Analysis of the Use and Impact of Twitter During American Society of Clinical Oncology Annual Meetings From 2011 to 2016: Focus on Advanced Metrics and User Trends

Naveen Pemmaraju, Michael A. Thompson, Ruben A. Mesa, and Tejas Desai

The University of Texas MD Anderson Cancer Center, Houston, TX; Aurora Research Institute, Aurora Health Care, Milwaukee, WI; Mayo Clinic, Scottsdale AZ; US Department of Veterans Affairs; and Nephrology On-Demand Analytics, Charlotte, NC

Corresponding author: Naveen Pemmaraju, MD, Department of Leukemia, The University of Texas MD Anderson Cancer Center, Unit 428, PO Box 301402, Houston, TX 77230-1402; Twitter: @doctorpemm; e-mail: npemmaraju@mdanderson.org.

Disclosures provided by the authors are available with this article at jop.ascopubs.org.

QUESTIONS ASKED: Little is known about the use of Twitter during ASCO annual meetings. Who are the users of Twitter? What are the most common topics discussed? Has the use of Twitter increased over time?

SUMMARY ANSWER: The number of individual authors increased from 1,429 during the 2011 ASCO annual meeting to 15,796 during the 2016 ASCO annual meeting, an 11-fold increase over the total 5-year period. There was a notable increase in tweets from the ASCO 2011 meeting (n = 7,746) to the ASCO 2016 meeting (n = 72,698), a nine-fold increase during the study period.

WHAT WE DID: We conducted an analysis of tweets during the ASCO annual meetings from 2011 to 2016, which consisted of a total data set of 190,732 tweets from 39,745 unique users. The tweets, which are all publically available, were collected and analyzed with the help of Nephrology On-Demand Analytics.

WHAT WE FOUND: The annual ASCO meetings have become the most attended gathering of the year in the hematology and oncology field. The use of Twitter among health care stakeholders during the ASCO meeting has markedly increased over time, demonstrating the increasing role of social media in the dissemination of findings at the meeting. The most commonly tweeted term or topic changed over time, generally reflecting the major findings in the field of each designated year. The use of social media has significantly increased at chronic disease and cancer conferences, likely resulting in increased impact of the findings from these meetings compared with before the social media era. From this analysis, it is evident that, over time, there has been a steady increase in the number of Twitter users each year at the ASCO meeting, with more tweets and retweets each year.

BIAS, CONFOUNDING FACTORS, REAL-LIFE IMPLICATIONS: One key limitation is in definitively capturing every involved stakeholder or participant because there is no central registry for all users. In addition, scoring tweets from individuals versus other entities is not always possible, and therefore, tracking the influence of third parties on Twitter conversations is a growing concern in the field. This data set demonstrates the increasing role of Twitter participation in the gathering, consumption, and dissemination of findings presented and discussed at the ASCO meeting. The use of Twitter at major medical conferences serves to highlight information, both to those attending the meeting on site and to those following remotely, in a real-time format for all health care stakeholders who have interests in the field of oncology. JOP

Analysis of the Use and Impact of Twitter During American Society of Clinical Oncology Annual Meetings From 2011 to 2016: Focus on Advanced Metrics and User Trends

Naveen Pemmaraju, Michael A. Thompson, Ruben A. Mesa, and Tejas Desai

The University of Texas MD Anderson Cancer Center, Houston, TX; Aurora Research Institute, Aurora Health Care, Milwaukee, WI; Mayo Clinic, Scottsdale AZ; US Department of Veterans Affairs; and Nephrology On-Demand Analytics, Charlotte, NC

Abstract

Purpose

The use of social media, in particular Twitter, has substantially increased among health care stakeholders in the field of hematology and oncology, with an especially sharp increase in the use of Twitter during times of major national meetings. The most attended meeting in the oncology field is the ASCO annual meeting. Little is known about the detailed metrics involved in the use, volume, and impact of Twitter during the ASCO annual meeting.

Methods

We conducted a retrospective review of tweets during the ASCO annual meetings from 2011 to 2016. The total data set encompassed 190,732 tweets from 39,745 authors over six consecutive ASCO meetings from 2011 to 2016 (inclusive). Tweets, all publically available, were collected by Nephrology On-Demand Analytics.

Results

The number of individual authors increased from 1,429 during the 2011 ASCO meeting to 15,796 during the 2016 ASCO meeting, an 11-fold increase over the total 5-year period. There was a notable increase in tweets from the 2011 ASCO meeting (n = 7,746) to the 2016 ASCO meeting (n = 72,698), a nine-fold increase during the study period. The most commonly tweeted term or topic changed over time, generally reflecting the breakthroughs of each designated year; these terms were "melanoma" for both the 2011 and 2012 ASCO meetings; "breast cancer" for the 2013 ASCO meeting; "lung cancer" for the 2014 ASCO meeting; and "ImmunOnc" or "immunotherapy/immuno-oncology" for both the 2015 and 2016 ASCO meetings.

Conclusion

The use of Twitter among health care stakeholders during the ASCO meeting has markedly increased over time, demonstrating the increasing role of social media in the dissemination of findings at the most highly attended hematology and oncology conference of the year.

INTRODUCTION

The use of social media has been continuously increasing among adults in the United States.[1] It is notable that among patients with cancer, patients with chronic diseases, and those undergoing palliative care the use of social media, and in particular Twitter, is markedly increasing, not

just in the United States, but worldwide.[2-5] One aspect of social media that has been especially helpful to some patients with cancer is the use of Twitter in forming, maintaining, and exploring new ways of patient education, support, and outreach with clinicians, other patients, and advocacy groups.[6,7]

In addition to the growing use of Twitter among patients and patient advocates, there has been an increase in usage of Twitter by clinicians, including hematologists and oncologists, in their respective fields and subfields.[8] Although there are obvious concerns about privacy, accuracy of information, and accountability, some physicians have found the opportunity to use Internet resources, such as Twitter, to get involved in dissemination of up-to-date health care information and cutting-edge research and to discover networking opportunities.[9,10]

Each year, hematologists and oncologists gather at several major medical conferences to discuss and debate the latest basic, translational, and clinical findings in the field. With the advent and widespread use of social media, members who are present the meetings and even members following along remotely (not on site for the meeting) are able to now, more than ever, participate, change, and influence the discussion in a real-time manner.[11] The most attended meeting of the year, the ASCO annual meeting, which takes place yearly in Chicago, Illinois, has become the focus of social media in the oncology world and has boasted a steady increase in health care stakeholder Twitter users every year over the past 5 years.[2,11] Various analytics companies and individuals have evaluated tweet volume and networks; however, still little is known about the detailed metrics of the increased use or its impact on the greater oncology community. The purpose of this analysis was to determine the usage and impact of the social media platform Twitter during the ASCO annual oncology conference over a 5-year period from 2011 to 2016. The ASCO Twitter username is @ASCO, and the annual meeting hashtag is #ASCOxx, where xx indicates the last two digits of the year. ASCO annual meetings will be henceforth identified using their annual meeting hashtag; for example, the 2011 ASCO annual meeting will be designated as #ASCO11.

METHODS

Tweets and their associated metadata were collected in Java Script Object Notation (JSON) format using application program interfaces programmed by Nephrology On-Demand (NOD) Analytics (Charlotte, NC). The associated metadata were analyzed using natively developed algorithms to provide quantitative metrics in the following three domains: tweet activity, tweet content, and tweet engagement. Tweet activity included such parameters as number of total and original tweets and number of retweets. Tweet content included parameters such as the number of financial security tweets (defined as any company traded on the New York Stock Exchange or Nasdaq Stock Market), hot topics, and hashtag analysis. Tweet engagement included parameters such as "@mentions" and retweet characteristics.

For analysis of individual Twitter topics of relevance, in this study, we categorized multiple terms under each topic to fully capture all discussions pertinent to an oncologic subject. For example, for the topic of breast cancer, we included under the category of #bcsm a family of tweets that encompasses "breast ca," "breast cancer," "BreastCancer," "breast carcinoma," and all relevant misspelled terms (eg, "brstcncr"). Importantly, because of the 140-character limit of Twitter, misspellings are often intentional to save character count in messages. The hashtags for each #ASCOxx year were evaluated during a time window around each annual meeting. The exact dates queried are as follows: #ASCO11: June 3 to June 7, 2011; #ASCO12: June 1 to June 5, 2012; #ASCO13: May 31 to June 4, 2013; #ASCO14: May 30 to June 3, 2014; #ASCO15: May 29 to June 2, 2015; and #ASCO16: June 3 to June 7, 2016.

In this collaborative analysis, we sought to identify trends in the most prolific physician Tweeters, most commonly discussed medical topics, most commonly involved pharmaceutical companies, and most used disease-specific hashtags during ASCO annual conferences from 2011 to 2016 (inclusive).

Individual Authors

Individual authors, or tweeters, were identified by calculating the number of distinct Twitter accounts that composed at least one tweet within the respective Twitter channel (hashtag). Prolific authors were then identified as those individuals who composed the most original tweets (OTs) within a specific Twitter channel. Authors with the largest number of OTs composed were determined by cross-referencing each OT with its author and tallying this total per author. A retweet (RT) represents an exact replication of an OT. Therefore, RTs are not the same as quoted tweets, but they are often considered similar because the button used to generate an RT is the same used to generate a quoted tweet. Quoted tweets are known as referenced tweets, in which the OT is modified by the contents of the quote. In this study, we analyzed metadata, which

automatically identifies pure RTs versus quoted tweets. The latter are analyzed like any other tweet, except that they are considered referenced.

The most retweeted authors were calculated by cross-referencing each RT with its original author and tallying the total per original author. Finally, the most mentioned authors were calculated by identifying all Twitter accounts mentioned within the body of each tweet and tallying the total per author (Fig 1A).

Composition of the Messages: The Tweet Data

Tweets were collected through an application program interface programmed by NOD Analytics (goo.gl/mfziXG) in the Java Script Object Notation file format. RTs were identified within each data set (eg, #ASCO11, #ASCO12) by the "RT" designation within each tweet. OTs were calculated as the difference between the total tweets and number of RTs. Tweet advertisements are those tweets that are specifically promoting a product or a service. Examples would be tweets that promote the use of a drug or medical device. Reference to a drug or device does not constitute a tweet advertisement. Our algorithms identify the product as well as the words or phrases used to determine whether the tweet is specifically referencing a product or promoting its use or distribution. Therefore, tweet advertisements were identified as those tweets soliciting the reader to try or purchase a product or service, commonly available for demonstrative purposes within the exhibition hall. The hottest topics were ultimately identified through frequency analyses of the main topic of each tweet.

Pharmaceutical Company Tweets

We determined the pharmaceutical companies discussed during the ASCO meetings by identifying the distinct number of publicly traded companies discussed within the tweets of a particular Twitter channel and cross-referencing each company name with Google Finance (www.google.com/finance) to identify those companies in the biomedical or biotechnology space. Financial tweets were calculated by identifying those tweets whose body included some sort of financial information. Financial tweets were identified by the inclusion of a financial entity within the body of the tweet. The most common pharmaceutical company discussed was identified by tallying the total number of companies discussed and reporting the highest value.

Disease-Specific Hashtag Tweets

These data were collected as total number of tweets mentioning the individual hashtag during the study period, and we included in this analysis the top five most commonly used disease-specific hashtags for each year analyzed. This analysis excluded #ASCO or any derivative of this hashtag (eg #ASCO16) to focus on the actual disease or cancer subjects that were generating the most discussion on Twitter.

RESULTS

We conducted a retrospective review of tweets during the ASCO annual meetings from 2011 to 2016. The total data set analyzed encompasses 190,732 tweets from 39,745 unique authors from six consecutive ASCO meetings from 2011 to 2016 (inclusive). These numbers may be different than other figures that include a different range of dates (eg, weeks before or after the meeting). Notably, the number of individual authors increased from 1,429 during #ASCO11 to 15,796 during #ASCO16, an 11-fold increase over the total 5-year period. The sharpest single-year increase in Twitter users was from #ASCO13 to #ASCO14, in which there was a three-fold increase in just 1 year (Fig 1B). Among authors with the largest number of OTs composed for each ASCO meeting, @mtmdphd (note, this is the Twitter handle for one of the study authors, M.A.T.) was the most prolific in 4 of the 6 years studied. The most retweeted author in 5 of the 6 years was @ASCO itself, with the exception of the latest year, #ASCO16, in which @bmsnews was the most retweeted author. The most mentioned author in all 6 years analyzed was @ASCO, with the number of mentions increasing each year, starting at only 272 mentions during #ASCO11 and peaking at 5,366 mentions during #ASCO16 (Table 1).

In terms of the tweets themselves, it is remarkable to note the dramatic increase in tweets from #ASCO11 (n = 7,746) to #ASCO16 (n = 72,698), a nine-fold increase during the study period. One interesting trend in this analysis is that the type of tweet that was most common changed over time. In #ASCO11, OTs composed 53% of all tweets and RTs composed 47%; by the time of #ASCO16, this had reversed, with OTs making up only 31% of total tweets and RTs making up the remaining 69%. The total number of tweet advertisements did increase over time (from 379 in #ASCO11 to 2,417 in #ASCO16), but the overall percentage remained in the same range (3% to 5% of all tweets) during each of the years in the study period. As expected, coinciding with the year's most important and practice-changing presentations, the most discussed topic
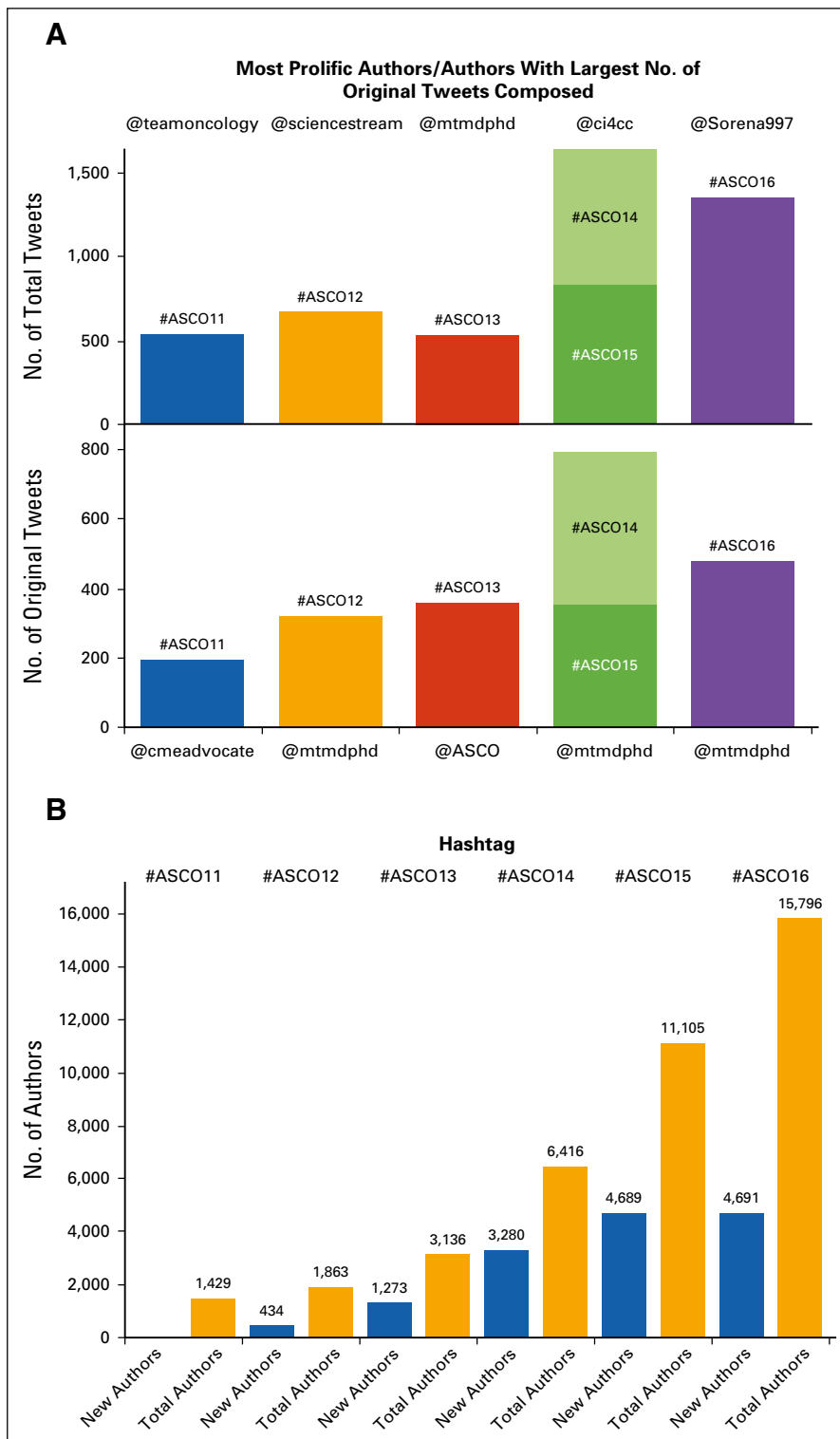
Fig 1. (A) Most prolific Twitter authors and authors with most original tweets composed during study period (2011 to 2016 ASCO annual meetings). (B) Number of new users (authors) and total users by year for ASCO 2011 to 2016 annual meetings. A new user was defined as a Twitter user that did not participate in the prior year.

Table 1. Information on Most Commonly Tweeting and Tweeted About Authors

Year of Meeting	Hashtag	No. of Authors	Most Prolific Authors (No. of tweets)	Authors With Largest No. of Original Tweets Composed (No. of tweets)	Most Retweeted Authors (No. of retweets accrued)	Most Mentioned Authors (No. of times mentioned)
2011	#ASCO11	1,429	@teamoncology (537)	@cmeadvocate (195)	@ASCO (262)	@ASCO (272)
2012	#ASCO12	1,863	@sciencestream (678)	@mtmdphd (321)	@ASCO (533)	@ASCO (556)
2013	#ASCO13	3,136	@mtmdphd (535)	@ASCO (359)	@ASCO (1,076)	@ASCO (1,147)
2014	#ASCO14	6,416	@ci4cc (803)	@mtmdphd (438)	@ASCO (1,409)	@ASCO (1,458)
2015	#ASCO15	11,105	@ci4cc (834)	@mtmdphd (352)	@ASCO (1,995)	@ASCO (2,019)
2016	#ASCO16	15,796	@Sorena997 (1,351)	@mtmdphd (477)	@bmsnews (3,317)	@ASCO (5,366)

(identified through frequency analysis of the main topic of each tweet) changed over time, as follows: "melanoma" for both #ASCO11 and #ASCO12; "breast cancer" for #ASCO13; "lung cancer" for #ASCO14; and "ImmunoOnc" or "immunotherapy/immuno-oncology" for both #ASCO15 and #ASCO16 (Table 2).

With regard to pharmaceutical companies discussed during the study period, we found that the number of companies discussed increased over time (from 30 in #ASCO11 to 124 in #ASCO16), with the most notable single-year leap identified as #ASCO13 to #ASCO14 (from 60 to 109 companies). The most frequently mentioned company during the study period was Bristol-Meyers Squibb, which topped the list in 2 separate years (#ASCO13 and #ASCO15; Table 3).

In terms of disease-specific hashtag usage during #ASCO11 to #ASCO16, we analyzed the top five most commonly used hashtags. The hashtag #cancer was the most commonly used in the first three ASCO meetings and in four of six meetings in total. The hashtag #melanoma was the second most commonly used hashtag during #ASCO11 and #ASCO12, and the third most common in #ASCO13. Notably, #immunotherapy/ #ImmunoOnc was not in the top five until its first appearance during #ASCO15, when it was the second most commonly used hashtag during the meeting. As would be expected, these topics generally were related to the most commonly buzzed about breakthroughs at the year's meeting (Table 4).

DISCUSSION

The annual ASCO meeting has become the most attended gathering of the year in the hematology and oncology field. The use of social media has significantly increased at chronic disease and cancer conferences, likely resulting in increased impact of the findings from these meetings compared with before the social media era.[12] From this analysis, it is evident that, over time, there has been a steady increase in the number of Twitter users each year at the ASCO meeting, with more tweets and RTs with each year.

Table 2. Information on Tweets, Retweets, and Most Commonly Tweeted Topics

Year of Meeting	Hashtag	Total Tweets	No. of Original Tweets (%)	No. of Retweets (%)	No. of Tweet Advertisements (%)	Hottest Topic
2011	#ASCO11	7,746	4,100 (53)	3,646 (47)	379 (5)	Melanoma
2012	#ASCO12	9,770	5,020 (51)	4,750 (49)	345 (4)	Melanoma
2013	#ASCO13	15,120	7,629 (50)	7,491 (50)	539 (4)	Breast cancer
2014	#ASCO14	32,899	12,993 (39)	19,906 (61)	1,003 (3)	Lung cancer
2015	#ASCO15	52,499	16,926 (32)	35,573 (68)	2,060 (4)	Immunotherapy
2016	#ASCO16	72,698	22,577 (31)	50,121 (69)	2,417 (3)	Immunotherapy/immuno-oncology

Table 3. Most Commonly Tweeted Pharmaceutical Companies

Year of Meeting	Hashtag	No. of Pharma Companies Discussed	No. of Financial Security Tweets (%)	Top Pharma Company Discussed
2011	#ASCO11	30	158 (2)	Exelixis
2012	#ASCO12	42	431 (4)	Johnson & Johnson
2013	#ASCO13	60	784 (5)	Bristol-Myers Squibb
2014	#ASCO14	109	1,645 (5)	Eli Lilly
2015	#ASCO15	106	2,960 (6)	Bristol-Myers Squibb
2016	#ASCO16	124	1,847 (3)	Immunomedics

From this analysis, we observed an increasing use of disease-specific hashtags over time.[13] Designed, organized, and available for the sake of bringing health care stakeholders to a common space on Twitter, dedicated hashtags have greatly facilitated conversations and discussions, especially in rare cancer subtypes and unique patient populations with cancer.[8,13-15]

The first ASCO meeting Twitter analysis was by Chaudhry et al,[11] and it focused on Twitter use during 2010 and 2011. In this analysis, the authors found a significant growth in the number of physician tweeters over time, and this included involvement from physicians who were able to participate in discussions but who were not in live attendance at the meeting.[11]

In our analysis at #ASCO11, OTs made up 53% of all tweets and RTs made up 47%; however, during #ASCO16, OTs composed 31% of total tweets, with RTs making up the remaining 69%. Multiple factors likely led to this change over time. One likely factor is that, in 2011, there were not as many total tweets to begin with and, therefore, not as many tweets to retweet. Second, over time, there has been a substantial increase in primary sources themselves now regularly tweeting major findings (eg, *New England Journal of Medicine,* @NEJM; *JCO,* @JCO_ASCO; *Blood,* @bloodjournal), resulting in the generation of a large amount of RTs. Third, the ease of retweeting major findings from key Twitter thought-leaders on a mutual topic of interest is also a major factor in the increase of RTs at conferences; retweeting is easily done from a smartphone, while standing in line at a conference concession stand or while in between meetings, and is an easy way to use Twitter for the new social media user. Finally, some social media users may see the use of volume-based metrics as something to "game" to achieve a ranking by retweeting repeatedly rather than generating unique content or adding to the diversity of discussions by commenting.

There are multiple limitations in this first-of-its-kind study. One key limitation is the difficult challenge of capturing all of the viable health care stakeholders who were a part of the meetings; because there is no preregistered group that designates all involved parties, the authors instead had to use social

Table 4. Top Five Most Commonly Tweeted Hashtags

Year of Meeting	Hashtag	Top 5 Hashtags				
		1	2	3	4	5
2011	#ASCO11	#cancer	#melanoma	#breastcancer	#myelofibrosis	#GIST
2012	#ASCO12	#cancer	#melanoma	#lungcancer	#myeloma	#breastcancer
2013	#ASCO13	#cancer	#breastcancer	#lungcancer	#melanoma	#oncology
2014	#ASCO14	#biotech	#cancer	#bcsm	#lungcancer	#lysm
2015	#ASCO15	#cancer	#immunotherapy	#lungcancer	#breastcancer	#gyncsm
2016	#ASCO16	#BMSatASCO	#cancer	#lcsm	#immunotherapy	#oncology

media analytics and best-guess approximations on locating the most likely Twitter users for this analysis.[16] Another limitation of this type of analysis is the scoring of tweet sources as individuals versus companies or entities, because there is no definitive way to know whether an individual is tweeting on his or her own or representing an entity or company. A further confounding factor to consider in this analysis is the fact that some entities or organizations can engage in purchased RTs and of course advertised or promoted RTs. An analysis by Silja Chouquet (@whydotpharma), cofounder of Merakoi whose specialties include social media analytics, revealed that at the ASCO 2016 annual meeting the second largest number of RTs was from fake engagement (a term that refers to the practice of purchasing RTs by a third party) from pharma-promoted tweets.[17] This tactic of purchasing RTs by third-party entities has been studied and can cloud the conversation going on among other stakeholders by adding an artificial and quite underappreciated aspect of the "Twittersphere" or greater "Twitterverse."[18] It is critical to note this influence in the use of social media, particularly among physicians and other groups during the time of major medical conferences. One recent study in this regard, by Desai et al,[18] found that third parties exerted as much as approximately half, or equal, the total influence by individual or physician users during the courses of 13 major medical conferences, thus highlighting the concern for the signal-to-noise ratio being unbalanced by outside party influence, with possibly more biased voices drowning out the "signal" for the "noise," which is an ongoing concern in any digital or online conversation space, especially when it comes to health care and social media.

As expected, the most commonly tweeted topics changed over time. We found that these changes reflected the most buzzed about topics at the ASCO meeting, generally in line with the most impactful breakthroughs presented. Notably, the most common topics changed from more traditional tumor subtype–based topics (eg, melanoma, breast cancer, lung cancer) to tumor cross-cutting areas such as immunotherapy/ #ImmunoOnc, which was the most tweeted topic in each of the last two ASCO meetings. This likely represents the social media oncology community's ability to absorb and reflect back the most important findings of the year and to spark the ongoing discussions in these fields that last well after the meeting itself has concluded. In conclusion, we present, to our knowledge, the largest analysis of Twitter data from a medical oncology conference series. This analysis demonstrates the steady, continuously growing number of Twitter users each year, over time, at the ASCO meetings from 2011 to 2016 (#ASCO11 to #ASCO16); reveals the types of topics most commonly discussed at each year's meeting; and details how this has changed over time. These data confirm the increasing role of social media in the gathering, consumption, and dissemination of findings for those gathering at the most highly attended hematology and oncology conference of the year, the ASCO annual meeting.

AUTHORS' RECOMMENDATIONS FOR BEST PRACTICES

Self-Surveillance in Social Media and Hematology and Oncology

Suggestions for continued #ASCOxx metric evaluations and improving the social media community include the following: do not buy followers; do not buy RTs; we, as a field, need to self-police spam and verbal and social media abuse, in part, by using the "block" and "report" functions in Twitter; and use hashtags to improve the signal-to-noise ratio.[13] In addition, understand the customs, pitfalls, and areas of uncertainty when venturing into any media, including social media, particularly paying special, close attention to matters of patient privacy and maintenance of online decorum.[9] As Dr Bryan Vartabedian has said, "We've reached a point where social media is now part of the professional workflow."[19] We need to continually engage and nurture that workflow to keep it professional and useful. JOP

Authors' Disclosures of Potential Conflicts of Interest
Disclosures provided by the authors are available with this article at jop.ascopubs.org.

Author Contributions
Conception and design: Naveen Pemmaraju, Michael A. Thompson, Ruben A. Mesa, Tejas Desai
Collection and assembly of data: Naveen Pemmaraju, Michael A. Thompson, Ruben A. Mesa, Tejas Desai
Data analysis and interpretation: Naveen Pemmaraju, Michael A. Thompson, Ruben A. Mesa, Tejas Desai
Manuscript writing: All authors
Final approval of manuscript: All authors
Accountable for all aspects of the work: All authors

Corresponding author: Naveen Pemmaraju, MD, Department of Leukemia, The University of Texas MD Anderson Cancer Center, Unit 428, PO Box 301402, Houston, TX 77230-1402; Twitter: @doctorpemm; e-mail: npemmaraju@ mdanderson.org.

References

1. Gage-Bouchard EA, LaValley S, Mollica M, et al: Cancer communication on social media: Examining how cancer caregivers use Facebook for cancer-related communication. Cancer Nurs [Epub ahead of print on July 20, 2016]

2. Dizon DS, Graham D, Thompson MA, et al: Practical guidance: The use of social media in oncology practice. J Oncol Pract 8:e114-e124, 2012

3. Borgmann H, Loeb S, Salem J, et al: Activity, content, contributors, and influencers of the Twitter discussion on urologic oncology. Urol Oncol 34:377-383, 2016

4. Tsuya A, Sugawara Y, Tanaka A, et al: Do cancer patients tweet? Examining the Twitter use of cancer patients in Japan. J Med Internet Res 16:e137, 2014

5. Nwosu AC, Debattista M, Rooney C, et al: Social media and palliative medicine: A retrospective 2-year analysis of global Twitter data to evaluate the use of technology to communicate about issues at the end of life. BMJ Support Palliat Care 5:207-212, 2015

6. Attai DJ, Cowher MS, Al-Hamadani M, et al: Twitter social media is an effective tool for breast cancer patient education and support: Patient-reported outcomes by survey. J Med Internet Res 17:e188, 2015

7. Pemmaraju N, Gupta V, Mesa R, et al: Social media and myeloproliferative neoplasms (MPN): Focus on Twitter and the development of a disease-specific community: #MPNSM. Curr Hematol Malig Rep 10:413-420, 2015

8. Pemmaraju N, Utengen A, Gupta V, et al: Social media and myeloproliferative neoplasms (MPN): Analysis of advanced metrics from the first year of a new Twitter community: #MPNSM. Curr Hematol Malig Rep 11:456-461, 2016

9. Lewis MA, Dicker AP: Social media and oncology: The past, present, and future of electronic communication between physician and patient. Semin Oncol 42:764-771, 2015

10. Thompson MA, Majhail NS, Wood WA, et al: Social media and the practicing hematologist: Twitter 101 for the busy healthcare provider. Curr Hematol Malig Rep 10:405-412, 2015

11. Chaudhry A, Glodé LM, Gillman M, et al: Trends in Twitter use by physicians at the American Society of Clinical Oncology annual meeting, 2010 and 2011. J Oncol Pract 8:173-178, 2012

12. Wilkinson SE, Basto MY, Perovic G, et al: The social media revolution is changing the conference experience: Analytics and trends from eight international meetings. BJU Int 115:839-846, 2015

13. Katz MS, Utengen A, Anderson PF, et al: Disease-specific hashtags for online communication about cancer care. J Clin Oncol 33, 2015 (suppl; abstr 6520)

14. Pemmaraju N, Gupta V, Thompson MA, et al: Social media and Internet resources for patients with blastic plasmacytoid dendritic cell neoplasm (BPDCN). Curr Hematol Malig Rep 11:462-467, 2016

15. Perales MA, Drake EK, Pemmaraju N, et al: Social media and the adolescent and young adult (AYA) patient with cancer. Curr Hematol Malig Rep 11:449-455, 2016

16. Sedrak MS, Cohen RB, Merchant RM, et al: Cancer communication in the social media age. JAMA Oncol 2:822-823, 2016

17. Chouquet S: Revealing ASCO's social DNA. https://www.slideshare.net/Silja/revealing-ascos-social-dna?next_slideshow=1

18. Desai T, Dhingra V, Shariff A, et al: Quantifying the Twitter influence of third party commercial entities versus healthcare providers in thirteen medical conferences from 2011-2013. PLoS One 11:e0162376, 2016

19. Vartabedian B: Social media has been introduced to physicians. http://33charts.com/2015/01/social-media-introduced-to-physicians.html?utm_source=feedburner&utm_medium=email&utm_campaign=Feed:%2033Charts%20(33%20Charts)

AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

Analysis of the Use and Impact of Twitter During American Society of Clinical Oncology Annual Meetings From 2011 to 2016: Focus on Advanced Metrics and User Trends

The following represents disclosure information provided by authors of this manuscript. All relationships are considered compensated. Relationships are self-held unless noted. I = Immediate Family Member, Inst = My Institution. Relationships may not relate to the subject matter of this manuscript. For more information about ASCO's conflict of interest policy, please refer to www.asco.org/rwc or ascopubs.org/journal/jop/site/misc/ifc.xhtml.

Naveen Pemmaraju
Honoraria: LFB Biotechnologies, Novartis, Stemline Therapeutics, Incyte, Roche Diagnostics
Consulting or Advisory Role: LFB Biotechnologies, Novartis, Stemline Therapeutics, Incyte, Roche Diagnostics
Research Funding: Cellectis, Stemline Therapeutics, Affymetrix, Novartis

Michael A. Thompson
Stock or Other Ownership: Doximity
Consulting or Advisory Role: Celgene, Bristol-Myers Squibb, AIM Specialty Health Consulting, VIA Oncology, Takeda
Other Relationship: Doximity

Ruben A. Mesa
Honoraria: Novartis, Shire, AOP Orphan Pharmaceuticals
Consulting or Advisory Role: Baxalta, Galena Biopharma, Incyte, Novartis
Research Funding: Incyte (Inst), Genentech (Inst), CTI (Inst), Promedior (Inst), NS Pharma (Inst), Gilead Sciences (Inst), Pfizer (Inst), Pharmaessentia (Inst), Celgene (Inst),
Travel, Accommodations, Expenses: Novartis, Incyte, AOP Orphan Pharmaceuticals

Tejas Desai
Stock or Other Ownership: Nephrology On-Demand Analytics