extended DAPT after stenting	Nat RevCardiol	Others
48	Iqbal	2015	The year in cardiology 2014: coronary intervention	EuropeanHeart Journal	Review

49	Kumana	2015	Absolute benefits and harms of dual antiplatelet therapy after drug eluting stenting	Hong Kong Medical Journal	Article
50	Keaney	2015	Balancing the Risks and Benefits of Dual Platelet Inhibition	NEJM	Editorial
51	Kereiakes	2015	Efficacy and Safety of a Novel Bioabsorbable Polymer-Coated, Everolimus-Eluting Coronary Stent The EVOLVE II Randomized Trial	Circulation-Cardiovascular Interventions	Article
52	Kereiakes	2015	Antiplatelet therapy duration following bare metal or drug-eluting coronary stents: The dual antiplatelet therapy randomized clinical trial	JAMA	Article
53	Kirtane	2015	Should all stent patients have prolonged dual antiplatelet therapy?	JACC: Cardiovascular Interventions	Editorial
54	Kohno	2015	Report of the American Heart Association (AHA) Scientific Sessions 2014, Chicago	Circulation Journal	Commentary
55	Koppara	2015	Optical coherence tomography surveillance following drug-eluting stent implantation	Minerva Cardioangiologica	Review
56	Lavi	2015	Biodegredable stent platforms–Are we heading in the right direction?	Canadian Journal of Cardiology	Editorial
57	Lee	2015	Bleeding risks are in the eye of the beholder	ACP Journal Club	Commentary
58	Lee	2014	Dual Antiplatelet Therapy for Coronary Artery Disease	Circulation Journal	Review
59	Lemesle	2015	Dual antiplatelet therapy and non-cardiovascular mortality	The Lancet	Commentary
60	Lhermusier	2015	Prasugrel hydrochloride for the treatment of acute coronary syndromes	Expert opinion on pharmacotherapy	Review
61	Liou	2015	Optimal duration of dual antiplatelet therapy following drug-eluting stents implantation: A meta-analysis of 7 randomised controlled trials	International journal of cardiology	Article
62	Lipkin	2014	1 out of a hundred patient will benefit from extended dual Rx	NEJM	Commentary
63	Liu	2015	P2Y12 receptor inhibitors for secondary prevention of ischemic stroke	Expert opinion on pharmacotherapy	Review

64	Liu	2015	Percutaneous coronary intervention strategies and prognosis for graft lesions following coronary artery bypass grafting	Experimental and TherapeuticMedicine	Article
65	Madhavan	2015	Post-PCI Antithrombotic Therapy in Patients Requiring Long-Term Anticoagulation	Currentcardiology reports	Review
66	Marrs	2015	Duration of Dual Antiplatelet Therapy after Drug-Eluting Stents	NEJM	Commentary
67	Matteau	2015	Balancing Long-Term Risks of Ischemic and Bleeding Complications after Percutaneous Coronary Intervention with Drug-Eluting Stents	The American journal of cardiology	Article
68	Matthews	2015	Persistence with secondary prevention medications after acute myocardial infarction: Insights from the TRANSLATE-ACS study	American Heart Journal	Article
69	Mauri	2015	Duration of Dual Antiplatelet Therapy after Drug-Eluting Stents - Author's reply	NEJM	Commentary
70	McKavanagh	2015	A Review of the Key Clinical Trials of 2014	Cardiology and therapy	Review
71	McMillan	2014	Nice slant	New England Journal of Medicine	Commentary
72	Mega	2015	Pharmacology of antithrombotic drugs: an assessment of oral antiplatelet and anticoagulant treatments	The Lancet	Review
73	Mehran	2015	DAPT Duration After DES: What Is the "Mandatory" Duration?	Journal of the American College of Cardiology	Editorial
74	Meneses	2014	About DAPT trial	New England Journal of Medicine	Commentary
75	Moschonas	2015	Protease-activated receptor-1 antagonists in long-term antiplatelet therapy. Current state of evidence and future perspectives	International journal of cardiology	Review
76	Mukherjee	2015	After drug-eluting stent placement, 6 months of dual antiplatelet therapy was noninferior to 12 months	Annals of Internal Medicine	Commentary
77	Navarese	2015	Optimal duration of dual antiplatelet therapy after percutaneous coronary intervention with drug eluting stents: meta-analysis of randomized controlled trials	BMJ	Article

78	Palmerini	2015	Mortality in patients treated with extended duration dual antiplatelet therapy after drug-eluting stent implantation: a pairwise and Bayesian network meta-analysis of randomized trials	The Lancet	Article
79	Papadimitriou	2015	Triple Antithrombotic Therapy: Is it Time to Drop the Aspirin?	Hospital Chronicles	Review
80	Parmar	2014	Error in Study Procedures!	NEJM	Commentary
81	Price	2015	The Optimal Duration of Dual Antiplatelet Therapy After Drug-Eluting Stent Implantation: Chasing a Mirage	Journal of the American College of Cardiology	Editorial
82	Raffoul	2015	Dual antiplatelet therapy duration after the placement of a drug-eluting stent: what are the data?	Current treatment options in cardiovascular medicine	Review
83	Rao	2015	The Conundrum of Reducing Ischemic and Bleeding Events After PCI∗	Journal of the American College of Cardiology	Editorial
84	Reejhsinghani	2015	Prevention of stent thrombosis: challenges and solutions	Vasc Health Risk Manag	Review
85	Rinfret	2015	Percutaneous Coronary Intervention: Finally Mature Enough	Journal of the American College of Cardiology	Editorial
86	Robbins	2015	Periprocedural management of aspirin during colonoscopy: a survey of practice patterns in the United States	Gastrointestinal endoscopy	Article
87	Rohla	2015	Double or triple antithrombotic combination therapy in patients who need anticoagulation and antiplatelet therapy in parallel	European Heart Journal-Cardiovascular Pharmacotherapy	Review
88	Ruparelia	2015	Dual antiplatelet therapy following drug-eluting stent implantation: how long is long enough?	Expert review of cardiovascular therapy	Editorial
89	Sabouret	2015	Dual antiplatelet therapy: optimal timing, management, and duration	European Heart Journal-Cardiovascular Pharmacotherapy	Review
90	Samardzic	2015	Temporal changes of platelet reactivity after coronary stenting–a thing to think about	American Journal of Cardiology	Commentary

91	Schiele	2015	Impact of prolonged dual antiplatelet therapy after acute myocardial infarction on 5-year mortality in the FAST-MI 2005 registry	International journal of cardiology	Article
92	Schulz-Schupke	2015	ISAR-SAFE: a randomized, double-blind, placebo-controlled trial of 6 vs. 12 months of clopidogrel therapy after drug-eluting stenting	European Heart Journal	Article
93	Secemsky	2015	Comparison of Short-and Long-Term Cardiac Mortality in Early Versus Late Stent Thrombosis (from Pooled PROTECT Trials)	The American journal of cardiology	Article
94	Shimohama	2015	Intrastent Thrombus - What You See Is What You Get?	Circulation Journal	Editorial
95	Simon	2015	Omeprazole, pantoprazole, and CYP2C19 effects on clopidogrel pharmacokinetic-pharmacodynamic relationships in stable coronary artery disease patients	European Journal of Clinical Pharmacology	Article
96	Sipahi	2015	Duration of Dual Antiplatelet Therapy after Drug-Eluting Stents	NEJM	Commentary
97	Sommer	2015	Stent Thrombosis: Current Management and Outcomes	Current treatment options in cardiovascular medicine	Review
98	Spencer	2015	Dual antiplatelets for 30 months after drug-eluting stents reduced stent thrombosis and CV and cerebrovascular events.	ACP Journal Club	Commentary
99	Spencer	2015	Longer Versus Shorter Duration Dual-Antiplatelet Therapy After Drug-Eluting Stent Placement: A Systematic Review and Meta-analysis Duration of Dual-Antiplatelet Therapy After Drug-Eluting Stents	Annals of Internal Medicine	Article
100	Takeuchi	2015	Optimum duration of dual antiplatelet treatment could be decided using 64-MDCT: A new hint to treating patients with stents	IJC Heart & Vasculature	Others
101	Thomas	2015	The future of P2Y12 receptor antagonists	Platelets	Review
102	Tomoda	2015	Duration of Dual Antiplatelet Therapy after Drug-Eluting Stents	NEJM	Commentary
103	Toyota	2015	Meta-analysis of Long-term Clinical Outcomes of Everolimus-eluting Stents	The American journal of cardiology	Article
104	Tremmel	2015	Late breaking trials of 2014 in coronary artery disease: Commentary covering ACC, EuroPCR, SCAI, TCT, ESC, and AHA	Catheterization and Cardiovascular Interventions	Commentary

105	Tsoumani	2015	Evaluating the bioequivalence of clopidogrel generic formulations	Current medical research and opinion	Editorial
106	Valgimigli	2015	Duration of dual antiplatelet therapy after drug-eluting stent implantation: will we ever reach a consensus?	EuropeanHeart Journal	Editorial
107	Van de Werf	2015	The year in cardiology 2014: acute coronary syndromes	EuropeanHeart Journal	Review
108	Vetrovec	2015	Another Challenge for the Presumed Safety Advantage of Bare Metal Stents	Catheterization and Cardiovascular Interventions	Editorial
109	Vranckx	2015	Peri-procedural use of rivaroxaban in elective percutaneous coronary intervention to treat stable coronary artery disease. The XPLORER trial	Thrombosis and Haemostasis	Article
110	Waksman	2015	Do you still have an appetite for a short DAPT trial?	Cardiovascular Revascularization Medicine	Editorial
111	Watanabe	2015	Antiplatelet therapy discontinuation and the risk of serious cardiovascular events after coronary stenting: observations from the CREDO-Kyoto Registry Cohort-2	PLoS ONE	Article
112	Wiviott	2015	Clinical evidence for oral antiplatelet therapy in acute coronary syndromes	The Lancet	Review
113	Yamaji	2015	Long-term Outcomes after Coronary Stent Implantation in Patients Presenting with versus without Acute Myocardial Infarction (An observation from Coronary Revascularization Demonstrating Outcome Study-Kyoto Registry Cohort-2)	The American journal of cardiology	Article
114	Yang	2015	Current antiplatelet agents: place in therapy and role of genetic testing	Journal of thrombosis and thrombolysis	Review
115	Yeh	2015	Benefits and risks of extended duration dual antiplatelet therapy after PCI in patients with and without acute myocardial infarction	Journal of the American College of Cardiology	Article
116	Yeh	2015	Dual Antiplatelet Platelet Therapy Duration Following Coronary Stenting	Journal of the American College of Cardiology	Editorial
117	Yeh	2015	Dual antiplatelet therapy duration and mortality–Authors' reply	The Lancet	Commentary
118	Yeh	2015	Close encounters with errors of the second kind: evaluating risks and benefits of long-term dual antiplatelet therapy	EuropeanHeart Journal	Editorial

Appendix 2: Content of the scholarly and public attention surrounding the DAPT study by source (n = 425)

Category	Overall n=425	Scientific communication 118 (27.7)	News 12 (2.8)	Blogs 3 (0.7)	Facebook posts 189 (44.4)	Tweets 75 (17.6)	YouTube 8 (1.9)	DAPT Website 20 (4.7)
Text favourable about the prolonged treatment	81 (19.1)	28(23.7)	9(75.0)	-	9(4.8)	11(14.7)	(100)	16(80.0)
Text uncertain, with inappropriate mention of mortality	19 (4.5)	13(11.0)	3(25.0)	2(66.7)	-	-	-	1(5.0)
Electronic link	151 (35.5)	-	-	-	113 (59.8)	38(50.6)	-	-
Referenced with no message	13 (3.1)	1(0.8)	-	-	10(5.3)	2(2.7)	-	-
Text uncertain, with no mention of mortality	100 (23.5)	37 (31.4)	-	1(33.3)	48(25.4)	13(17.3)	-	1(5.0)
Text uncertain, with appropriate mention of mortality	34 (8.0)	29(24.6)	-	-	1(0.5)	3(4.0)	-	1(5.0)
Text not favourable about the prolonged treatment	15 (3.5)	3(2.5)	-	-	8(4.2)	3(4.0)	-	1(5.0)
Text not favourable about the prolonged treatment and critical of the authors' interpretation	12 (3.0)	7(6.0)	-	-	-	5(6.7)	-	-

Paper 4: Interpretation of health news reporting results with or without spin: Protocol for a prospective meta-analysis of 16 randomized controlled trials.

The protocol is accepted at BMJ OPEN.

Interpretation of health news items reported with or without spin: Protocol for a prospective meta-analysis of 16 randomized controlled trials

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ABSTRACT

Introduction: We aim to compare the interpretation of health news items reported with or without spin. "Spin" is defined as a misrepresentation of study results, regardless of motive (intentionally or unintentionally) that overemphasizes the beneficial effects of the intervention and overstates safety compared to that shown by the results.

Methods and analysis: We have planned a series of 16 RCTs to perform a prospective meta-analysis. We will select a sample of health news items reporting the results of 4 types of study designs, evaluating the effect of pharmacologic treatment and containing the highest amount of spin in the headline and text. News items reporting 4 types of studies will be included: 1) pre-clinical studies, 2) phase I/II (non-randomized) trials, 3) randomized controlled trials (RCTs), 4) observational studies. We will rewrite the selected news items and remove the spin. The original news and rewritten news will be appraised by 4 types of populations: 1) French-speaking patients, 2) French-speaking general public, 3) English-speaking patients, and 4) English-speaking general public. Each RCT will explore the interpretation of news items reporting one of the 4 study designs by each type of population and will include a sample size of 300 participants. The primary outcome will be participants' interpretation of the benefit of treatment after reading the news items: (*What do you think is the probability that treatment X would be beneficial to patients? (scale, 0 [very unlikely] to 10 [very likely]).*

This study will evaluate the impact of spin on the interpretation of health news reporting results of studies by patients and the general public.

Ethics and dissemination: This study has obtained ethics approval from the Institutional Review Board of INSERM, (registration No IRB00003888). The description of all the steps and the results of this prospective meta-analysis will be available online.

Registration number: CRD42017058941

Strengths and limitations of this study

- This will be the first prospective meta-analysis of randomized controlled trials for interpretation of health news items reporting the results of studies with or without spin.

- It will address the impact of spin on the interpretation of health news by patients and the general public.

- The involvement of patients and the public may help to improve the reporting of medical research in health news.

- News stories are only one way that the public hears news about health.

- Logistically, the recruitment of large number of participants at the same time may be a challenge, but to manage this, participants will be recruited separately for each trial.

INTRODUCTION

Health news is an important way to communicate updates about medical research to the public. News items reporting the results of medical research attract a large audience [1]. However, the quality of reporting in health news is uneven. The merits of a wide range of treatments and tests are overplayed, and harms are underplayed [2]. Several studies have shown the presence of spin (i.e., distorted presentation of study results) in health news [3-10]. Distorted facts can be misleading and can affect the behaviour of physicians, healthcare providers and patients [1 11 12]. However, little research has assessed whether spin can affect readers' interpretation [13]. Some studies have explored whether laypeople are able to recognize the tentativeness of research findings reported in media [14 15]. Kimmerle et al. found that negative framing and accentuation of the limited reliability of provisional research findings in a newspaper report made people more aware of the tentativeness of these findings [14]. In another work, the authors assessed the impact of some personality factors (i.e., scientific literacy, epistemology beliefs, and academic self-efficacy) and previous users' comments on an online website on laypeople's understanding of the tentativeness of medical research findings. Laypeople's understanding of the tentativeness of research findings was influenced by their personality factors and also by other users' comments contributed to the forum [15].

To our knowledge, no meta-analysis has assessed whether news items reported with spin can influence readers' interpretations.

Our hypothesis is that spin can influence the reader's interpretation of health news items. We aim to compare the interpretation of health news items reported with or without spin. We will focus on news items reporting studies evaluating the effect of a pharmacological treatment, containing the largest amount of spin in the headline and text, and receiving high levels of public attention online.

METHODS

Theoretical framework

Previous works have shown a high prevalence of spin in scientific articles [16-19] and in the mass media [8-10 20]. However, a question remains: Are readers influenced by spin or are they able to disentangle the appropriate interpretation from the news? In this study, we will consider only news items reporting studies evaluating pharmacological treatments where readers may overestimate the beneficial effect of the treatment if the news is reported with spin and change their behavior accordingly. We will consider different types of readers: patients and the main public. To increase generalisability we will also consider two different populations: located in the United States and in France.

Definition of "spin"

In the context of this study, we define "spin" as a misrepresentation of study results, regardless of motive (intentionally or unintentionally) that overemphasizes the beneficial effects of the intervention and overstates safety compared to that shown by the results [16].

The definition of spin we used has been used for exploring spin in the scientific literature [8 13 16 19 21 22]. This definition does not take into account the notion of intent because it is impossible to distinguish between the two (i.e., intentional and unintentional spin) and the consequences for readers could be the same.

Study design

We have planned a series of 16 randomized controlled trials (RCTs) to perform a prospective meta-analysis (MA), and a comparing the interpretation of health news items reported with or without spin. Each RCT will explore the interpretation of news items reporting one of 4 study designs: 1) pre-clinical studies, 2) phase I/II trials (non-randomized), 3) RCTs, and 4) observational studies. The news items reporting each study design will be assessed by 4 different

targeted populations: 1) French-speaking patients, 2) French-speaking general public, 3) English-speaking patients, and 4) English-speaking general public. Each RCT will be a parallel group with two-arms. In each RCT, participants will be randomly assigned to appraise health news items reported with or without spin *(see figure 1)*.

The planning, implementation, analysis and writing of this protocol will follow the SPIRIT [23] and PRISMA-P [24] guidelines. This study has obtained ethics approval from the Institutional Review Board of INSERM, (registration No IRB00003888), and the protocol is registered at PROSPERO website (CRD42017058941).

News items with and without spin

Selection of news items with spin

News items reporting studies evaluating a pharmacologic treatment that received a great deal of public attention online and contained a large amount of spin in the headline and text will be selected from a sample of news items retrieved from Altmetric Explorer.

Search strategy

We will search for articles on "PubMed" using the following search strategy: field ((Randomized controlled trial[Publication Type] OR Observational study[Publication Type]) OR Meta-analysis[Publication Type]) OR Randomized[Title/Abstract]) OR controlled[Title/Abstract]) OR trial[Title/Abstract]) OR cross-sectional[Title/Abstract]) OR case-control[Title/Abstract]) OR cohort[Title/Abstract]) OR Meta-analysis[Title/Abstract]) OR systematic review[Title/Abstract]) AND (has abstract [text] AND ("2014/01/01"[PDAT] : "2014/06/30"[PDAT])). The publication period will be restricted to the first 6 months of 2014 to minimize the risk of recall bias among study participants.

To retrieve relevant news coverage of these articles, we will apply the "PubMed search details" on "Altmetric Explorer". The Web application Altmetric Explorer provides access to all sources

where the published study is mentioned online in the mass media and sorts the items according to the Altmetric score [25]. The Altmetric score is one way to quantify the public attention an article received in online news outlets, blogs and social media (https://www.altmetric.com/) (a high Altmetric score = high public attention).

Screening process

Screening will be performed in two steps: first, one researcher will systematically screen the retrieved Altmetric Explorer citations, which will be sorted from the highest to the lowest Altmetric score (i.e., highest to lowest amount of public attention), and will identify studies evaluating the effect of a pharmacological treatment, regardless of study design and study population (including human and animal/laboratory). For each study fulfilling eligibility criteria, the researcher will retrieve 1) the published article and 2) all related online news items available at Altmetric Explorer.

Second, the researcher will identify the news item with spin in the headline and text by using a standard scheme of spin [10 19]. When several news items have spin in the headline, the researcher will select the news item with the most spin in the text. We will include news items reported by general or medical news outlets or lay press whose target consumers are the general population.

As a quality procedure, a second researcher will confirm the eligibility of all included studies and screen 10% of the excluded studies.

The screening process will be performed sequentially, the studies being sorted from the highest to the lowest Altmetric score (i.e., highest to lowest public attention). We will include the first 40 studies fulfilling the eligibility criteria and relevant 40 news items containing the most spin in the headline and text: 10 reporting pre-clinical studies, 10 reporting phase I/II non-randomized trials, 10 news items reporting RCTs and 10 reporting observational studies.

Identification and description of spin

We will identify the spin in the headlines and text of selected news items and will classify them according to following 3 categories of spin — misleading reporting, misleading interpretation and misleading extrapolation — that were previously developed [10].

Misleading reporting is defined as incomplete or inadequate reporting of any important information in the context of the research that could be misleading for the reader. This category includes 1) misleading reporting of study design; 2) not reporting study population (if an animal study); 3) selective reporting of outcomes favoring the beneficial effect of the treatment (e.g., statistically significant results for efficacy outcomes or statistically non-significant results for safety outcomes); 4) not reporting adverse events; 5) linguistic spin (i.e., any word or expression emphasizing the beneficial effect of the treatment [26]; 6) not reporting study limitations; 7) not reporting any caution about study design and results, and 8) any other type of misleading reporting not classified under the above section.

Misleading interpretation is defined as an interpretation of the study results in news stories that is not consistent with the results reported in the scientific articles and overestimating the beneficial effect of the treatment. This category includes claiming 1) a beneficial effect of the treatment despite statistically non-significant results; 2) an equivalent effect of the treatment for statistically non-significant results in superiority RCTs; 3) that the treatment is safe for statistically non-significant results despite a lack of power; 4) safety of the treatment despite adverse events reported in the scientific articles; 5) a causal effect (i.e., implies a cause-and-effect relationship between the intervention being assessed and the outcome of interest [27]) despite a non-randomized study design; 6) a beneficial effect of the treatment despite a small sample size; and 7) a beneficial effect despite lack of a comparator as well as 8) focus on p-value instead of clinical importance; 9) interpretation of relative risk as absolute risk; and 10) any other type of misleading interpretation not otherwise classified.

Misleading extrapolation is defined as overgeneralization of study results in news stories to different populations, interventions or outcomes that were not assessed in the study. This category includes extrapolating 1) animal study results to human application; 2) preliminary study results to clinical application; 3) the effect of study outcomes to other outcomes for the disease; 4) the beneficial effect of the study intervention to a different intervention (e.g., broccoli, which contains sulphoraphane, was claimed as beneficial by health news items, but the study evaluated the benefit of a sulphoraphane compound only); and 5) from the study participants to a larger or different population as well as 6) inappropriate implications for clinical or daily use (i.e., an improper recommendation or advice to use the intervention in clinical practice or daily use not supported by study results); and 7) any other types of extrapolation not otherwise classified.

All other spin that could not be classified with this scheme will be systematically recorded and secondarily classified.

Construction of news without spin

Format of the news items

Our aim is to keep the same context and format of the original news item and conceal the names of pharmacological treatments, authors and funders to avoid evaluation bias. Consequently, to rewrite the news items we will:

1. Keep the same context and structure

2. Create hypothetical names of reported pharmacological treatments

3. Conceal the names of study authors and experts by using different names selected based on the origin of the name from an online list of names including all countries of the world

(http://www.studentsoftheworld.info/penpals/stats.php3?Pays) to keep the news content natural.

4. Keep the name of the research institute/university/hospital where the study was conducted.

5. Replace the name of the funding source with standardized terms for profit or non-profit funding organizations.

6. Delete the name of the online news outlet, date the news story was published online, name of the journalist who wrote the news with spin, name of the medical journal in which the study was published, reference to the original article and trial registration number or name (if reported).

Guidelines to remove spin in the news items

To construct health news stories without spin, we will delete the spin identified in the headline and text and will add some caution, depending on context. The guidelines used to remove the spin are described in Table 1. The guidelines to add caution are in Table 2.

One researcher (RH) will identify and remove the spin in each news item selected (in the headline and text) and will rewrite the news story without spin, according to the guidelines described in Tables 1 and 2. Two researchers (IB) and (AY) will check the rewritten news items. Finally, a sample of the rewritten news stories will be checked by a researcher working in the field of medical journalism (IO). Appendix 1 provides an example of a news item reported with and without spin. Our sample of news will contain 80 news items [40 original news items (with spin) and 40 rewritten news items (without spin)].

Translation of the news items reported with and without spin

All news items will be translated into French language to be used in RCTs involving French-speaking participants. One French native speaker researcher (AY) will validate the French translation of news items. Further, a French medical journalist will also validate the French translated news items.

Population

We will compare the health news reported in English and French languages and will assess their interpretation by different types of populations to increase the generalisability of our results. Each RCT will target one of the four following study populations:

1. French-speaking patients

2. French-speaking general public

3. English-speaking patients

4. English-speaking general public

Eligibility criteria

We will enroll participants older than 18 years.

Recruitment strategy

To recruit participants, we will contact online communities of patients, patients' associations, popular health forums, and investigators of e-cohorts. We will also use the online platform (www.findparticipants.com) which enables access to thousands of interested participants to

participate in research studies worldwide. We will also advertise the study in hospitals and GP practices.

Each participant will provide an online informed consent at the time of enrollment.

We will send participants an invitation by email (appendix 2). If respondents agree to participate in the survey, an Internet link included in the invitation email will give them access to information regarding the study and a screening question asking them whether they are willing to participate in the study. If they answer yes, respondents will be randomly assigned to read 1 news item with spin or one news item without spin.

Invitation emails will be sent in waves until the planned number of participants log on and complete the assessment. A maximum of two reminders will be sent to participants.

Interventions

We will compare the interpretation of "health news items" reported with spin (original news = active comparator) or without spin (rewritten news = experimental group).

Random assignment

A random assignment sequence will be computer-generated by a statistician by using blocks of 10 (i.e., number of news items selected x 2) for each study design type. The list will not be disclosed to investigators. Allocation concealment will be assured by the use of a computerized random-assignment system. After randomization, participants will be asked to complete a questionnaire. Participants who log on and do not evaluate the news will be excluded and the news item will be automatically allocated to another participant.

Blinding

Blinding of participants is not possible, but to minimize bias, participants will be blinded to the study hypothesis. All participants will be informed that they are participating in a survey about the interpretation of news reporting medical research that evaluates treatments. They will not be informed about the objectives and hypothesis of the study.

After the completion of study, each participant will be told about the study objectives, hypothesis and results.

Study outcomes

Our primary outcome will be participants' interpretation of the benefit of the treatment measured on a scale from 0 to10.

1. *What do you think is the probability that treatment X would be beneficial to patients?*
   (scale, 0 [very unlikely] to 10 [very likely])

Secondary outcomes are as follows:

2. *What do you think is the size of the potential benefit for patients? (scale, [none, small, moderate or large])*

3. *How safe do you think that treatment X would be for patients? (scale, 0 [very unsafe] to 10 [very safe])*

4. *Do you think this treatment should be offered to patients in the short term? (scale, 0 [absolutely no] to 10 [absolutely yes])*

5. *Do you think this treatment will make a difference in the existing clinical practice? (scale, 0 [absolutely no] to 10 [absolutely yes])*

These study outcomes are surrogate markers measuring the perception by readers of the treatments' efficacy, safety, availability and use in current clinical practice.

Sample size

Each participant will read a news item with or without spin. We want to assess a mean difference of 1.0 for the primary outcome between groups on a 0-10 scale, with a standard deviation of 2.5 [13]. For each RCT, a sample of 266 assessments of news items will be needed to detect an effect size of 0.4 with a power of 90% and α risk of 5% for each RCT. Each news item will be read the same number of times (balanced design) and we will to take into account clustering due to the fact that a news items will be read many times. To achieve this, we will use a sample size of 300 participants (150 in each group) in each RCT (i.e., an inflation factor of about 1.1). Therefore, each news item will be assessed 15 times in each group (10 news items with or without spin for 150 participants) for each RCT.

Statistical analysis

The statistical analysis will be undertaken by a statistician who will use R v2.15.1 (R foundation for Statistical Computing, Vienna, Austria) at the Center for Clinical Epidemiology, Paris, France. All outcomes will be quantitative and the number of participants and news items will be balanced in each group. For each RCT, the following analysis will be done: The differences between groups will be analyzed by using a linear mixed model with a fixed group effect and random group effect and news items–group interaction effects. Random effects will allow us to account for the following 2 levels of clustering: within-group clustering as a result of the news (each news item will be assessed 15 times in each group) and between-group clustering (pairing between the news used in the 2 arms of the trial). Inferences will be based on the restricted maximum likelihood. This model will compare the mean difference between 2 arms for each trial. For primary and secondary outcomes, we will estimate the difference between means with 95% confidence intervals (CIs). $P < 0.05$ will be considered statistically significant.

Finally, after analyzing each RCT separately, a prospective meta-analysis will be done to summarize intervention effects. The mean difference with 95% CIs will be estimated by using a random-effects model based on the DerSimonian-Laird method. Forest plots will be created for visual interpretation of results. The heterogeneity will be assessed by X^2 test *(P <0.05)* and degree of heterogeneity by the I^2 statistic *(>75%)* to assess statistical significance (Higgins JPT et al, 2014). We will also assess the variance (τ^2) between trials.

STUDY DURATION

The total duration of this study will be 24 months. Expected period of inclusion of participants will also be 24 months and the duration of participation per participant/patient will be 1 hour. The anticipated start date of trials will be June, 2017.

DISCUSSION

To best of our knowledge, we present the first prospective meta-analysis of randomized controlled trials for interpretation of health news items reporting the results of studies with or without spin.

We have designed 16 randomized controlled trials which will focus on interpretation of news items reporting results of 4 types of study designs: 1) pre-clinical studies, 2) phase I/II trials (non-randomized), 3) RCTs, and 4) observational studies. There will be 80 news items reporting these study designs (20 new items / study design: 10 original news items with spin + 10 rewritten news items without spin). Each RCT will target one of the 4 types of populations: 1) French-speaking patients, 2) French-speaking general public, 3) English-speaking patients, and 4) English-speaking general public. In total, 4800 participants will be involved in 16 planned RCTs (300 participants/ RCT). Once the planned RCTs are completed, then the results of different RCTs will be included to perform a meta-analysis.

The concept of prospective meta-analysis allows us to compare the interpretation of health news stories reporting results of studies with or without spin by different types of populations. This new form of synthesis of evidence answers the question of whether spin can influence patients' and the publics' interpretation of health news.

We will document all practical issues and difficulties encountered to demonstrate that this type of synthesis of evidence is feasible. We are aware of some challenges, such as recruitment of participants. Logistically, the recruitment of large number of participants at the same time may be a challenge, but to manage this, participants will be recruited separately for each trial.

EXPECTED RESULTS

This study will evaluate the impact of spin on patients' and the public's interpretation of news items reporting results of studies.

Supplementary Data

Appendix1: An example of a news item with and without spin

Appendix 2: Informed consent

MODIFICATIONS MADE IN THE PROTOCOL SUBMITTED TO ETHICAL COMMITTEE

We made following changes in the protocol submitted to the ethical committee:

Rewriting news items

- Word count: The condition to keep the word count of ±20% from original news to rewritten news items is deleted.

- Concealment: The name of the research institute/university/hospital where the study was conducted will be kept in the rewritten news items.

- Guidelines to remove spin: We will also report the caution or recommendation by study authors, reported in the related article when available.

Eligibility criteria: We edited from "older than 30 years" to "older than 18 years.

Survey questionnaire

A: Demographic characteristics:

- We added 5 levels to specify age instead of requesting the age as follows:

  o Your age, please tick the appropriate box
     Under 18, 18 -29, 30 – 49, 50 – 69, 70 years old and more

- We merged two questions related to demographic information into one: How often do you read news items? Never/sometimes (once per month)/often(once per week)/daily

B: Outcomes

- We modified the wording of the answer modality for question 3 and question 4 as follows:

	Before	Now
Q3	How safe do you think that treatment X would be for patients? (scale 0 [very unlikely] to 10 [very likely])	How safe do you think that treatment X would be for patients? (scale 0 [very unsafe] to 10 [very safe])
Q4	Do you think this treatment should be offered to patients in the short term? (scale 0 [very unlikely] to 10 [very likely])	Do you think this treatment should be offered to patients in the short term? (scale 0 [absolutely no] to 10 [absolutely yes])

Guidelines

- We report SPIRIT and PRISMA-P guidelines to follow for protocols of clinical trials and meta-analysis respectively.

Data sharing statement

This article is the protocol of a prospective meta-analysis. The authors plan to report transparently all the planned trials and will provide open access to all extracted data for each trial.

Open Access

Ethics and dissemination

"This study obtained ethics approval from the Institutional Review board of INSERM (Registration No: IRB0003888), and the protocol is registered at the PROSPERO website (CRD42017058941). We report SPIRIT [23]and PRISMA-P [24] guidelines for protocols of clinical trials and meta-analyses, respectively. The results of this meta-analysis will be disseminated as a published article. Upon the completion of this study, the results will be sent to all participants."
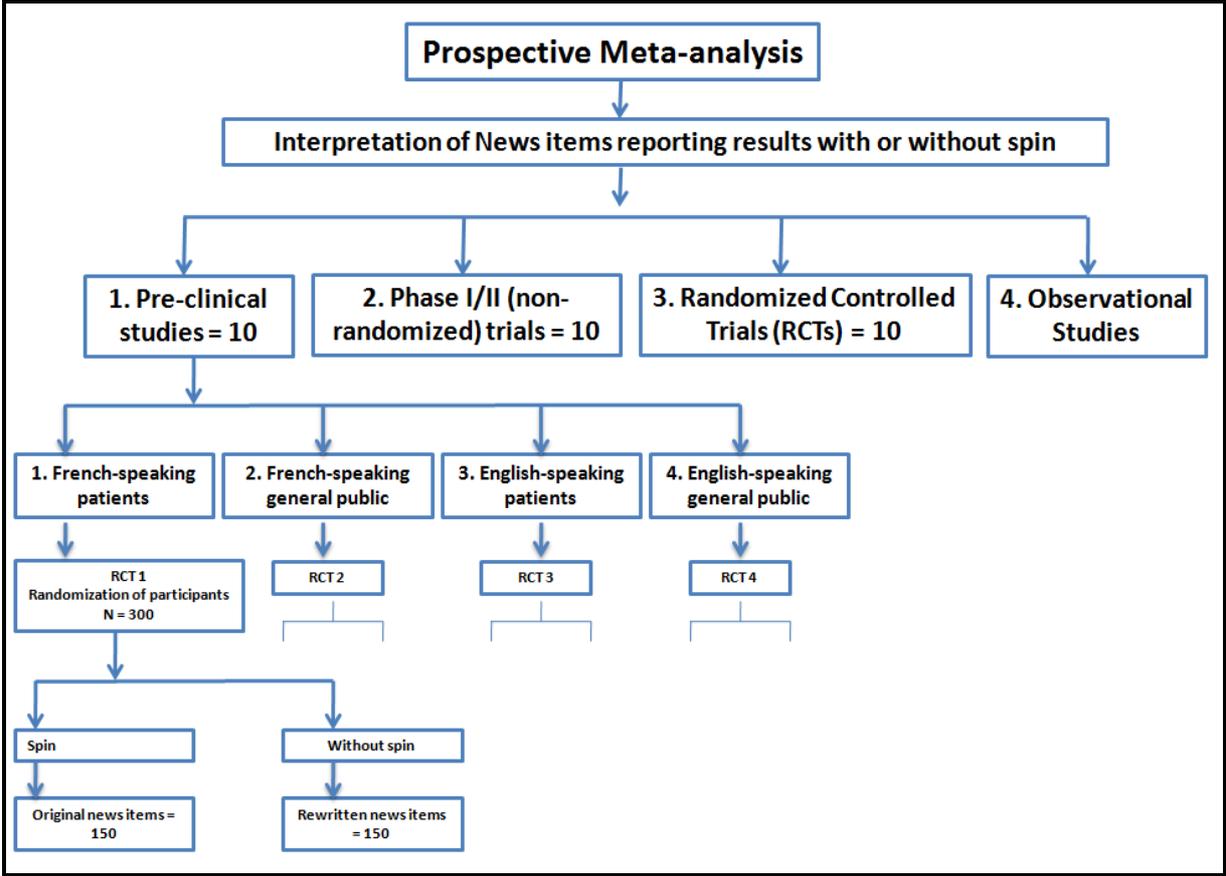
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Figure 1: Series of 16 RCTs that will be included in the prospective meta-analysis

Each RCT will explore the interpretation of news items reporting 4 study designs: 1) pre-clinical studies, 2) phase I/II trials (non-randomized), 3) RCTs, and 4) observational studies. Each RCT will target 4 types of populations: 1) French-speaking patients, 2) French-speaking general public, 3) English-speaking patients, and 4) English-speaking general public.

Table 1: Guidelines to remove spin

Spin	Interventions/modifications
Spin in headline	Delete the misleading information and report the appropriate information
Spin in text	
Misleading reporting	
• Misleading reporting of study design	Report the appropriate study design
• Not reporting study population if an animal study	Report animal study subjects
• Selective reporting of outcomes	Report the results for all primary outcomes.
• Not reporting adverse events	Report adverse events when higher in one group [We considered reporting more frequent and serious adverse events related to treatment primarily.]
• Use of linguistic spin	Delete linguistic spin
• Not reporting study limitations and caution specific to study design	Report the study limitations and cautions. The cautions with standardized text are described in table 2.
Misleading interpretation	
• Claiming a beneficial effect of intervention despite statistically non-significant results • Claiming an equivalent beneficial effect of intervention despite statistically non-significant results in superiority RCTs	Delete this spin and use the generic wording, such as [Treatment A was not more effective on "primary outcome" than the comparator B in patients with....]
• Claiming the treatment is safe despite statistically non-significant results in treatment and comparison groups • Claiming safety despite adverse events • Claiming a causal effect despite non-randomized study design • Claiming a beneficial effect despite small sample size not reported • Claiming a beneficial effect despite lack of comparator • Focus on p-value instead of magnitude of the effect (effect size)	Delete this spin; reword and provide the appropriate information when needed.
Misleading extrapolation	
• Animal study results to human application • Preliminary study results to clinical application • Study outcomes to other outcomes for the disease • Study intervention to a different intervention • Study participants to a larger or different population	Delete the inappropriate extrapolation
• Inappropriate implication for clinical or daily use	Delete the statement and clearly report the immediate unavailability in clinical practice
Author's/expert's statement (interview)	
	Delete the spin in the statement
	Report the caution or recommendation by study authors, reported in the relevant article when available.

Table 2: Reporting of cautions with standardized wording

Study design	Standardized text
• Animal or laboratory study	"The study was based on animals; it is impossible to know whether this treatment will work on humans or not."
• Small study	"These results are based on a small study; larger studies are needed to understand whether the treatment works across a large population."
• Uncontrolled study/Lack of comparator	"Everyone in this study took drug X. Without investigating patients who did not take that drug, it is impossible to know whether taking drug X accounted for the outcome".
• Controlled but not randomized study	"The study participants were not randomized. We do not know whether it was drug X or something else that really accounted for the effect observed."
• Important adverse event	"The benefit observed should be weighed against the adverse effects (or other downsides such as inconvenience, cost, etc)."

Appendix 1: An example of a news item with and without spin

Original News (with spin)	Rewritten News (without spin)
Now, 'sticky balls' that can prevent cancer spread	**~~Now, 's~~Sticky balls' that ~~can~~ may prevent cancer spread in mice**
Researchers have developed cancer-killing "sticky balls," that can destroy tumour cells in the blood and may prevent cancer spread.	Researchers ~~have~~ are ~~developed~~developing cancer-killing "sticky balls," that ~~can~~ may destroy tumour cells in the blood of mice ~~and may prevent cancer spread~~.
The most dangerous and deadly stage of a tumour is when it spreads around the body.	The most dangerous and deadly stage of a tumour is when it spreads around the body.
Scientists at Cornell University, in the US, have designed nanoparticles that stay in the bloodstream and kill migrating cancer cells on contact, the BBC reported.	Scientists at Cornell University, in the US, have designed nanoparticles that stay in the bloodstream and may kill migrating cancer cells on contact, the BBC reported.
They said the impact was "dramatic" but there was "a lot more work to be done".	~~They said the impact was "dramatic" but there was "a lot more work to be done".~~
The team at Cornell attached a cancer-killing protein called Trail, which has already been used in cancer trials, and other sticky proteins to tiny spheres or nanoparticles.	The biomedical engineers tested the new technology in live mice and human blood samples in cell culture.
When these sticky spheres were injected into the blood, they latched on to white blood cells.	The team at Cornell attached a ~~cancer-killing~~ protein called ~~Trail~~ TRAIL, which has already been used in cancer trials and other sticky proteins to tiny spheres or nanoparticles.
Tests showed that in the rough and tumble of the bloodstream, the white blood cells would bump into any tumour cells which had broken off the main tumour and were trying to spread.The research showed the resulting contact with the Trail protein then triggered the death of the tumour cells.	~~When these sticky spheres were injected into blood, they latched on to white blood cells.~~
Word count = 169	Tests showed that in the rough and tumble of the bloodstream, the white blood cells would bump into any tumour cells which had broken off the main tumour and ~~were trying to spread~~ bind to the TRAIL protein. The research showed the resulting contact with the Trail protein then may ~~triggered~~ result in the death of the tumour cells.
	However, it may take years to know whether this treatment will work for human or not. Indeed, less than 1% of the drugs tested on animals are approved for clinical use in patients.
	Word count = 188

Appendix 2: Informed consent

Invitation letter

Objective: Interpretation of health news items: an academic study

We invite you to participate in an international academic study to investigate people's understanding of health news items.

The study will require only a minimal amount of work on your part, and you will be helping to improve the reporting/communication of results related to medical research in health news for patients and the public.

Your participation would involve in reading a news item and answering five short questions about the findings in the news item. To avoid any biased interpretation, the description of the treatment and name of the study has been masked.

Your responses will be kept confidential. This study has been approved by INSERM, Institutional Review Board (IRB 00003888).

We will share with you the results of this study upon its completion.

You can complete the survey by XX

Or by copying and pasting the following link into your web browser: XX

With best wishes

Pr Isabelle Boutron (Paris Descartes University, INSERM UMR 1153, France)
Romana Haneef (Paris Descartes University, INSERM UMR 1153, France)
Dr. Amélie Yavchitz (French Cochrane Center, Paris, France)
Pr Philippe Ravaud (Paris Descartes University, INSERM UMR 1153, France)
Mr. Gabriel Baron (Centre d'Épidémiologie Clinique, Hôpital Hôtel-Dieu, Paris, France)
Pr Ivan Oransky (New York University's Arthur Carter Journalism Institute, New York, USA)
Pr Gary Schwitzer (University of Minnesota, School of Public Health, Minnesota, USA)

If you prefer not to receive future reminders regarding this study, please click here.

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Please complete some simple information about yourself

- Your age, please tick the appropriate box
  Under 18, 18 -29, 30 – 49, 50 – 69, 70 years old and more
- Sex: Female Male

- Do you have a chronic health condition yes/ no *(according to the answer, the participant will be directed to the survey dedicated to patients or to the public)*

- Where are you currently located?

  France/ UK/ Other European country/ USA/ Canada/ South America/ Asia/ Oceania

- How often do you read news items?

  Never/sometimes (once per months)/often (once per week)/daily

- Do you rely on health news items to decide about your health?

- What is your primary source to obtain information related to new treatments?

  Physicians/family or friends/online health news/television/social media/other

Submit

Next page

This news item describes a study evaluating a treatment published in a peer-reviewed journal.

Insertion of the news items

Based on the information reported in the news, please answer the following questions about the treatment:

1. *What do you think is the probability that "treatment X" would be beneficial to patients? (scale, 0 [very unlikely] to 10 [very likely])* (Primary outcome)
2. *What do you think is the size of the potential benefit for patients? (scale, [none, small, moderate or large])*
3. *How safe do you think that this treatment X would be for patients? (scale, 0 [very unlikely] to 10 [very likely])*
4. *Do you think this treatment should be offered to patients in the short term? (scale, 0 [very unlikely] to 10 [very likely])*
5. *Do you think this treatment will make a difference in the existing clinical practice? (scale, 0 [absolutely no] to 10 [absolutely yes])*

Do you have any comments?

Write your comment here ...

Submit

Thank you very much for your participation in this study.

If you wish to receive the results of this study, please indicate your email address here.