

# Using Digital Surveillance to Examine the Impact of Public Figure Pancreatic Cancer Announcements on Media and Search Query Outcomes

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- Background** Announcements of cancer diagnoses from public figures may stimulate cancer information seeking and media coverage about cancer. This study used digital surveillance to quantify the effects of pancreatic cancer public figure announcements on online cancer information seeking and cancer media coverage.
- Methods** We compiled a list of public figures (N = 25) who had been diagnosed with or had died from pancreatic cancer between 2006 and 2011. We specified interrupted time series models using data from *Google Trends* to examine search query shifts for pancreatic cancer and other cancers. Weekly media coverage archived on Google News were also analyzed.
- Results** Most public figures' pancreatic cancer announcements corresponded with no appreciable change in pancreatic cancer search queries or media coverage. In contrast, Patrick Swayze's diagnosis was associated with a 285% (95% confidence interval [CI]: 212 to 360) increase in pancreatic cancer search queries, though it was only weakly associated with increases in pancreatic cancer media coverage. Steve Jobs's death was associated with a 197% (95% CI: 131 to 266) increase in pancreatic cancer queries and a 3517% (95% CI: 2882 to 4492) increase in pancreatic cancer media coverage. In general, a doubling in pancreatic cancer-specific media coverage corresponded with a 325% increase in pancreatic cancer queries.
- Conclusion** Digital surveillance is an important tool for future cancer control research and practice. The current application of these methods suggested that pancreatic cancer announcements (diagnosis or death) by particular public figures stimulated media coverage of and online information seeking for pancreatic cancer.

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Advancing our understanding of cancer media coverage and information seeking at the beginning of the 21st century is critical, particularly given the new media landscape (1,2). Although methodological tools such as content analysis (3) and self-report surveys (4) are two traditional means of study in these areas, novel tools, such as digital surveillance, have recently become available (5). Such tools hold several advantages relative to more traditional methods because they are available in near-real time, are publicly available, are of low cost, and do not rely on self-reports (6).

One area where both media coverage and information seeking are relevant, and where such digital tools can be applied, is when public figures announce cancer diagnoses or die from cancer. Such announcements can spur significant increases in cancer news coverage (7–9), exposing large proportions of the population to cancer-related messages (10). For example, studies have documented significant increases in cancer news coverage as a result of public figure announcements in the areas of breast (7,11) and cervical cancer (8,9).

Studies also demonstrate that such announcements can result in a number of specific effects. For example, the announcement of First Lady Nancy Reagan's breast cancer resulted in increased

breast cancer knowledge (10) and affected surgery choice among women undergoing breast cancer surgery (12). Similarly, announcements about Ronald Reagan's colon tumor surgery resulted in a surge of calls to the Cancer Information Service about colon cancer and increased use of early detection tests for colon cancer (13). More recently, the cervical cancer diagnosis (in 2008) and death (in 2009) of Jade Goody, a reality television star in the United Kingdom, resulted in significant increases in Google searches for "cervical cancer" and "smear test" (9) and in increases in cervical cancer screenings (9,14). In fact, one study demonstrated that cervical screenings increased by approximately 43% during the month that Goody died (14). Similarly, studies reveal that the breast cancer diagnosis of Kylie Minogue, an Australian British singer-songwriter, resulted in a 40% increase in mammography appointments (7) and an increase in breast imaging among women aged 25–44 (15). Although these studies reveal mostly positive effects of such announcements, some effects, such as choosing a more radical surgical procedure (12) or obtaining a mammogram at a young age (15), may not be clinically recommended and could potentially cause harm.

Although existing studies have demonstrated these substantive effects, gaps in the literature remain. First, to our knowledge, only a single study (conducted in the United Kingdom) has examined digital search query data to understand cancer information seeking in response to a celebrity event (9). This is despite the fact that the majority of US adults search for health information online (16) and the Internet is now the first place most individuals go to in search of health information (17). Second, there have been few contemporary studies of this phenomenon in the United States, despite several recent high-profile cancer diagnoses and deaths (18). Third, virtually all studies (18) have examined only single, major public figures or celebrities, failing to examine lesser-known figures. Finally, previous studies tend to examine either media coverage or health-related actions in isolation. Combining these topics in the same study is critical to advancing our understanding of media effects in the 21st century (19), and digital tools are well equipped to be applied in this manner.

The purpose of the study was to use digital surveillance to examine patterns of search queries and media volume for pancreatic cancer, examining the extent to which significant changes were driven by diagnoses and deaths of public figures from pancreatic cancer. We also sought to examine the *association* between media coverage (ie, news volume) and search queries, operating under the assumption that spikes in media coverage of the public figure's pancreatic cancer may result in increased information seeking (20). Finally, in addition to examining pancreatic cancer media and search queries, we also analyzed general cancer media and search queries to examine the possibility of generalized effects from public figure announcements about pancreatic cancer.

## Methods

We compiled a list of all public figures and celebrities who were diagnosed with or had died from pancreatic cancer since 2006, using numerous online publicly available data sources. Our search uncovered 25 public figures, some well known and others lesser known, that had been diagnosed with or had died from pancreatic cancer. The list included prominent producers, singers, college presidents, chief executive officers, attorneys, artists, authors, actors, Olympic medalists, and others. To address our study objectives, we analyzed all Google search queries and media in the United States for queries specific to pancreatic and all other cancers from 2006 to 2011.

### Search Query Trends

We monitored all Google queries conducted in the United States that included the terms “pancreatic cancer” or “pancreatic cancers” (pancreatic cancers) and “cancer” or “cancers” (removing queries for pancreatic cancer). Google was chosen because it is the leading search engine, with market share greater than 80% (21). Aggregate query trends were downloaded from *Google Trends* ([www.google.com/trends](http://www.google.com/trends)), a public database of worldwide Google Search queries dating back to 2004. Given that queries are increasing over time, and also that Google considers raw numbers of queries proprietary, the data are provided on a relative search volume (RSV) scale. Trends were analyzed on this RSV scale, with queries normalized to the period with the highest search proportion, eg, RSV = 100 is the highest search proportion period for that topic, and RSV = 50 is 50% of the highest search proportion period. This approach

corrects for the trending in absolute search volume that is usually increasing for all queries (22).

### Media Trends

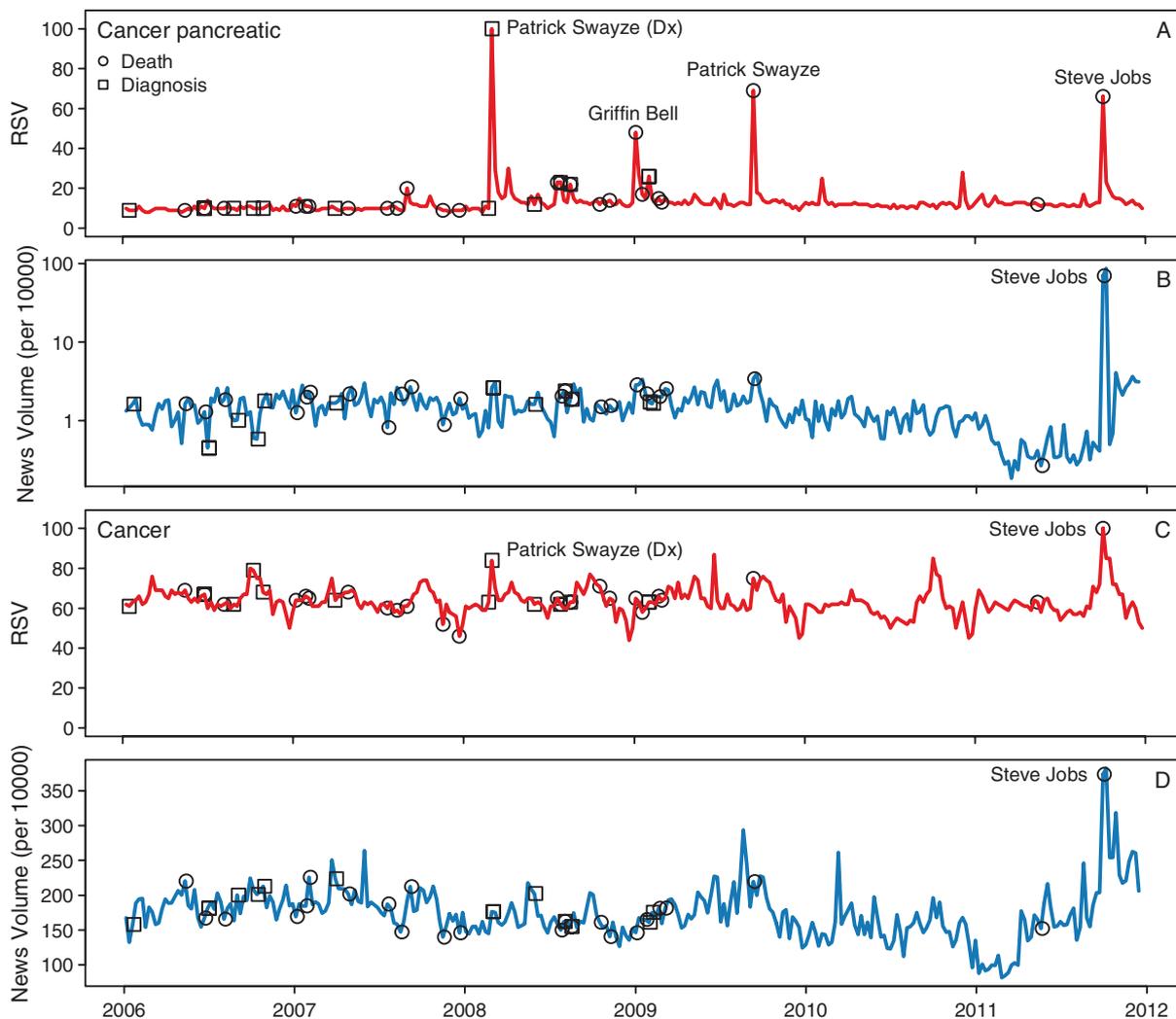
Weekly media archived on Google News that mentioned cancer or pancreatic cancer were also monitored ([news.google.com](http://news.google.com)). Google News is a free, public archive that captures a broad spectrum of English language newspapers, magazines, and news archives (23). It includes both online and print content that has traditionally been available offline only, and it contains both free and paid content. Google News uses computer algorithms to select what to include from among thousands of sources, such as major newspapers (eg, [nytimes.com](http://nytimes.com)), broadcast networks (eg, [nbcnews.com](http://nbcnews.com)), and cable news (eg, [cnn.com](http://cnn.com)). All stories on pancreatic cancer and all other cancers were monitored separately relative to all stories. We calculated “news quotients,” where the numerators were the number of sources containing the phrase “pancreatic cancer” or “pancreatic cancers” (pancreatic cancers) and “cancer” or “cancers” (all cancers minus pancreatic cancer), and the denominator was the number of sources that contained any universal conjunctive phrases, eg, “the,” thereby indicating a count of all stories. This quotient was reported per 100 000 sources.

### Analysis Strategy

Data were analyzed for weekly and daily time trends. Visual inspection of the data suggested that the likely impact of a public figure's cancer diagnosis or death was a pulse effect, an immediate change in mean media or query trends rather than a durable shift. As a result, we specified interrupted time series models (24) to compare the mean value around and including celebrity diagnosis or death (2 weeks before, the week of, and 2 weeks after) to capture these spikes in reference to the mean search or news volume during the entire study period. The mean volume for the entire study period was calculated without the month of October and the last 2 weeks of December to adjust for potential confounding due to breast cancer awareness month and the Christmas and New Year holidays. The change in media or search query trends was estimated as a ratio between diagnosis or death period and the reference period to make estimates comparable across individual public figures (25). Traditional model diagnostics were used to ensure nonviolation of traditional linear regression assumptions (26), and Augmented Dickey–Fuller tests were used to test for nonstationarity of the time series (27). The results of these diagnostics suggested that our approach was properly specified.

## Results

Figure 1 shows that pancreatic cancer and other cancer search query trends spiked around the diagnosis and death of some of the public figures in the United States. For instance, pancreatic cancer queries reached a high (RSV = 100) in the period 2006–2011 around the time of Patrick Swayze's diagnosis (Figure 1A), and all other cancer queries reached a high (RSV = 100) during 2006–2011 around the time of Steve Jobs's death (Figure 1C). On the other hand, media trends had pronounced increases, reaching all-time highs, in both pancreatic (Figure 1B) and all other cancer (Figure 1D) news coverage on Steve Jobs's death, potentially



**Figure 1.** Search and media trends for pancreatic cancer and other cancers in relation to the diagnosis and death of public figures. RSV = relative search volume.

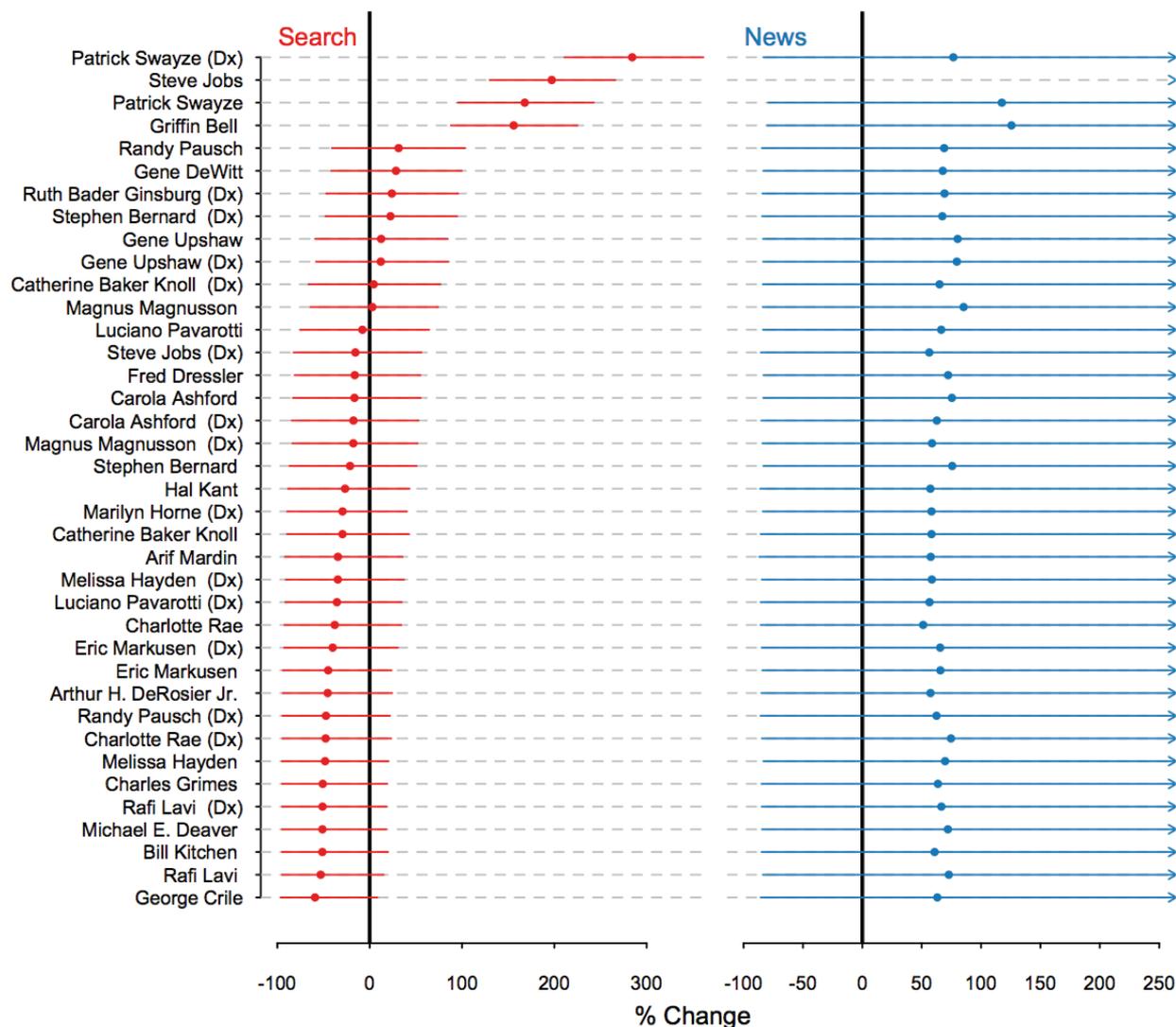
masking more subtle variation around the timing of other public figures' pancreatic cancer diagnosis and death.

Statistical analysis suggested that public figures' pancreatic cancer diagnosis and death were associated with increases in cancer queries and media trends, though the associations were highly variable. On average, a public figure's diagnosis or death was associated with a 28% (95% confidence interval [CI]: 10 to 48) increase in pancreatic queries and an 11% (95% CI: -0.6 to 22) decrease in all other cancer search queries (although not statistically significant). Similarly, a public figure's diagnosis or death was associated with a 183% (95% CI: 63 to 511) increase in pancreatic cancer media coverage and a 6% (95% CI: -7 to 18) decrease in all other cancer media coverage (although not statistically significant).

Figure 2 shows all public figure diagnoses and deaths ranked according to the associated increase in pancreatic cancer search query and media volume. Patrick Swayze's diagnosis was associated with a 285% (95% CI: 212 to 360) increase in pancreatic cancer search queries, followed by a 167% (95% CI: 96 to 265) increase around the time of his death. Other notable increases included Steve Jobs's death and Griffin Bell's death, with search queries increasing 197% (95% CI: 131 to 266) and 155% (95% CI: 88

to 225), respectively. Figure 3 shows all public figures diagnosis and death ranked according to the associated increase in all other cancer search query and media trends. The increase in all cancer search queries was marginal for all public figures, and only marginally statistically significant for Steve Jobs's death (41%; 95% CI: -3 to 86). As appreciable from Figure 1, Steve Jobs's death was associated with large statistical increases in pancreatic and other cancer media coverage, increasing 3517% (95% CI: 2882 to 4492) and 92% (95% CI: 47 to 137), respectively. None of the other 24 public figure diagnoses or deaths were associated with statistically significant increases in pancreatic or other cancer news coverage.

Pancreatic and other cancer media coverage explained moderate amounts of variance in pancreatic and all cancer search queries. The value of multiple  $r^2$  was 0.60 for pancreatic search queries and 0.73 for all cancer search queries. Figure 4 compares the magnitude of effect sizes for search query and media trend increases around specific public figures' diagnosis and death by pancreatic cancer and all other cancers. Analyses showed that the effect of increasing media exposure on searches was differential between queries on pancreatic and all cancers. Increases in media fostered larger increases in pancreatic searches compared with all cancer searches,



**Figure 2.** Increases in search and media trends for pancreatic cancers. News increases due to Steve Jobs's death were removed from the figure as outliers ( $P < .0001$ ).

suggesting increases in pancreatic media coverage had increasing returns on pancreatic queries (slope  $> 1$ ) but increases in other cancer coverage had a smaller impact on all cancer queries (slope  $< 1$ ). As such, a doubling in pancreatic cancer media coverage corresponded with about 325% increase in pancreatic cancer queries, but a doubling in other cancer media coverage corresponded to about a 60% increase in other cancer queries.

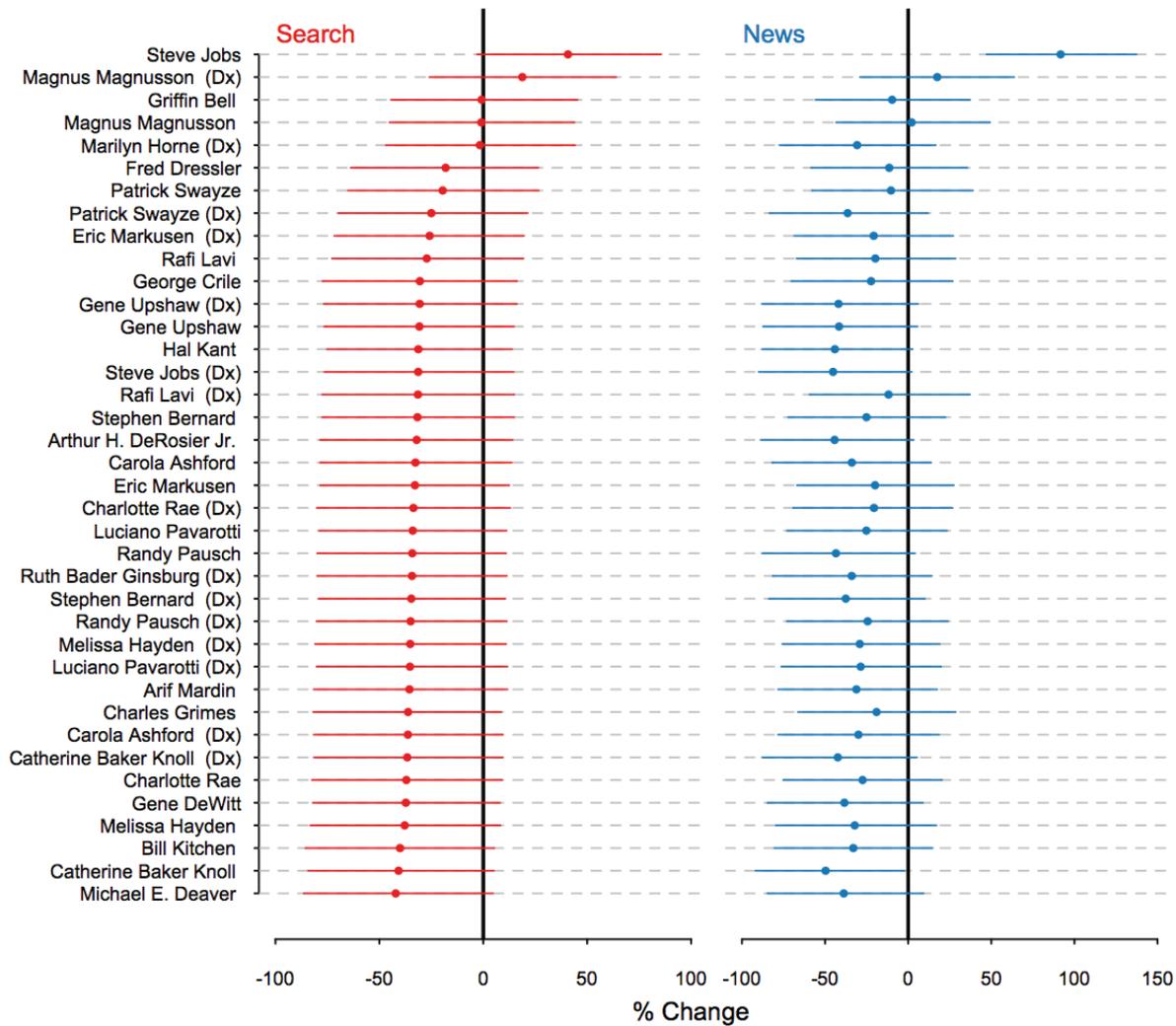
## Discussion

The changing media environment has brought with it significant increases in online cancer information seeking, media availability, and consumption (4). As the 21st-century cancer communication landscape evolves (2), so should our methods for studying this landscape (28). The current study applied innovative digital surveillance methods to study trends in pancreatic cancer information seeking and media coverage. Our results indicated that, on average, a public figure's diagnosis or death was associated with increases of 183% in pancreatic cancer media coverage and 28% in pancreatic search queries. However, results were highly variable, and analysis of individual

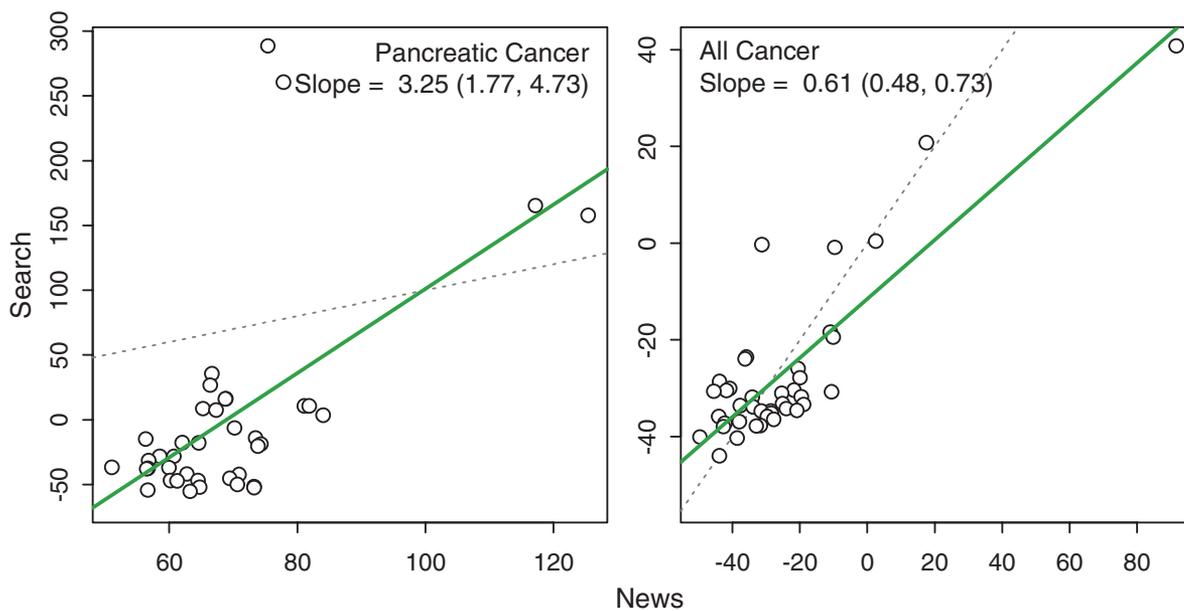
public figures revealed that most public figure diagnoses and deaths had little to no appreciable effect on media coverage or search queries.

In contrast with most of the public figures, Patrick Swayze's diagnosis and death, in addition to Steve Jobs's death, resulted in significant increases in search queries for pancreatic cancer: 285%, 167%, and 197% increases, respectively. Swayze's diagnosis thus resulted in more pancreatic search queries than any other event, although both Swayze's and Jobs's deaths resulted in similar levels of pancreatic cancer searches. Interestingly, one other public figure also demonstrated an effect—Griffin Bell (attorney general under President Jimmy Carter)—whose death was associated with a 155% increase in pancreatic cancer searches. These results are consistent with those from previous studies that demonstrate that public figure cancer diagnoses or deaths can stimulate significant cancer information seeking on the part of the public (20). However, they go beyond most previous studies (18) by demonstrating these effects using unobtrusive digital surveillance rather than more traditional self-report surveys.

With reference to media coverage, only Steve Jobs's death was associated with (very large) increases in pancreatic cancer media



**Figure 3.** Increases in search and media trends for other cancers.



**Figure 4.** The relationship between media and search around celebrity cancer events. The solid line indicates best fit regression, and the dotted line indicates slope of 1.0 (ie,  $y = x$ ). The data on Steve Jobs were removed from the panel on pancreatic cancer as outliers ( $P < .0001$ ).

coverage and with increases in general cancer media coverage. In addition, our analyses examining the association between news and search *did* suggest that increases in media coverage are at least partly responsible for increased search query volume, especially for pancreatic cancer but also for cancer in general. Thus, in the new media landscape, media coverage of cancer appears to play a role in stimulating cancer information seeking online.

### Digital Surveillance in Cancer Prevention and Control

The methods used in this study are innovative and can be broadly applied to cancer prevention and control. Indeed, a major challenge in cancer control is how to evaluate and respond to population health trends in real time given sparse data streams. Traditionally, data are unlikely to be collected on the same time line as serendipitous cancer-related events unfold. Digital surveillance provides a pathway to potentially study population trends in near-real time, taking place rapidly and covering gaps where traditional cancer surveillance may not exist or may be limited. Given the instantaneous availability of our data and the cost-effective manner by which the data can be examined, the approach we use has strong potential as an adjunct to more traditional surveillance.

It is perhaps no surprise, then, that search query data are increasingly being used for digital surveillance purposes (5,29). Applications have appeared in areas as diverse as chicken pox (30), Lyme disease (31), influenza (32), dengue fever (33), and mental health (34). In tobacco control, these methods have recently been used to examine trends in sales and popularity of e-cigarettes (35), to evaluate the global effects of “World No Tobacco Day” (36), and to monitor tax avoidance and smoking cessation related to the “State Children’s Health Insurance Program” cigarette tax increase (37). As shown in the current study, applying these methods to cancer information seeking can give researchers a near-real-time view of what cancer topics are being searched for when, and research tying search patterns to key events in public life can advance our understanding of cancer information seeking online. Moreover, the current study demonstrated the value of examining associations between media volume and search queries, and future studies might apply these same methods to studying trends in blogging and posting on social media sites (38–42).

Although digital surveillance methods comprise a fruitful set of tools, it is important to note that they may not tell us everything we want to know, such as *who* is searching or consuming media. This observation suggests that these methods may at times be complementary to other methods, such as survey research (43), content analysis (9), and/or medical data (14). For instance, a recent survey of employees at a large public university found a spike in pancreatic cancer information seeking in the wake of Steve Jobs’s death, similar to this study. However, the same survey also revealed that Asian race, lower education, higher identification with Steve Jobs, and higher cancer worry in response to Jobs’s death were associated with pancreatic cancer information seeking (43).

### Study Limitations

Although this study demonstrates the value of digital surveillance, it is not without its limitations. First, we only examined search queries on one search engine—Google—although it is the primary search engine used today, with a market share greater than

80% (21). One study suggests that in comparison with Yahoo (8% market share) or Bing (5% market share) (21), Google may capture users who are slightly younger, with higher income, and from larger households (44). Second, although Google data are informative, they do not tell us *who* searched, and we also do not know what web sites were visited and which news stories were read. Third, because the term “cancer” is sometimes used in different ways (eg, as a metaphor), it is possible that this reduced our ability to detect effects about general cancer when compared with that of pancreatic cancer (a more precise term). Fourth, we only examined media coverage in terms of volume, not placement of news stories or content. Finally, time series analyses make inferences of causality, and it is always possible that other unknown events influenced our findings.

### Conclusion and Implications for Cancer Communication

The current study suggests that particular public figure cancer diagnoses and deaths garner significant attention from both the media and the public. These events may thus provide an opening for cancer communicators to promote prevention and detection messages, eg, placing sponsored links with search engines might be considered. Thus, when an individual searches for “Steve Jobs,” sponsored links with high-quality information about pancreatic cancer could be provided, as could links related to cancer prevention and screening for other cancers. Social media and news sites could also be leveraged to reach individuals online, such as using targeted advertisements directed at those who post about or read articles about Steve Jobs. Cancer-related organizations could prepare digital and other communication materials in advance and be ready to deploy them on learning of the death of a major public figure. In this manner, these unfortunate and often premature deaths could be used to bolster population-level cancer education and prevention efforts.

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