

# Frequently cited sources in cancer news coverage: a content analysis examining the relationship between cancer news content and source citation

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**Abstract** The media are a frequent and sometimes sole source of cancer information for many people. News coverage of cancer can be influential to cancer-related practices such as prevention or detection behaviors, and sources cited by journalists may be influential in shaping this coverage. A content analysis ( $n = 3,656$  stories) revealed that the most frequently cited sources in cancer news articles—research institutions and medical journals—receive disproportionately more attention compared to the National Cancer Institute (NCI), the American Cancer Society (ACS), and pharmaceutical companies. Research institutions were cited twice as frequently as medical journals, and more than three times as frequently as pharmaceutical companies. Most clinical trial stories were optimistic or neutral in tone, and tone was significantly related to citations of pharmaceutical companies and medical journals. Implications for effects of cancer coverage on behaviors, and the influence of sources such as research institutions and pharmaceutical companies, are discussed.

**Keywords** Cancer · Media · Cancer control · Journalists

## Introduction

What many individuals know about cancer can be traced back to the news media [1–7]. Attending to newspaper coverage of cancer is associated with knowledge about cancer risks [8], and individuals relying on the media are better informed than counterparts relying on other sources of health information [9, 10]. Media also affect cancer-related behaviors, including cancer-preventive actions [11] and cancer screening [12–16]. In fact, for many, news media are their sole source of health information [4, 5, 17]. As a result, news media wield a considerable amount of influence over cancer beliefs, attitudes, and behaviors.

Nevertheless, cancer news coverage is often unbalanced, inaccurate, or skewed [18]. For example, past content analyses have found that cancer treatment is discussed far more than other aspects of cancer, including prevention, detection, survivorship, and end-of-life issues [19]. This, despite the fact that the cancer research community is increasingly prevention focused [20]. In other words, there is a discrepancy between the content of cancer news coverage and the recommendations of the cancer research community.

The purpose of the present study is to examine by means of a content analysis whether sources cited in cancer news stories—research institutions, medical journals, pharmaceutical companies—are in any way related to this discrepancy. Sources provide context and comment [21] and can affect what the media cover and how those issues are framed [22]. In fact, past research on news coverage has suggested that sources can often skew coverage, typically to serve their own interests (economic, political, or

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otherwise) [18, 23]. To that end, the present study identifies frequently cited sources in cancer news coverage and how source citation is related to mentions of the cancer continuum, cancer clinical trials, and types of stories.

## Literature review

In 1980, the National Cancer Institute (NCI) conducted the last comprehensive cancer news content analysis [24, 25]. The present study is part of a larger project that replicated, updated, and expanded the 1980 NCI content analyses [8, 19, 26]. Available data from the larger project provides the most recent glimpse of the current state of cancer news coverage. One study from that project [19] found that treatment was the focus of most cancer coverage, whereas prevention, detection, and survivorship received far less attention. Half of stories discussing clinical trials had a positive tone, and only one in 10 of stories took a negative tone toward clinical trials [19]. The findings of other researchers [27] echo these results. In a content analysis of news coverage of cancer in newspapers, television, and magazines, discussions of cancer treatment dominated news reports [27].

The status of current cancer news coverage, then, appears to focus heavily on cancer treatment. Medication receives a great deal of attention, as do clinical trials. One explanation for this dominance of cancer treatment coverage may be the sources health journalists cite. Journalists are dependent upon their sources [28–30], and sources can help shape and influence the content of news reporting [30–32]. Journalists reporting about health issues are particularly dependent upon sources because of the often complex scientific information at the center of their work [30]. Reporters need sources to guide and interpret health news from the start [30, 31]; thus, the very nature of health news necessitates close ties between journalists and sources. A survey of 139 health reporters at American network television affiliates found that, regardless of the experience level of the journalist, more than half of respondents reported drawing ideas for health reports directly from sources [30]. Journalists reported also needing to turn to sources for assistance in explaining and interpreting information [30]. Another survey of 468 local and national news reporters demonstrated that sources directly influence health reporters and news stories [32], a relationship supported by the extant literature [21, 29, 31, 33–36].

Sources can shape news in particular ways. An analysis of print media coverage of research on passive smoking between 1981 and 1994 showed that despite mounting evidence over time that passive smoking was dangerous, press coverage continued to portray the issue as controversial [23]. The authors linked this disparity to the sources

used in the lay press. Similarly, for the screening mammography debate of the 1990s, the frequent use of sources on the pro-mammography side of the controversy skewed coverage of the issue even after NCI and other organizations publicly stated that there was insufficient evidence to recommend mammography for women 40–49 years of age [18].

Because the news media are influential in altering the health knowledge and health behaviors of the news audience [9–16], sources that influence the news itself merit closer scrutiny. Given the status of current cancer news coverage, the myriad of influences on news stories, and the potential for these sources to affect the news audience, we investigate patterns of source citation in cancer news coverage. We explore the sources most frequently cited in cancer newspaper stories, whether types of sources in cancer newspaper stories vary by story topic, whether mentions of the cancer continuum vary by sources cited, the most frequently cited sources in stories about clinical trials, and the relationship between sources and the tone of coverage of cancer clinical trials.

## Materials and methods

### Sample

Data for this study were drawn from a comprehensive analysis of cancer news coverage in the top major US newspapers for 2003. Stories containing at least a minimal amount of cancer information ( $n = 5,327$ ) were identified by our rigorously validated search term (for the search term, see Appendix; for a further description of the search term, see [37]). The search incorporated measures of recall and precision to estimate reliability and validity. A total of  $n = 3,656$  stories in our sample discussed cancer in depth (e.g., devoted more than a passing reference to, or mention of, cancer; went into detail about cancer), and it was from this group of stories that we gathered the data for these analyses.

Relevant stories were sampled from any of the top 50 newspapers in the US, based upon circulation data, available through Lexis–Nexis that provided full-text continuous coverage for the study time period. Lexis–Nexis is an online database of newspapers, magazine articles, legal documents, public records, press releases, and other printed information sources. A total of 44 papers were used because full-text continuous coverage was not available for six of the top 50 papers.

### Variables

Variables of interest included *story topic*, *the cancer continuum*, *sources*, and *tone of clinical trials*.

### Story topic

Story topics were coded as a report of cancer research; profile of someone dealing with cancer; cancer fundraiser; cancer politics or policies; cancer awareness or education; a lawsuit; stock story; or some other topic.

### Cancer continuum

Coders indicated which aspects of the cancer continuum (prevention; detection/diagnosis; treatment; survivorship; and end of life) were mentioned.

### Sources

Coders recorded whether any medical journal, research institution, pharmaceutical company, NCI, or the American Cancer Society [ACS] were mentioned. Coders next recorded the citation of every medical journal, research institution (including universities and hospitals), and pharmaceutical company, as well as every citation of NCI and/or ACS.

### Tone of clinical trials

Coders evaluated whether the emotional tone regarding the treatment under trial was pessimistic, neutral/balanced, or optimistic. For example, stories where there were approximately equivalent amounts of pessimism and optimism were coded as *neutral/balanced*; stories with a tone weighted more negatively were coded as *pessimistic*; and more positive stories were coded as *optimistic*.

### Inter-coder reliability

Using stories published in 2002 and 2004, four coders received approximately 90 h of training over 4 months prior to establishing inter-coder reliability. Disagreements among coders during the interrater reliability process were resolved by discussing the differences among coders, changing the coding manual, and re-testing reliability using the updated manual. This iterative process continued until coders reached acceptable reliability levels. Reliability was rechecked every 3 months during actual coding.

Reliability was computed using Krippendorff's alpha [38]. For the full dataset, the averaged Krippendorff's alpha across reliability checks for each variable was within the range 0.7–0.89. Specific reliability ranges for each variable were: story topic: 0.62–0.80; cancer continuum: 0.68–0.96; medical journal: 0.82–0.96; research institution: 0.77–0.90; pharmaceutical company: 0.76–0.80; tone of discussion about clinical trials: 0.72–0.96; whether NCI, ACS, neither, or both were cited: 0.77–1.0.

## Results

### Most frequently cited sources

Out of  $n = 3,656$  stories, research institutions were found to be the most frequently cited source, receiving mention in roughly one-third of all cancer stories (29.73%; 95% CI = 28.25–31.21). Medical journals were the next most common source (12.30%; 95% CI = 11.27–13.41) followed by ACS (9.57%; 95% CI = 8.62–10.52), pharmaceutical companies (5.17%; 95% CI = 4.45–5.89), and NCI (4.54%; 95% CI = 3.87–5.21).

The specific research institutions, medical journals, or pharmaceutical companies mentioned in each news article were also recorded (see Table 1). Overall, the 10 most frequently cited sources were the *New England Journal of Medicine*, the *Journal of the National Cancer Institute*, the *Journal of the American Medical Association*, Johns Hopkins University, Memorial Sloan Kettering Cancer Institute, Genentech, Fred Hutchinson Cancer Center, Harvard University, H. Lee Moffitt Cancer Center, and *Science*.

### Sources and story type

To determine whether sources in cancer news stories varied by story type, we first calculated the frequency of different story types. Profiles of people with cancer, reports of cancer research, and cancer fundraisers/benefits were the most common types of stories (accounting for 73.8% of all cancer news stories). Cancer awareness/education, cancer policy/politics, lawsuit, stock market, and other stories were far less common.

Table 2 depicts the percentage of stories within each story type that cited a particular source. Research institutions were identified in the 1980 NCI analyses as the most common source in cancer news; consistent with previous research, research institutions were the most commonly cited source in almost every story type. Most notably, research institutions were frequently cited in stories about cancer research, awareness/education, fundraisers/benefits, and policy/politics. Profiles of people with cancer and stories about lawsuits rarely cited a source; however, when they did it was overwhelmingly a research institution.

As one might expect, medical journals were a frequent source in stories focused on cancer research (but rarely cited anywhere else). ACS was a common source in stories about cancer research, cancer fundraisers/benefits, cancer awareness/education, and cancer policy/politics. NCI was a frequent source in news reports of cancer research and in stories about cancer policy/politics, but rarely mentioned in any other story type.

**Table 1** Research institutions, journals, and pharmaceutical companies cited in cancer newspaper stories

Research Institutions	<i>n</i>	Journals	<i>n</i>	Pharmaceutical companies	<i>n</i>
Johns Hopkins University	38	<i>New England Journal of Medicine</i>	121	Genentech	33
Memorial Sloan-Kettering Cancer Center	35	<i>Journal of the National Cancer Institute</i>	70	Merck	13
Fred Hutchinson Cancer Center	30	<i>Journal of the American Medical Association</i>	60	AstraZeneca	11
Harvard University	28	<i>Science</i>	25	ImClone	10
H. Lee Moffitt Cancer Center	28	<i>Lancet</i>	20	Wyeth	10
M. D. Anderson Cancer Center	22	<i>Cancer</i>	14	Bristol-Myers Squibb	7
University of California at Los Angeles	20	<i>Proceedings of the NAS</i>	14	Novartis	7
Massachusetts General Hospital	16	<i>Journal of Clinical Oncology</i>	12	Eli Lilly	6
Ohio State University	16	<i>Annals of Internal Medicine</i>	11	Corixa	6
Dana-Farber Cancer Institute	15	<i>CA: A Journal for Clinicians</i>	11	OSI Pharmaceuticals	5
Institute of Medicine	15	<i>Nature</i>	11	Genomic Health	5
Yale University	15	<i>Archives of Dermatology</i>	9		

Note: Frequency that specific research institutions, medical journals, and pharmaceutical companies were cited in cancer news coverage

**Table 2** Percentage (%) of articles that mentioned a particular source by story type

	Research institution % (95% CI)	Medical journal % (95% CI)	Pharm % (95% CI)	ACS % (95% CI)	NCI % (95% CI)	<i>n</i>
Story topic						
Profile of person with cancer	15.59 (13.53–17.65)	0.17 (–0.06–0.40)	0.25 (–0.03–0.53)	3.27 (2.26–4.28)	0.67 (0.21–1.13)	1,193
Report of cancer research	64.38 (61.18–67.58)	46.10 (42.77–49.43)	9.90 (7.90–11.90)	14.30 (11.98–16.66)	12.34 (10.14–14.54)	859
Cancer fundraiser/benefit	12.77 (10.19–15.35)	0.00 (–0.20–0.20)	0.62 (0.01–1.23)	12.39 (9.77–14.85)	0.9 (0.19–1.67)	642
Cancer awareness/education	38.27 (33.46–43.08)	7.40 (4.81–9.99)	1.02 (0.03–2.01)	17.09 (13.36–20.82)	5.61 (3.33–7.89)	392
Cancer policy/politics	23.81 (18.76–28.86)	6.96 (3.94–9.98)	4.03 (1.70–6.36)	13.19 (9.18–17.20)	8.79 (5.43–12.15)	273
Lawsuit	13.85 (7.91–19.79)	2.31 (–0.27–4.89)	4.62 (1.01–8.23)	0.77 (–0.73–2.27)	0.00 (–0.90–0.90)	130
Stock story	11.76 (5.51–18.01)	0.98 (–0.93–2.89)	68.63 (59.63–77.63)	1.96 (–0.73–4.65)	0.00 (–1.2–1.2)	102
Other	32.31 (20.94–43.68)	1.54 (–1.45–4.53)	9.23 (2.19–16.27)	4.62 (–0.48–9.72)	0.00 (–1.69–1.69)	65
Cancer continuum						
Prevention	40.17 (37.33–43.01)	24.37 (21.88–26.86)	3.14 (2.13–4.15)	15.46 (13.37–17.55)	10.04 (8.30–11.78)	1,145
Detection	31.51 (29.38–33.64)	11.32(9.87–12.77)	2.84 (2.08–3.60)	12.04 (10.55 – 13.53)	5.58 (4.53–6.63)	1,828
Treatment	29.63 (27.89–31.37)	9.16 (8.06–10.26)	6.48 (5.54–7.42)	8.86 (7.78–9.94)	4.11 (3.35–4.87)	2,653
Survivorship	30.22 (27.87–32.57)	9.69 (8.18–11.20)	4.43 (3.38–5.48)	12.96 (11.24–14.68)	4.84 (3.74–5.94)	1,466
End of life	29.06 (26.66–31.46)	12.60 (10.84–14.36)	3.06 (2.15–3.97)	15.08 (13.19–16.97)	6.63 (5.31–7.95)	1,373
Clinical trials	53.63 (48.14–59.12)	21.45 (16.93–25.97)	29.65 (24.62–34.68)	9.78 (6.51–13.05)	10.73 (7.32–14.14)	317

Note: Percentages refer to the percentage of articles that mentioned a particular source

Previous research suggested that pharmaceutical companies might be a routine source in cancer news; however, pharmaceutical companies rarely appeared in cancer news, and were cited with any frequency only in news reports of cancer research and stock stories. Concerning the latter, pharmaceutical companies are the only source in the present study that also involved tradable commodities. As a result, stock stories were almost entirely about the

financial climate surrounding the stock of pharmaceutical companies.

#### Sources and the cancer continuum

Table 2 depicts how often various aspects of the cancer continuum were mentioned both overall and in relation to source citation. Treatment was mentioned the most

frequently, appearing in about three out of every four cancer news articles. Detection was mentioned in roughly half of all articles. Survivorship, end of life, and prevention were less likely to appear in stories, with prevention the least frequently mentioned aspect of the cancer continuum.

A comparison of source citation by mentions of the cancer reveals that one source dominates the coverage, namely research institutions, especially in cancer stories that mentioned prevention (research institutions were mentioned in 40.2% of prevention stories). But even when research institutions were mentioned in a lower percentage of stories, other sources also correspondingly decreased in number. Thus, research institutions seemed to have some influence with regard to all mentions of the cancer continuum.

Medical journals were cited in about one of every 10 news stories for most aspects of the continuum, except for prevention. In prevention stories, about one in four articles mentioned a medical journal. Pharmaceutical companies were rarely cited, but treatment stories were more likely to mention pharmaceutical companies.

ACS was more likely to be mentioned in continuum stories than NCI. In particular, ACS was more prevalent as a source in stories mentioning detection, survivorship, and end of life issues.

### Clinical trials

All articles in the sample that mentioned clinical trials ( $n = 317$ ) were coded for source. Table 2 depicts the percentage of clinical trial stories that cited a particular source. Research institutions were the most frequently cited source in clinical trial stories; 53.6% of clinical trial stories cited a research institution. Medical journals and pharmaceutical companies were frequently cited sources as well, appearing in about one out of every four clinical trial stories. ACS and NCI were the least frequently mentioned sources, but they still were cited in about one out of every 10 articles.

### Tone of clinical trials

Overall, news coverage tends to be favorable toward clinical trials; for example, over half of all news stories focused on clinical trials were optimistic in tone. The rest of the stories tended to depict clinical trials in a neutral or balanced tone. Very few articles were pessimistic.

To test whether there were significant relationships between sources cited and the tone of clinical trial coverage, a series of gamma tests were conducted. Two sources, medical journals and pharmaceutical companies, were significantly linked to the tone of news coverage of clinical trials (see Table 3). News articles that cited medical

**Table 3** Tone of clinical trial articles by source citation

	Pessimistic <i>n</i> (%)	Neutral <i>n</i> (%)	Optimistic <i>n</i> (%)	<i>n</i>
All clinical trial articles	31 (9.8)	126 (39.7)	160 (50.5)	317
Research institution				
Mentioned	15 (8.8)	59 (34.7)	96 (56.5)	170
Not mentioned	16 (10.9)	67 (45.6)	64 (43.5)	147
	Gamma = 0.14, $p = 0.14$			
Medical journal				
Mentioned	7 (10.3)	18 (26.5)	43 (63.2)	68
Not mentioned	24 (9.6)	108 (43.4)	117 (47.0)	249
	Gamma = 0.27, $p = 0.02$			
Pharmaceutical				
Mentioned	9 (9.6)	22 (23.4)	63 (67.0)	94
Not mentioned	22 (9.9)	104 (46.6)	97 (43.5)	223
	Gamma = 0.35, $p < 0.01$			
ACS				
Mentioned	3 (9.6)	12 (38.7)	16 (51.6)	31
Not mentioned	28 (9.7)	114 (39.8)	144 (50.3)	286
	Gamma = -0.01, $p = 0.92$			
NCI				
Mentioned	0 (0.0)	16 (47.0)	18 (52.9)	34
Not mentioned	31 (10.9)	110 (38.8)	142 (50.1)	283
	Gamma = 0.25, $p = 0.10$			

*Note:* Percentages refer to the percentage of articles that mentioned a particular source. For example, 31/317 clinical trial articles were pessimistic (i.e., 9.8%). Percentages are cumulative horizontally, not vertically

journals or pharmaceutical companies were more likely to depict clinical trials in an optimistic tone (and less likely to use a neutral or balanced tone). The same trend was observed for research institutions, but it was not statistically significant.

### Discussion

Our study explored how sources might influence the content or tone of cancer news articles. In particular, we focused on identifying prominent sources and examining whether source citation might explain trends in cancer news coverage. Content analysis revealed that research institutions—such as Johns Hopkins University, the Memorial Sloan Kettering Cancer Institute, and the Fred Hutchinson Cancer Center—were the most frequently cited source in cancer news coverage. For specific sources, the most frequently cited sources overall were unsurprisingly some of the most prominent medical institutions and organizations in the country. The citation of sources and story type (e.g., report of cancer research) varied logically;



for example, it would be expected that ACS—an organization dedicated to cancer awareness/education—would be frequently cited in cancer awareness/education stories. Clinical trials were discussed primarily with a positive or balanced tone, and pessimistic clinical trial stories were rare. The prevalence of optimistic clinical trial stories appears to be significantly linked to the abundance of citations of medical journals and pharmaceutical companies in clinical trial stories.

One surprising result of our analysis is the lack of explicit citations of pharmaceutical companies in most cancer stories. It seemed logical that pharmaceutical companies would utilize their considerable monetary resources to shape coverage, but there was more evidence that research institutions influenced stories in this manner (with the exception of research and stock stories). There is little evidence in the present data supporting the assertion that pharmaceutical companies are a routine source in cancer news.

With regard to sources and story type, our finding about pharmaceutical companies notwithstanding, certain sources varied logically by story type. Research institutions dominated all story types, which is to be expected; a profile of someone with cancer might mention the research institution or hospital where treatment occurred, or a report of new research might cite the source of the research data. As cancer research is published in medical journals, the link between reports of research and medical journals is consistent as well.

Overall, these results speak to a broader issue of what influences and drives the type of cancer news coverage available in newspapers: that is, the intricate relationship of research outcomes, perceptions of newsworthiness, accessibility of sources, and information needs of the audience. We now briefly discuss the potential influence of each.

One explanation for the particular pattern of sources cited, and the prevalence of citations of research institutions especially, may be how journalists select their sources. Journalists assess sources based upon productivity, reliability, trustworthiness, authoritativeness, articulateness, and accessibility [31]. Journalists likely turn to research institutions because such sources are perceived to be unbiased, credible, and accessible, just as research institutions have an interest in receiving news coverage and publicity. Notably, accessibility of sources is a key aspect of source selection [31, 32]. In most cases, the easier it is to obtain information from a source, the more likely it is a journalist will seek out that source. A survey of journalists from 21 top circulation newspapers confirms the importance of these characteristics; the most important variables that determined whether a source was consulted were credibility, accessibility, and time pressure [33]. Journalists turning to established, accessible sources that can provide

information quickly can explain the pattern of results of source citation uncovered here.

Results of the medical research, and the publication thereof, also can influence the sources cited in and tone of news coverage. In the case of clinical trial news coverage, one reason for the optimistic tone of clinical trial stories may be publication bias—the tendency for studies with statistically significant results to be published [39–42]. Research has established a strong link between statistically significant results of a clinical trial and later publication [41], just as other research found that journals are more likely to publish studies with statistically significant results [40]. If journalists are reliant upon medical journals as sources, more likely than not they are reading about research with significant results, and thus are affected by publication bias.

Another contributing factor to the abundance of citations of research institutions and the way that clinical trials are portrayed in news coverage may be pre-written press releases. Journalists report that the likelihood of reporting medical research is influenced by pre-written press releases [36]. Previous research has found that press releases were more likely to be written for articles deemed newsworthy by that medical journal, and articles in medical journals that are accompanied by press releases were more likely to be published in mainstream news compared to articles not accompanied by a press release [43]. Further compounding the issue, at least when press releases are involved, is the matter of content. Press releases do not give as much coverage to study limitations and may inflate the importance of a study's findings [44], underscoring the fact that journalists cannot rely solely on the press release to learn about and present research findings to their audiences. Given that the onus of presenting a story balanced in tone or including independent comment is on the reporter [22], the prevalence of optimistic and favorable stories about clinical trials suggests that this balance is not being achieved, at least in the case of clinical trial news coverage.

Finally, news organizations must also attend to the preferences and desires of their audience. Despite the progress of cancer research in recent years, “the hunger for a silver bullet remains” [45, p. 30], and in general, people prefer good news rather than bad news [46]. The emphasis on cancer treatment (e.g., where stories may highlight making progress or working toward a cure) and the optimistic tone of clinical trial coverage may be attributable, at least in part, to a response to news audience's desire for positive or good news.

#### Limitations and future directions

This study is not without its limitations. Our data reflect explicit mentions of sources in news coverage, and thus

illustrate patterns in source citation, but the influence of non-cited sources is unclear. Journalists may consult many sources when researching and writing a story without explicitly citing those sources, and it is possible that unnamed sources are influential as well. For example, the lack of explicit citations of pharmaceutical companies could indicate that pharmaceutical companies are rarely consulted as sources for news stories—but it is also possible that companies were consulted for the story but not explicitly cited, or that research institutions, working on behalf of pharmaceutical companies (i.e., through grants, donations), were pursuing a pharmaceutical agenda (i.e., a treatment-focused approach to cancer). Content analysis limits us to determining explicit patterns of source citation and does not allow us to explore broader issues of source influence. Nevertheless, this research provides more details to help explain differences in cancer news coverage, a matter raised by Slater and colleagues when they noted that influences on news coverage such as pharmaceutical companies should be explored [27].

A second limitation is that sources were grouped together into categories without differentiating between primary sources (e.g., the source of the medical research; the sponsor of a cancer fundraising event) and independent sources (e.g., sources with no conflicts of interest; sources not involved in the medical research or event). Among its many uses, independent comment can help put research results into perspective, suggest limitations to the research, and provide a more balanced tone to the story. Inclusion of an independent perspective is frequently cited as one of the most important criteria for quality, unbiased coverage of medical issues [22, 31, 47–49]. Because our data did not distinguish between primary and independent sources, we were unable to determine whether any disparities in source citation of primary and independent sources influenced our findings.

Finally, our study is limited by the nature of our sample. Because the sample was comprised of news stories published in American newspapers, results cannot be generalized to other countries or other forms of media (e.g., magazines). Findings were also culled from only 1 year of news coverage; however, as the sample was randomly drawn, coders were trained on stories from two other years of news coverage, and the sample contains stories from the top US newspapers, we are confident that our data are neither atypical nor nonrepresentative of cancer news coverage.

In this study, we analyzed explicit mentions of cancer news sources, but future research should explore less overt relationships. Current surveys of and interviews with health news reporters represent a step toward untangling the complex relationships between sources and journalists, but to go even further, the subtle influences of bodies such as

pharmaceutical companies should be explored. Analyzing funding sources for research institutions or even statements of disclosure in medical journals or reports of research may capture what an explicit content analysis could not regarding the financial stakes of cancer research, cancer news coverage, and public health. Future research should explore whether patterns of independent and primary sources explain differences in the tone of cancer news coverage, particularly stories about clinical trials. Future studies should also incorporate sources other than newspapers, as newspapers are but one news source for the public.

The purpose of this study was to understand how news sources can shape cancer news coverage. In all, cancer is now the second leading cause of death for Americans [50]. In 2005, an estimated 1.37 million Americans were diagnosed with cancer and an estimated 1,500 died each day [51]. Paradoxically, a bulk of these deaths could be prevented through the adoption of healthier lifestyles. Two-thirds of America's cancer deaths can be linked to behavioral factors such as tobacco, diet, obesity, and a lack of physical activity [52]. As cancer diagnoses escalate, the media and the public are turning more attention to health [4, 53]. If the cancer epidemic is to be abated, the news media and the sources they turn to for cancer information can likely have a considerable effect on the public's health. By demonstrating the sources utilized for reporting cancer news, and exploring the relationships between features of a news story and the sources cited therein, this analysis adds to our understanding of how news stories are shaped, which is particularly important because news sources can influence news content [22, 36, 39], thereby influencing the public and the public health.

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## Appendix: Search term

The open search included any mention of the following words, appearing anywhere in the article (an exclamation point is used for truncated searches in Lexis–Nexis):

Body<sup>25</sup> (cancer! or leukemia! or lymphoma! or melanoma! or hodgkin! or tumor! or sarcoma! or carcino! or retinoblastoma! or adenoma! or astrocytoma! or blastoma! or glioma! or macroglobulinemia! or meningioma! or mesothelioma! or mycosis! or myelo! or neoplas! or neuroblastoma! or osteosarcoma! or pheochromocytoma! or rhabdomyosarcoma! or anti-cancer! or oncol!).

Our closed search term was the following:

“OPEN TERM” and BODY (atleast 2 (cancer! or leukemia! or lymphoma! or melanoma! or hodgkin! or tumor! or sarcoma! or carcino! or retinoblastoma! or adenoma! or astrocytoma! or blastoma! or glioma! or macroglobulinemia! or meningioma! or mesothelioma! or mycosis! or myelo! or neoplas! or neuroblastoma! or osteosarcoma! or pheochromocytoma! or rhabdomyosarcoma! or anticancer! Or oncol!)) and not body((feline pre/1 leukemia) or (capricorn)).

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