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Celebrity Cancer on Twitter: Mapping a Novel Opportunity for Cancer Prevention

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Abstract

Social media platforms have the potential to facilitate the dissemination of cancer prevention and control messages following celebrity cancer diagnoses. However, cancer communicators have yet to systematically leverage these naturally occurring interventions on social media as these events are difficult to identify as they are unfolding and little research has analyzed their effect on social media conversations. In this study, we add to the research by analyzing how a celebrity cancer announcement influenced Twitter conversations in terms of the volume of social media messages and the type of content. Over a 9-day period, during which actor Ben Stiller announced that he had been treated for prostate cancer, we collected 1.2 million Twitter messages about cancer. We conducted automated content analyses to identify how often common cancer sites (prostate, breast, colon, or lung) were discussed. Then, we used manual content analysis on a sample of messages to identify cancer continuum content (awareness, prevention, early detection, diagnosis, treatment, survivorship, and end of life). Chi-square analyses were implemented to evaluate changes in cancer site and cancer continuum content before and after the announcement. We found that messages related to prostate cancer increased significantly more than expected for 2 days following Stiller's announcement. However, the number of cancer messages that described other cancer locations either did not increase or did not increase by the same magnitude. In terms of message content, results showed larger than expected increases in diagnosis messages. These results suggest opportunities to shape social media conversations following celebrity cancer announcements and increase prevention and early detection messages.

Keywords

celebrity cancer announcements, twitter, content analysis, cancer prevention, prostate cancer

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When actress Angelina Jolie discussed her preventative mastectomy[1] or Brazilian President Lula da Silva announced his diagnosis with laryngeal cancer,[2] attention to cancer increased. Indeed, such events have been observed with sufficient frequency that they have been called "naturally occurring interventions." Celebrity cancer announcements offer opportunities to increase public engagement with cancer and, in so doing, potentially decrease the incidence and severity of the disease.[3] Previous research has found that these announcements have the potential to increase prevention and control behaviors, like smoking cessation,[2] and early detection behaviors, like testing for colon cancer before symptoms are experienced.[4] However, these events occur without notice and do not last long. As a result, health communicators have yet to identify strategies to systematically leverage these events to further increase engagement with cancer prevention and control.[3] Social media website platforms such as Facebook and Twitter present an opportunity for leveraging celebrity announcements, as they

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allow cancer communicators to respond quickly and communicate directly with targeted audiences.

Previous research has found that celebrity cancer announcements increase online information seeking, as measured by Google queries[2] and the use of online cancer resources.[1] However, to date, no research has considered how these events influence the volume and topic of cancer-related messages on social media. Survey research examining celebrity cancer announcements suggests that people learn about celebrity illness from social media,[5] indicating that these platforms would be an important source of information following a celebrity cancer announcement. Although previous research on cancer communication on social media websites has examined the presence of social support and awareness messages,[6,7] to our knowledge, no research has examined how the content of social media messages relates to the cancer continuum, which includes awareness, prevention, early detection, diagnosis, treatment, survivorship, and end of life.[8,9] This is of particular interest for cancer communicators as the translation of knowledge across the continuum has the potential to reduce cancer burden.[10] A change in the information content of messages, as it relates to the cancer continuum, may indicate that social media users are more receptive to certain types of content following a celebrity announcement.

In this study, we use actor and director Ben Stiller's 2016 announcement about prostate cancer treatment to examine how social media conversations change in response to celebrity cancer announcements, both in terms of the volume of messages related to specific cancer sites and the content of those messages as it relates to the cancer continuum. On October 4, 2016, Stiller tweeted to his 5.1 million followers that he had been treated for cancer and that a "test" had saved his life (Stiller, 2016).[11] By analyzing the social media reaction to this event, we hope to begin to provide the research base that will allow cancer communicators to strategically use social media in response to these events and increase cancer prevention and control behaviors, ultimately reducing the incidence and severity of disease.

Methods

Data Collection

Between September 30 and October 8, 2016, we collected 1.2 million unique Twitter messages that contained one of 6 keywords commonly used to describe cancer (cancer, chemo, malignant, tumor, biopsy, and metastasizing). Messages were collected from the streaming API, using our server-based system that continuously collects messages containing preidentified keywords as those messages are created. As previous research examining increases in topic attention on Twitter suggests that spikes in attention have a short duration,[12] we opted to analyze 9 days of messages: 4 before Stiller's announcement, the day of the announcement (1), and 4 days after.

Automated Computer Coding

Using standard computer coding methods,[13] we conducted a series of keyword analyses to identify messages that described one of the 4 most common cancers (prostate, breast, lung, and colorectal).[14] We also coded for messages that mentioned Ben Stiller. We verified the accuracy of this coding by drawing repeated random samples to spot-check coding. Messages that contained pink, breast, mammogram, or BCAM (Breast Cancer Awareness Month) were coded as breast cancer messages. Messages that contained prostate, Movember, PCSM (Prostate Cancer Awareness Month), and PSA (prostate-specific antigen) were coded as prostate cancer messages. Messages that contained lung or LCSM (Lung Cancer Social Media) were coded as lung cancer messages. Messages that contained colon, colonoscopy, rectal, colorectal, or bowel were coded as colorectal cancer messages. Messages that contained Stiller or Stiller's Twitter handle (@RedHourBen) were coded as Stiller. Codes were distinctive but not mutually exclusive; each message was coded for the presence or absence of each characteristic and could be coded for multiple characteristics.

Manual Content Analysis

In order to evaluate the content of messages, we drew a random, stratified, proportional sample of 2000 messages, following best practices for sample construction over time.[15-17] Messages were then coded for their place on the cancer continuum using a coding scheme that was developed based on previous research examining mediated cancer story content[8,9] and previous research examining cancer content on Twitter.[7,18] Following a brief training session, during which researchers discussed the coding scheme and practiced coding with sample messages, 2 coders each coded 100 randomly selected messages to establish intercoder reliability (ICR). In general, ICR, which was measured using Krippendorff α,[19,20] was high (0.7 or above; see Table 1). Following establishment of ICR, the rest of the sample was coded independently by one coder.

Message content was coded for its relationship to the cancer continuum, as the goal of the study was to investigate whether celebrity announcements influenced the type of cancer information communicated on social media and evaluate whether these announcements have the potential to change the information environment and increase interest in information related to certain aspects of the cancer continuum. Messages that included information about awareness, cancer prevalence, and general research were coded as awareness information. Messages that included information about risk factors (eg, smoking), prevention behaviors, or prevention-related research were coded as risk and prevention information. Messages that included information about symptoms or early detection tests (eg, mammograms) were coded as early detection. Messages that described a diagnosis occurring (past or future) or described research about cancer diagnosis were coded as diagnosis. Messages that described treatment occurring (past or future) or a particular treatment, including research, were

Table 1. Tweet Content: Definitions, Descriptive Information, Intercoder Reliability, and Examples.

Variable	Definition	Descriptive Information (n, % of Total)	Intercoder Reliability[a]	Example Tweets[b]
Awareness	Fundraising, cancer prevalence, colors (pink), general research.	636, 38.4%	$\alpha = 0.84$	RT @name: WEAR YELLOW TO TOMORROW'S HOME FOOTBALL GAME IN SUPPORT OF CHILDHOOD CANCER The brain cancer walk is tom in Audubon Park Shelter 10 @ 8am! If you didn't register, you can register there starting at 7am! #AshleysArmy
Risk and prevention	Risk factors (eg, smoking), prevention behaviors, research.	130, 6.5%	$\alpha = 0.92$	Fruit and veg! #prevent #cancer! @name @name @name https:\t.co11s7FSEXfE RT @name: Being physically active decreases the risk of these cancers.. #exercise #Healing #cancer #Fitness #Health #Wellness https:\u2026
Early detection	Symptoms, signs, tests (eg, PSA test), research.	278, 16.8%	$\alpha = 0.91$	RT @name Early Signs Of The Silent Killer Ovarian Cancer . . . https:\t.coiMusD5esmT Thankful my dad got the PSA test . . . @name opens up about prostate cancer diagnosis. https:\t.coTQvdkwsHNF
Diagnosis	Personal experience and research.	82, 5.0%	$\alpha = 0.75$	RT @name: When your child has cancer, you go into survival mode. A mom reflects on her child's #pediatriccancer diagnosis RT @Maddieee_Dianne: Today was pink out day for breast cancer. Last week my aunt was diagnosed with stage three. Everyone keep her in you2026
Treatment	People in/remembering treatment and research.	382, 23.1%	$\alpha = 0.82$	Praying for my grandma to have a successful surgery for her breast cancer tomorrow RT @name: This teacher has cancer and 400+ students came to sing outside his house, this is so beautiful https:\t.coOBQLMizba1
Survivorship	Messages about life after treatment, includes research.	100, 6.0%	$\alpha = 0.85$	Today, on the way home from finding out that my cancer is still in remission I almost pulled out in front of a speeding fire truck. Typical. RT @name: Combined #aerobic and #resistance training improves #bone #health of female cancer survivors https:\t.coM8F7rzmMKA httpu2026 RT @name _Bang: Cancer took both heads of my family tree #FvckCancer https:\t.coQhbg6spLGN
End of life	Information, experiences, and research related to death.	73, 4.4%	$\alpha = 1$	Rest In Peace, abuelita Licha. Breast cancer took u from us way too soon, I'll forever have u looking over us. ud83dudc97u2026 https:\t.cokBb1B8VyEG

Abbreviation: PSA, prostate-specific antigen.
[a]Intercoder reliability was measured using Krippendorff α.[20]
[b]Account names have been anonymized.

coded as treatment. Messages that described life after treatment, including research related to survivorship, were coded as survivorship. Messages that included information related to cancer death and dying were coded as end of life. Definitions for each code, example messages, descriptive statistics, and ICR assessments are presented in Table 1. Like the automated codes, manual codes were distinctive but not mutually exclusive; each message was coded for the presence or absence of each characteristic and could be coded for multiple characteristics.

Analysis

As the length, in terms of days, that the celebrity announcement would increase interest on Twitter was unknown, we first conducted a descriptive and visual analysis of the data, plotting the number of cancer messages by type and by day, to identify before and after time periods of equal lengths. We then used χ^2 analysis[21] to assess whether there was a significant change in the volume of messages before and after the announcement. As the coded variables were distinct but not mutually exclusive, we conducted separate analyses for each cancer site and each cancer continuum category. In order to reduce the likelihood of type I error, we took a conservative approach and divided the significance value ($P = .05$) by the number of comparisons in each set of analyses.[22] In some cases, the χ^2 analyses were not significant or the standardized residual (z) was between -1.96 and 1.96; in those cases, the results were not interpreted.[21] We used odds ratios to evaluate the magnitude of any significant effects. All analyses were conducted using SPSS version 24.

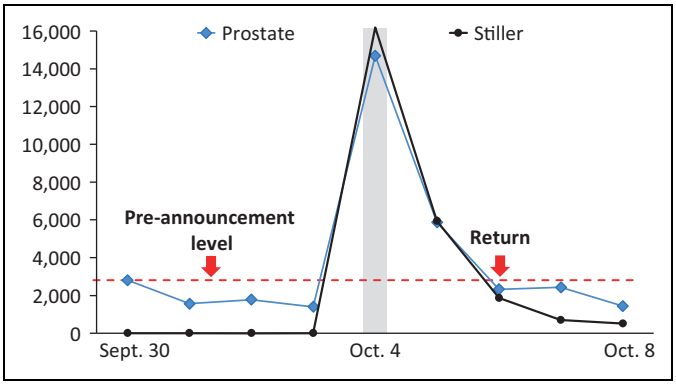

Figure 1. The volume of Twitter messages containing keywords related to prostate cancer or actor Ben Stiller over the course of the study period (September 30 to October 8, 2016). Notice the sharp increase in messages on October 4 and 5, following Stiller's announcement.

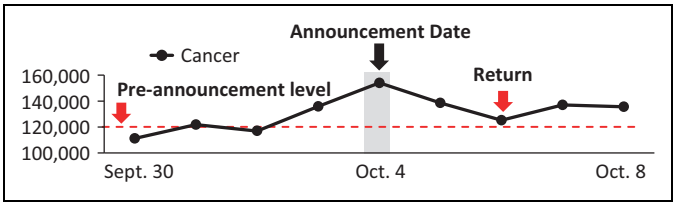

Figure 2. The total volume of cancer-related Twitter messages collected each day during the study period.

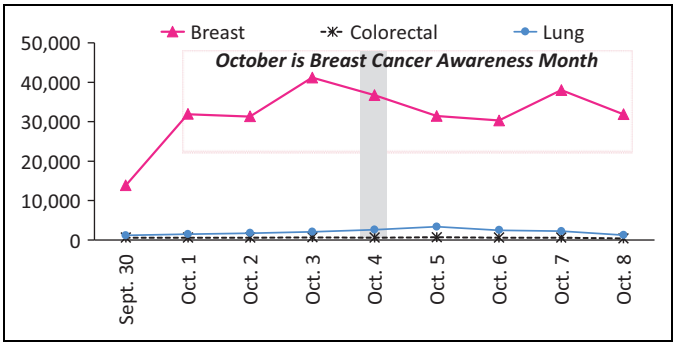

Figure 3. The volume of messages containing keywords related to breast, colorectal, and lung cancer during the study period. Notice the sharp increase in breast cancer messages beginning on October 1, the first day of Breast Cancer Awareness Month.

Results

Over the course of the study, most messages did not contain keywords related to one of the 4 major cancers or Stiller (n = 833 051). These messages either contained keywords related to another cancer or did not name a specific cancer. Approximately one-third of messages contained keywords (29.1%, n = 342 053) related to one of the 4 major cancers. Very few messages (n = 1 236, 0.00%) contained keywords related to more than one cancer. However, most of the Stiller messages also contained keywords related to prostate cancer (n = 16 890, 81.2%); very few (n = 11) contained keywords related to other cancers. In addition, all of the Stiller messages (n = 20 812) occurred after the announcement. After examining the Stiller messages that did not contain prostate cancer keywords (n = 3922), we concluded that these messages were also about prostate cancer and that the 2 categories were not distinctive. As a result, we combined these messages into one category, prostate cancer, for analysis. Of the cancer-specific messages, breast cancer messages (n = 286 696) appeared most often in the data set, followed by prostate cancer messages (n = 38 195), lung (n = 18 435), and colorectal messages (n = 5258).

Some the prostate cancer messages were replies (n = 189) to or retweets (n = 3551) of Stiller's original message. Although Stiller had a substantial number of followers at the time of the announcement (5.1 million), the retweets quadrupled exposure to his original message. The accounts retweeting Stiller's message had a *median* of 354 followers (interquartile range = 131-932). Retweeting of Stiller's message resulted in an estimated 21.2 million additional exposures to his message.

Visualization of traffic data shows a sharp increase in the number of total messages and the number of prostate cancer messages on October 4, the day of Stiller's announcement (see Figure 1). After October 4, the total number of cancer messages decreases by approximately 10% a day, returning to preannouncement levels on October 6 (see Figure 2). We also see an increase in breast cancer messages and awareness messages on October 1, the first day of BCAM (Figure 3). In order to compare the volume of messages before and after Stiller's announcement, messages (n = 252 873) that occurred 2 days prior (October 2 and 3) to the announcement were compared to messages (n = 292 682) that occurred on the day of the announcement and the day following (October 4 and 5).

After Stiller's announcement, significantly more messages than expected contained keywords related to prostate cancer message. Based on the odds ratio, the odds of a message containing keywords related to prostate cancer was 6.77 times higher if the message was sent after the announcement (see Table 2). Other cancer-site messages did not show a similar pattern. The odds of a message containing keywords related to breast cancer was less likely after the announcement (0.76), as were the odds of a message containing keywords related to colorectal cancer (0.88). Although the number of lung cancer messages increased significantly more than expected after Stiller's announcement, the magnitude, as indicated by the odds ratio, was much smaller than the change in prostate cancer messages. The odds of a message containing keywords related to lung cancer was 1.4 times higher after the announcement.

Message Content

In terms of the influence on the cancer continuum content of messages, Stiller's announcement coincided with an increase in the number of diagnosis messages that was significantly larger than expected (see Table 3). The odds of a message containing diagnosis content was 3.1 times higher after the announcement.

Table 2. Chi-Square Analyses Examining Volume of Messages Before and After Stiller's Announcement.[a]

	χ^2 (*df*)	*P*	Before (October 2 and 3)	After (October 4 and 5)	Total
Total tweets	–		252 873	292 682	525 555
Cancer site			n (% of time period)		
Prostate	13 089.28 (1)	.00	3170 (1.3%)	23 150 (7.9%)	26 320
Standardized residual			−81.8	76	
Breast	2056.06 (1)	.00	72 536 (28.7%)	68 191 (23.3%)	140 727
Standardized residual			28.6	−26.6	
Colorectum	10.50 (1)	.00	1249 (0.5%)	1271 (0.4%)	2520
Standardized residual			2.4	−2.2	
Lung	218.00 (1)	.00	3821 (1.5%)	5981 (2.0%)	9802
Standardized residual			−10.7	10.0	

[a]In order to control for type I error, the significance value for this set of analyses was set at 0.05 and divided among the tests. As a result, the test-level significance value was $P < .02$.

Table 3. Chi-Square Analyses Examining Cancer Continuum Content Before and After Stiller's Announcement.[a]

	χ^2 (*df*)	*P*	Before (October 2 and 3)	After (October 4 and 5)	Total
Total tweets	–		346	438	784
Cancer continuum content			n, (% of time period)		
Awareness	12.57 (1)	.00	160 (46.2%)	148 (33.8%)	308
Standardized residual			2.1	−1.8	
Risk and prevention	0.11 (1)	.74	34 (9.8%)	40 (9.1%)	74
Standardized residual			0.2	−0.2	
Early detection	0.12 (1)	.73	53 (15.3%)	71 (16.2%)	124
Standardized residual			−0.2	0.2	
Diagnosis	10.59 (1)	.00	10 (2.9%)	37 (8.4%)	47
Standardized residual			−2.4	2.1	
Treatment	8.17 (1)	.00	55 (15.9%)	106 (24.2%)	161
Standardized residual			−1.9	1.7	
Survivorship	2.55 (1)	.11	19 (5.5%)	37 (8.4%)	56
Standardized residual			−1.1	1.0	
End of life	0.01 (1)	.94	17 (4.9%)	21 (4.8%)	38
Standardized residual			0.1	0.0	

[a]In order to control for type I error, the significance value for this set of analyses was set at $P < .05$ and divided among the tests. As a result, the test-level significance value was $P < .01$.

No other cancer continuum categories showed significant increases following the announcement.

Overall, during the 9-day study period, messages most often contained information related to awareness (n = 636, 38.4%). Fewer messages contained information about treatment (n = 382, 23.1%) and early detection (n = 278, 16.8%). A small proportion of messages contained information related to prevention and risk information ($n = 130$, 7.9%), survivorship (n = 100, 6.0%), diagnosis (n = 82, 5.0%), or end of life (n = 73, 4.4%).

Discussion

Just as celebrity cancer announcements increase media coverage of cancer and general awareness, these announcements also increase the volume of social media messages related to cancer and have the potential to influence the content of messages, as that content relates to the cancer continuum. At the same time, the increased interest following an announcement does not last long. The analysis from this study suggests that the increased interest in the cancer type and the change in message content last 2 days. This suggests that cancer communicators need to respond quickly to capitalize on these naturally occurring interventions.

Despite the short time period, these events create a spike in attention. Following Stiller's announcement, the number of Twitter messages related to prostate cancer increased substantially. The results did not show a similar increase in messages related to other major cancers. This increase in cancer conversation related to prostate cancer far exceeded the interaction that occurred between Stiller and his followers in the form of replies and retweets. At the same time, the direct interaction with Stiller's message was substantial and increased the reach of Stiller's message: His original message was retweeted more than 3000 times, resulting in more than 21 million potential exposures to the message.

The increase in prostate messages does not account for total increase in cancer messages that occurred during that same

time period. However, it is unclear from these results whether this increase is attributable to Stiller's announcement or to other factors, like BCAM. What is notable is that many messages did not contain keywords related to any of the 4 major cancers. Some of these messages may contain references to other cancer sites; however, another possibility is that people do not necessarily discuss cancer in terms of cancer site, as medical specialists do. For example, Stiller's original tweet (Stiller, 2016)[11] does not use a key term to indicate prostate cancer: He only mentions that he had cancer.

The increase in lung cancer messages that coincided with the increase in prostate cancer may be an indication of other celebrity cancer announcements. During this time period, British actress Leah Bracknell announced that she had been diagnosed with lung cancer, and officials at Louisiana State University announced that the school's mascot, Mike the Tiger, had terminal lung cancer. Although these lesser known celebrities did not create the same spike in attention that Stiller did, they did create a noticeable bump that may be more important than its size suggests as it shows how small celebrities, and even famous animals, can draw attention to cancers that are less prevalent in social media discussions. In this study, the number of breast cancer messages far exceeded the number of messages related to prostate, colorectal, and lung cancer—even though these other cancers are also highly prevalent in the population.[14]

In addition, these smaller celebrities may create opportunities to reach audiences who are likely to experience health disparities. Previous research on celebrity announcements suggests that people who identify with a celebrity are more likely to seek information and more likely to talk to others about cancer.[23,24] So, for example, Mike the Tiger's terminal lung cancer could create an opportunity to engage Louisiana State fans in rural areas on the topic of lung cancer prevention, even though Mike is not human. For example, messages could urge fans to honor Mike's memory by quitting smoking.

In terms of the content of messages, the results of this study showed large numbers of awareness messages; however, few messages contained information related to prevention and risk or early detection. Although awareness messages play a role in cancer control, these messages do not provide information that would help people engage in behaviors that prevent potential cancers. However, prevention and early detection messages have the potential to alter behaviors and improve cancer outcomes across the cancer continuum. The lack of prevention information in social media messages following a celebrity announcement is similar to the lack of attention to this topic in newspaper coverage of cancer both in general[25] and during these events.[26] News coverage generally focuses attention on the people involved and their individual stories. These stories rarely include information about common risk factors, early signs and symptoms, and protection strategies.[26] This is the type of information that cancer communicators could supply on social media; unlike news media, social media allows cancer communicators to directly communicate with audiences. For example, in the case of Stiller's announcement, cancer communicators could discuss early detection of prostate cancer, the pro/cons of the PSA test, and those at risk for prostate cancer. Or, cancer communicators could use the moment to discuss other, more general strategies for cancer prevention, like the importance of everyday behaviors (eg, eating fruits and vegetables, exercising, not smoking).

Engaging in this type of strategy would require cancer communicators to react to on-going events in addition to their existing strategies of creating a campaign. To be most effective, these messages would likely need to leverage the relevant aspects of the celebrity event. For example, in the case of the Stiller event, messages could focus on early diagnosis of prostate cancer. Although these messages could draw on past campaign materials, cancer communicators would also need to identify which audiences would be most likely to respond to the celebrity announcement and what information would be most helpful to those audiences, given the specific details of the event. In the case of Stiller, the audience most likely to respond may be young men in their 20s and 30s. Leveraging these events would allow organizations to correct misinformation or highlight prevention strategies that were not covered in the news media. For example, the coverage of British reality television star Jade Goody's illness and death from cervical cancer rarely mentioned the human papillomavirus vaccine.[26]

In order to do this effectively on social media, more research is needed on how to increase the reach of cancer messages per se on social media through message passing. Message passing (sharing on Facebook and retweeting on Twitter) substantially increase message reach, as the example of Stiller's message shows, spreading the message beyond the followers of the original sender. As a result, this measure is often used as a metric of message success and engagement on social media.[27,28] While evidence regarding cancer-specific strategies is more limited, research has identified effective strategies for increasing the reach of social media messages relating to public health and safety, and it is plausible that many of these strategies will also be applicable in the cancer domain. For example, social media messages have the option of including #hashtags, which serve to organize messages as part of virtual conversations. This feature has been found to increase message passing in the hazard context, likely because it allows messages to be seen by others who are interested in the same topic.[13] In the case of the Stiller announcement, including a hashtag related to the event would increase the likelihood that users who were interested in Stiller's illness saw the message. Other relevant message strategies that increase retweeting are including picture with a message[29,30] and posting content relevant to the event.[29]

Future Research and Limitations

Although this study did not examine how this celebrity announcement effected the retweeting of cancer-related messages, research on health messages related to emerging infectious diseases suggests that messages are more likely to be passed on or retweeted during moments of increased

saliency.[29] Future research should examine how often cancer communicators are sending social media messages during these events and whether these messages have an increased reach during these events. In addition, future research should consider what types of messages would be most appropriate to send during these events and which messages would be most likely to encourage behavior change related to prevention and early detection activities. In order to answer these questions, researchers should examine the tone of messages sent in response to these events and the emotional reactions that individuals express in those messages, as emotions have been found to mediate behavioral responses to these events.[23] Researchers should also identify the types of users (eg, individuals, organizations) responding to these events on social media and analyze the events' influence the volume of users contributing to the conversation, in addition to the volume of messages.

This study had several limitations. Most notably, we identified messages about cancer by collecting messages that included one of 6 cancer-related keywords; as a result, this study does not include any cancer-related messages that do not include one of these keywords. In addition, we did not include surgery-related keywords (eg, prostatectomy) in our analysis of cancer messages related to specific cancers. As a result, we likely missed some messages related to specific cancer sites. Because of the way the data were collected, we cannot know who saw these messages or whether these messages had any behavioral effects. However, the messages represent spontaneous, unsolicited comments from social media users and as such they are not influenced by study demand.[31]

Conclusion

Following a celebrity announcement about cancer, conversations related to a specific cancer increased on Twitter, a popular social networking site. This finding adds to the existing research that has established that celebrity announcements increase attention to specific cancers, increase information seeking related to those cancers, and increase prevention and detection behaviors. The results of this study also indicate that celebrity announcements influence the content of social media conversations, as it relates to the cancer continuum. This suggests an opportunity for cancer communicators to design social media messages to respond to these events and shape online conversations with the goal of encouraging people to engage in cancer prevention and control behaviors.

Authors' Note

The views presented here represent the views of the authors, not the National Science Foundation.

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