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Social Media Engagement at Academic Conferences: Report of the Association of Pathology Chairs 2018 and 2019 Annual Meeting Social Media Committee

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Abstract

The use of social media at academic conferences is expanding, and platforms such as Twitter are used to share meeting content with the world. Pathology conferences are no exception, and recently, pathology organizations have promoted social media as a way to enhance meeting exposure. A social media committee was formed ad hoc to implement strategies to enhance social media involvement and coverage at the 2018 and 2019 annual meetings of the Association of Pathology Chairs. This organized approach resulted in an 11-fold increase in social media engagement compared to the year prior to committee formation (2017). In this article, the social media committee reviews the strategies that were employed and the resultant outcome data. In addition, we categorize tweets by topic to identify the topics of greatest interest to meeting participants, and we discuss the differences between Twitter and other social media platforms. Lastly, we review the existing literature on this topic from 23 medical specialties and health care fields.

Keywords

social media, academic conference, Twitter, pathology

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Introduction

It is well-documented that social media at academic conferences can promote an atmosphere of excitement, amplifying and communicating content to people who were unable to attend and providing a forum for continued discussion of ideas presented at the meeting.[1-3] For this reason, organizers of many national meetings have sought to enhance social media engagement.[4] However, many conference organizers remain unfamiliar with popular social media platforms and therefore are not aware of the best steps to take toward this goal. Although many papers have described the outcome of social media at conferences, there is little written about best methods of implementation to better help future conferences. Moreover, it would be useful to analyze the popular tweets by topic to determine which topics received the most public interest. Additionally, in our experience, there is generally an unquestioned assumption that Twitter is more appropriate than other social media platforms, with little explanation of why this is so.[5] Our aim in this study was to address these issues based on existing literature and on analysis of data we collected at recent Association of Pathology Chairs (APC) annual meetings and present our findings in a manner that would be interesting and insightful to all readers, including those with little or no social media experience.

Materials and Methods

Formation of a Committee

Prior to the both the 2018 and 2019 annual meetings, a social media committee was formed ad hoc and tasked to develop a structured plan with the goal of enhancing social media engagement at the conference. Strategies were developed based on published literature, past experience, and a willingness to try new ideas. These strategies are summarized in Table 1. To recruit committee members, all meeting attendees were invited to join the committee via a premeeting questionnaire. A committee meeting was held on the first day of both the 2018 and 2019 annual meetings, which included a meet-and-greet for committee members to become acquainted with each other, a short presentation to outline goals and to share skills with committee members who were new to social media, and a moderated group discussion fostering input and shaping of the committee's activities and conduct. This meeting was also used to establish a code of conduct encouraging productive, positive tweets. To ensure visibility of the social media project, APC issued special ribbons on the conference ID badge designating the social committee members.

One meeting goal was to "amplify the quieter voices" and provide additional coverage to the presentations that often receive less attention, such as posters and discussion groups. Using a signup sheet, members volunteered to cover specific posters and discussion groups by tweeting content from these presentations from their personal Twitter accounts. To encourage dialogue, members were also encouraged to mark tweets with relevant Handles, which are tags that represent the twitter account of a person or institution that relates to the material. In addition, members were encouraged to include all kinds of tweets, including live tweets that shared content from an academic presentation, logistical tweets that shared information about session times or room changes, and "share the vibes" tweets that focused on the social excitement, such as meeting up with colleagues from a previous institution.

Before each meeting commenced, the committee designated a hashtag to label discussions pertinent to the conference. Hashtags represent topics of discussion, and they are used to tag tweets so they are found readily by interested viewers. The 2018 conference hashtag was #APCprods2018, and the 2019 hashtag was #APC19Boston. Social media users included this tag in their posts to foster discussion about the meeting and to identify tweets for postconference analysis. To ensure all used the correct hashtag, the organization published the hashtag in all online communications and printed materials. The social media committee also promoted the correct hashtag on Twitter. When an incorrect hashtag was identified, committee members retweeted the post using the correct hashtag. This served to educate the tweeter and collate the tweet into the ongoing thread attached to the correct hashtag.

Collection of Data

After each meeting, the Twitter coverage of the meeting was quantified by analyzing tweets labeled with the meeting hashtag. We used Tweetbinder, a third-party company that analyzes tweets based on hashtags, and we were able to obtain Tweetbinder reports for the 2018 and 2019 meetings. We also wanted to compare Twitter activity during these years with that of the 2017 annual meeting, which were marked with the hashtag #APC50years (owing to 2017 being the 50th annual meeting of the APC). There had not been a social media committee at the 2017 meeting, and we used 2017 as a negative control, to test the assumption that a significant increase in Twitter engagement was likely have occurred in 2018 with continuation into 2019 as a result of convening the social media committee. A Tweetbinder report was not available to us for 2017, and therefore, we manually counted the 2017 tweets based on a search for the hashtag in the twitter.com search bar.

Several metrics were tracked for each hashtag, including total tweets, original tweets, retweets, likes, replies, contributors, impressions, and reach. Reach denotes the potential number of people who saw at least one tweet and is calculated as the number of followers for each contributor, summated for all contributors. This includes people who merely saw the tweet in their twitter feed but did not actively engage with, reply, or forward the tweet. Impressions, also known as Impact, denotes the number of times a tweet or hashtag was potentially seen. Impressions of a specific tweet are calculated as the number of followers of the author plus the followers of all users who retweeted it. Impressions of a hashtag are the sum of the impressions of each of the tweets bearing the hashtag.[6] Impressions are greater than Reach because a single person who saw

Table 1. Strategies to Enhance Social Media Coverage.

Strategy	Goal
Recruitment via meeting questionnaire	– Self-selection of motivated committee members
Training session/reception for Social Media Committee	– Guided discussion to establish strategies and goals
	– Establish working relationships between members
	– Distribute signup sheet to ensure all meeting presentations are covered
Ribbon on name tag or conference badge	– Provides recognition and encourages commitment
	– Allows other meeting participants to seek out guidance
	– Alleviates risk of "live-tweeting" being misinterpreted as disinterest in the session
Mark tweets with relevant #hashtags	– Hashtags refer to topics and begin with #
	– Hashtags increase visibility by causing a tweet to be shown when users search for tweets on a given topic
	– Hashtag for the meeting should be chosen by organizers after confirming that the chosen hashtag is not already in use for a different topic
	– Hashtag for the meeting should be displayed prominently in the promotional material that is distributed before the meeting
Mark tweets with relevant @handles	– Handles refer to other Twitter accounts and begin with @. They mark a tweet as relevant to a specific person or institution
	– Handles cause the tagged account to receive a notification as an opportunity to respond. For example, if a handle attributes authorship, that author will often join the Twitter conversation and respond to questions
Establish a code of conduct encouraging productive, positive tweets	– Attitudes are contagious; positive and negative tweets each tend to propagate similar attitudes
	– Should a meeting participant use social media to publicize grievances against the conference organizers, it is helpful to have social media committee members notice this promptly and respond with a productive comment, encouraging further positive comments
Encourage all kinds of tweets (not only academic!)	– While some may consider tweets that share academic ideas to be "more professional," it would be a mistake to overlook the benefit of nonacademic tweets
	– For example, a tweet sharing photos of a participant with old friends conveys the excitement of a national meeting as an opportunity to meet colleagues who are usually separated by a distance
	– Tweets are accessible to everyone and some viewers may be patients. Keep many tweets in a language understandable by all, especially those lacking a medical background. Foster a sense of community
Use Twitter analytics from several third-party providers	– Twitter offers analytics only to the authors. They are the most reliable statistics
	– Academic conference organizers frequently desire aggregated data by hashtag across all authors
	– Symplur is a free service that provides data regarding hashtags related to health care. It is popular and quoted in several pathology journals. Symplur provides a count of tweets, a transcript, a time graph that shows when a hashtag was trending, and the Twitter accounts that were most active
	– Other third-party analytics include additional metrics for a small fee. For example, Tweetbinder costs less than $30 and tabulates tweets by language, presence of photos, and number of Likes and Retweets

multiple tweets represents only one unit in calculating Reach, but multiple units in calculating Impressions.

Classification of Tweets by Topic

The goal of classification of tweets by topic was to determine which topics were most popular on social media, and therefore, we needed a system to quantify the popularity of individual tweets. We defined an Engagement Index that was based on the Likes and Retweets that each tweet had attracted. Engagement Index was defined as the number of Likes plus the number of Retweets and expressed as Engagement Index = (n [Likes] + n [Retweets]). Every tweet was assigned an Engagement Index based on the Likes and Retweets data reported by Tweetbinder. The classification of tweets by topic required careful manual review; therefore, only the 100 most engaging tweets of each year were analyzed. Where there was a tie, the random number

function in Excel was used as a tiebreaker. To quantify engagement by topic, the Engagement Indices of the tweets in each topic were summed to represent the total Engagement Index of each topic. Data management and calculations were performed in Microsoft Excel.

Results

Committee Membership

The first measure of engagement in this social media initiative was volunteerism for service on the social media committee. In 2018, 35 individuals participated in the committee. Reflecting the sectional organization of the APC, the committee makeup was: 8 department chairs, 7 residency program directors, 5 directors of undergraduate medical education, 4 department administrators, 6 administrators for graduate medical education, 3 pathology residents, and 2 other faculty. In 2019, 75

Table 2. Twitter Metrics.

Year	2018	2019
Total tweets	2978	2096
Original tweets	922	750
Retweets	2056	1346
Total likes	6266	6142
Replies	156	147
Links and pictures	626	562
Contributors	362	349
Reach	578 008	527 585
Impressions	6 720 763	6 827 914

Figure 1. Tweets by year. The number of tweets at the annual meeting is given for each year. This demonstrates a significant increase from 2017 to 2018 concurrent with implementation of a social media committee.

individuals volunteered to the committee, 16 of whom were return members from the 2018 committee. The 2019 committee makeup was 28 department chairs, 20 residency program directors, 3 directors of undergraduate medical education, 5 department administrators, 8 administrators for graduate medical education, 7 pathology residents, 1 medical student, and 3 other faculty. The committee memberships represented 8% and 15% of total meeting attendees in 2018 and 2019, respectively.

Outcome Metrics

The 2018 and 2019 meetings produced a total of 2978 and 2096 tweets, respectively. The tweets were insightful and positive, garnering interest and discussion. The metrics detailed in Table 2 show that, in both years, approximately one-third of the tweets were original and two-thirds were retweets, indicating that each tweet was retweeted approximately 2 times on average. Approximately 150 tweets in each year were replies to a previous tweet, indicating that these users were engaging with each other in direct dialogue. The total number of contributors, which represents Twitter users who actively discussed the meeting, was approximately 350 in both years. In addition, in both years, the tweets had a reach greater than 500 000 and impressions greater than 6 million.

In contrast to the large number of tweets in 2018 and 2019, the 2017 meeting produced only 264 tweets. This corresponded to an 11-fold increase that occurred during the 1-year span (2017-2018) in which the social media committee was initiated (Figure 1).

We correlated the trend in social media activity to the meeting content. In Figure 2, each peak in social media volume is labeled by the concurrent lecture content that was presented at that time. In both years, the greatest volume of Twitter activity corresponded to the Leadership Development & Diversity session, a named keynote plenary lecture with no competing sessions. In 2018, the lecture was entitled *Sexual Harassment in Academic Medicine: Zero Tolerance and Prevention Strategies* by Lynn Gordon, MD, PhD, and concurrent twitter activity peaked with 148 tweets in that 1 hour. In 2019, the lecture was entitled *Diversity and Excellence Are Friends: Valuing and Promoting Excellence* by Janice Gross Stein, PhD, and concurrent social media activity peaked with 128 tweets in the 1 hour. Although the timing of this session had changed from the
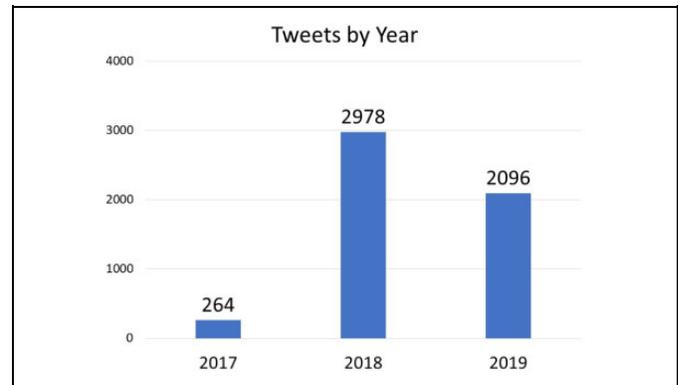
morning of last day of the meeting in 2018 to the afternoon of the second day in 2019, the peak in social media activity consistently tracked with this session.

Analysis of Tweets by Topic

The 100 most engaging tweets of each year were classified into 17 topics, and each topic was assigned an Engagement Index based on the sum of Likes and Retweets as described above. Table 3 tabulates all the topics and corresponding Engagement Indices. In 2018, the most popular topics and corresponding Engagement Indices were Social media use (622), What pathologists do (518), Pathology pipeline (337; referring to recruitment of medical students into the field of pathology), Mentor models (248), and Resident education (244). In 2019, the most popular topics and corresponding Engagement Indices were Social media use (536), Pathology pipeline (481), Social tweet (468), Resident education (413), and Burnout (280).

Table 3 showing distribution of the top 100 tweets. Each tweet was assigned an Engagement Index based on likes and retweets, and each topic was assigned an engagement index based on the summation of corresponding tweets. Engagement Index = (n(Likes) + n(Retweets)).

Discussion

In this article, the social media committee of the APC reports strategies and outcome metrics from the 2018 meeting, held July 15 to 18 at the Hotel Del Coronado in San Diego, California, and the 2019 meeting, held July 21 to 24 at the Boston Seaport Hotel and World Trade Center, in Boston, Massachusetts. This meeting is a "doing meeting" with emphasis on management within a department, leadership within an institution, and advocacy and education within society at large. The meeting provides an extraordinary networking opportunity for those who are new to department leadership positions to benefit from advice from experienced leaders within the same role. For all attendees, the meeting is a valuable opportunity to learn best practices from
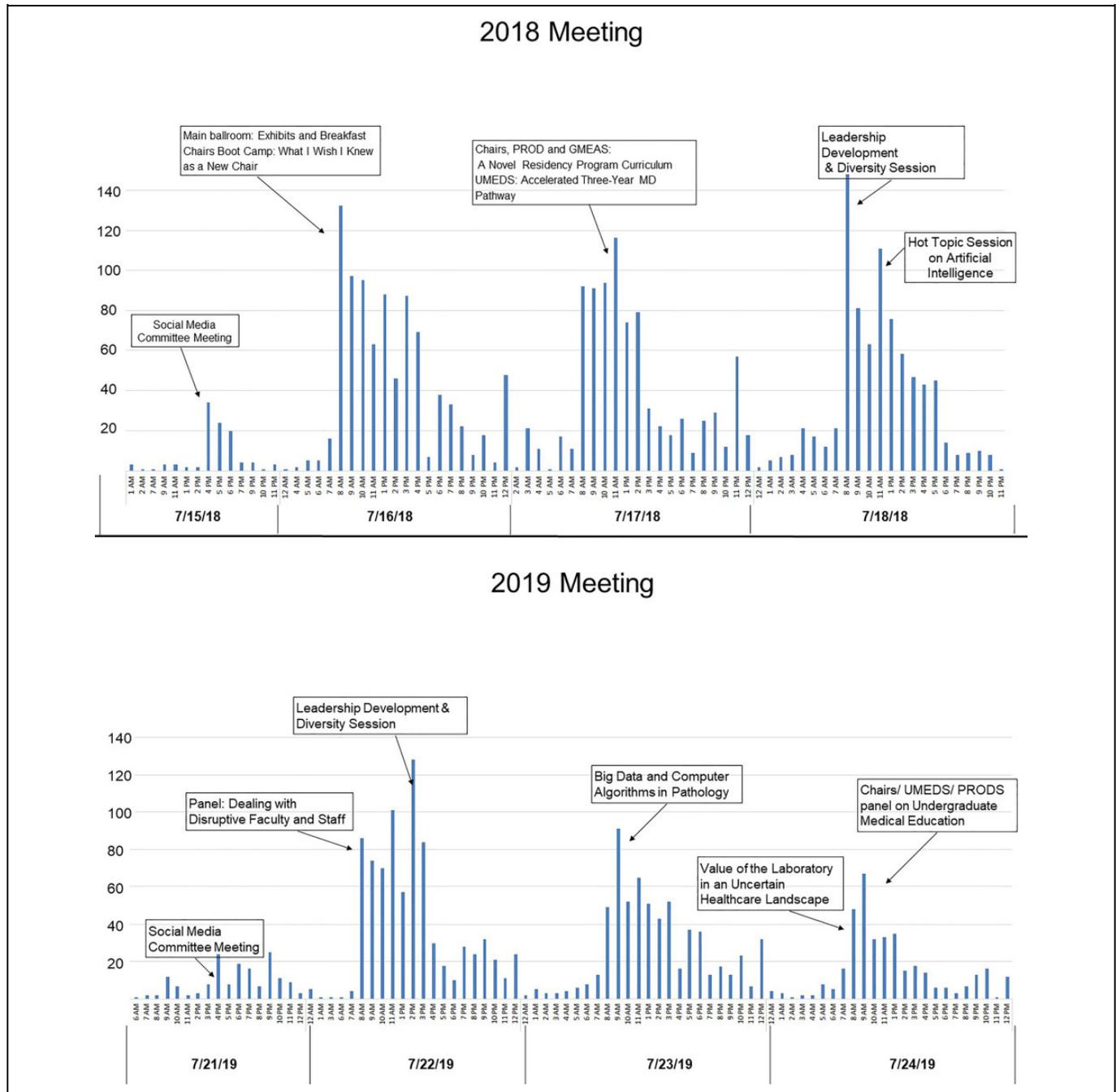
Figure 2. Timeline of twitter engagement. The horizontal axis represents each hour of the conference, and the height of the bar represents the number of tweets. The 4 days of the meeting are shown for 2018 and 2019 in the top and bottom panels, respectively. The graph is annotated to show the meeting sessions that coincided with each peak. GMEAS indicates Graduate Medical Education Administrators Section; PRODS, Pathology Residency Program Directors Section; UMEDS, Undergraduate Medical Education Directors Section.

one another and to grapple with the challenges facing the future of academic pathology. Each meeting is dedicated to a unique theme. The theme in 2017 was *The Role of Pathology in Population Health*; in 2018, it was *Educating Stakeholders on the Roles of Pathologists*, and in 2019, it was *Innovation through Collective Excellence: Shaping the Future of Pathology*.

The meeting is divided into 5 tracks, each with a full set of programming directed to a unique role. In keeping with the sectional structure of the APC, the tracks are as follows: Department Chairs, Residency Program Directors Section, Undergraduate Medical Educators Section, Pathology Department Administrators Section, and Graduate Medical Education Administrators Section. As noted in the Results, volunteers joined the committee from all 5 tracks, indicating that the interest in social media is well distributed among the various department leadership roles. Notably, 2 groups were outstanding for

Table 3. Analysis of Tweets by Topic.

Topic	2018	2019
Social media use	622	536
Pathology pipeline	337	481
Social tweet	234	468
Resident education	244	413
What pathologists do	518	89
Undergraduate medical education	166	251
Miscellaneous	152	258
Burnout	48	280
Diversity	153	134
Artificial intelligence and new technology	175	106
Mentor models	248	32
Faculty development	76	202
Leadership	33	194
Research	160	37
Effective feedback	53	22
Quality improvement	39	29

their volunteerism for service on the committee, especially during 2019 when the committee was more established. Social media committee membership represented 23% of the residents and medical students and 26% of the chairs and senior fellows. This may reflect the familiarity with social media in the former group and the readiness to advocate for the field of pathology in the latter group.

There was an 11-fold increase in social media presence and engagement at the 2018 APC meeting compared to the year prior. Implementation of the social media committee with a formal strategy at the 2018 meeting was the main driver of this dramatic increase. Although a small fraction may be due to an overall increase in social media adoption in general, the magnitude of this change supports the premise that a dedicated committee has great potential to increase social media engagement.

In addition to the increased activity of social media users, our data also suggest that implementation of a social media committee encourages the less active social media users to become more engaged. Studies have shown that a small percentage of Twitter users typically generate the majority of the online content, with most users acting as silent observers.[7] This phenomenon is sometimes expressed as "The 90:9:1 Rule of Participation Inequality,"[8] which states that 90% of social media users are observers who do not contribute, 9% engage a little, with the remaining 1% accounting for almost all the action. In an effort to quantify the participation inequality at our meeting, we found that in both years 50% of the tweets could be attributed to approximately 10 users (2% of meeting attendees), with the remaining tweets contributed by approximately 350 users. It is likely that at least half of the contributors were on-site in attendance at the meeting. Considering that the 2018 and 2019 meetings consisted of 440 and 513 attendees, respectively, it is plausible that a proportion of attendees much higher than 10% fell into the middle group of being "engaged."

A dedicated committee offers many qualitative benefits as well. It can organize coverage of presentations that typically receive less attendance, broadening exposure of such sessions to other meeting participants and facilitating use of social media for those who want guidance. In addition, the committee helps structure the communications into both format and mission that align with the overall meeting goals.

This approach was first done with great success at the United States and Canada Academy of Pathologists annual meeting in 2015, and an article written by that committee helped shape our approach.[4] The authors describe the formation and execution of a dedicated committee that proved to provide an organizational framework to systematically share the meeting content. The formation of a dedicated committee does not discourage ad hoc user engagement but rather serves to equally distribute meeting content to the public. In the past meetings, it could be observed that the larger sessions drew more social media posts than smaller sessions. The work of a dedicated committee is focused on covering all sessions equally, with the main purposes of distributing information for the benefit of the presenters and the online audience.

We note that there was a decrease from 2978 tweets in 2018 to 2096 tweets in 2019. The reason for this is not clear. It may be due to extra enthusiasm for a first-time committee in 2018 or perhaps due to an artifact of normal year-to-year variation. Since the majority of the tweets were from a small group of people, random changes in that group can be consequential. Of note, during this time frame, the number of Likes stayed relatively constant and the amount of Impressions actually increased, so the trend seen in the number of tweets is not consistent or systematic.

As a guide to social media organizers at other meetings, the strategies that we found to be most successful are outlined in Table 1. In particular, thought should be given to the hashtag, which is a short sequence of characters that is used to label the tweets that pertain to the meeting. The phenomena of "hashtag drift" refers to the tendency of slow changes to the hashtag caused by social media users who misread, mistype, or otherwise invent new hashtags that will compete with the correct hashtag. This compromises the meeting's visibility on social media, and committee members should therefore look out for incorrect hashtag use during the meeting. If an incorrect hashtag is identified, committee members can retweet the post using the correct hashtag to encourage the original contributor and others to stick to the correct hashtag. In addition, prior to choosing a hashtag, conference organizers should search Twitter for competing uses. This risk is illustrated by the confusion associated with the hashtag of the 2019 meeting of the American Academy of Pediatrics in New Orleans. The hashtag chosen for the meeting, #AAP19, was also used by the Aam Aadmi Party, which is an Indian Political party in Delhi that was the true subject of many of the tweets that bore this hashtag.[9]

Outcome data were collected and analyzed using third-party tools that analyze tweets based on hashtags. Many services are available, such as Symplur, Tweetbinder, Hashtagify, and Hashtracking. Symplur is very popular in published literature, and it is free of charge when used for topics related to health care.[10] However, we found that other companies provide data

Table 4. Effect of Social Media on Various Stakeholders at an Academic Meeting.

Entity	Effect
Speakers	– Amplified the reach and impact of their message nationally and internationally
	– Potential platforms to answer questions and interact with learners after session finishes
Meeting participants	– Enhanced exciting and collegial atmosphere
	– Forum to continue discussion of ideas after sessions are finished
	– Opportunity to network in the atmosphere of a national meeting that unites people from distant places together around common interests; reinforce existing connections and develop new ones
Interested people who could not attend	– Opportunity to learn key points
	– Opportunity to network remotely at a time when people who share their interests are engaged
Organization	– Increased publicity around the organization's meeting
	– A sense of a "common mission" around the organization's goals

for a small fee that is more insightful and comprehensive. We chose Tweetbinder, which provides aggregated data pertaining the hashtag, such as number of tweets, likes, top contributors, and analysis by time-of-day, and also an Excel spreadsheet with data on each individual tweet, such as text transcript, permalink, and number of likes and retweets. A graphic provided by Tweetbinder is shown in Supplemental Figure 1.

We used 2 different quantitative strategies to identify the topics of greatest interest to followers on social media. The timeline shown in Figure 2 is based on raw volume of tweets, while the measurement of engagement tabulated in Table 3 is based on likes and retweets. It is clear that many of the topics identified in the 2 analyses are the same. The Leadership Development and Diversity Session was concurrent with the highest volume of tweets per hour in both years, and Diversity ranks among the top topics in engagement. Other topics that were outstanding in both quantitative analyses include Artificial Intelligence, Undergraduate Education/Pathology Pipeline, and Social Media for Pathologists. This consistency underscores the interest that these topics held to our social media followers.

A core question of interest to the authors was how people actually felt about use of social media. Did users feel that of social media participation had enhanced their meeting experience or effected their careers in general? Many of the tweets that pertained to the topic of Social Media for Pathologists actually address this directly, often using the hashtag "#SoMe" in place of the words "social media." One tweet stated "So many great things you can do on SoMe. #MedicalEducation. Promoting #pathology to the world. Meeting friends/colleagues."[11] Another wrote "#SoMe has really changed my life and my career in the best way, and I have gotten to meet these fine people (and friends!) because of it. Thank you all for incredible work you have done. The future is bright!"[12] The reflections that were expressed by social media users were overwhelmingly positive.

The benefits of social media are unique for each of several groups of stakeholders, as tabulated in Table 4. Speakers benefit from an amplified impact of their ideas. Participants benefit from the opportunity for networking and discussion with people who share common interests. Finally, the sponsoring organization benefits from the increased publicity and the sense of a

common mission around the organization's goals. Our experience shows that formation of a dedicated social media committee is a strategy that can provide valuable benefits to academic meetings.

Differences Between Twitter and Other Social Media Platforms

The decision to choose Twitter above other social media platforms is often taken for granted in the community of academic pathology and academic medicine in general. However, many would be surprised to learn that according to a Pew Research Center survey,[13] Twitter is not even in the top 5 most popular social media platforms in the general population (Supplemental Figure 2). Therefore, it is worthwhile to understand the preference that is displayed to Twitter over other platforms. We chose Twitter because of 3 main advantages: emphasis on interaction with previously unknown people, opportunity for robust dialogue, and the platform's emphasis on visual graphics and photos. Each of these considerations will be discussed individually below.

Whereas Facebook and WhatsApp emphasize content from people with whom the user has an existing relationship, Twitter's "push" algorithm emphasizes interaction with previously unknown people. This algorithm identifies new people who are likely to be interested in a user's content based on past interest, and posts are automatically displayed and accounts are recommended to follow. In addition, users favor Twitter's 280-character limit because it forces tweets to distill the most important points of any conversation and present only those key points for consideration. This enables users to browse many posts to select those of interest even when using a small device, with no need to load long articles, videos, or high-resolution graphics.

Secondly, Twitter encourages active conversation by encouraging viewers to actively respond and post comments. Any user can read, share, or participate in a conversation between other public Twitter accounts. On a platform such as Instagram or YouTube, viewer comments are typically targeted at the post's author and not intended to attract the attention of third-party viewers. This dynamic is emphasized by the graphic design of Instagram or YouTube, in which there is a strong

distinction between the original post versus a viewer's comment in response. Comments are displayed in a smaller font size and they are collapsed beyond a certain number. On Twitter, in contrast, there is no distinction between an original post and a comment, as every comment is treated as a post in its own right. These tweets are presented together with graphic branch lines that indicate the back-and-forth relationships, a feature that is not available on any other major platform. In addition, Twitter provides an option for a "quote tweet" in which a user creates a new tweet that can incorporate an existing tweet below it, and this too is not offered on any other platform. Furthermore, Instagram and YouTube allow users to disable viewers' comments, while on Twitter, comments are always available. Lastly, on Twitter, the choice of which tweets are displayed most broadly is determined by a proprietary algorithm that prioritizes new posts which are currently being discussed and likelihood of generating active discussion with engagement by the original author. In contrast, other platforms prioritize content that was "most watched" or "most liked," which biases the algorithm in favor of older, established material.

Thirdly, Twitter's emphasis on photographs is especially valuable for pathology and other visual disciplines. In general, histologic images are eye-catching and often the focus of robust pathologist-to-pathologist Twitter discussions, frequently with some extra explanation to include followers who are not trained in or are new to pathology. In the context of an academic meeting, a photo of a lecture slide with a comment that includes a summary or highlight of the topic is a popular and effective way to share ideas presented at the meeting. Previously, this type of curated material could only be accessed by those who physically attended the meeting. With social media, global participation is possible, and the presenter has a much farther reach.

In summary, Twitter is not among the top 5 social media platforms among the general public but is by far the most popular for medical conferences and academic disciplines. Advantages of Twitter include emphasis on interaction with previously unknown people, opportunity for robust dialogue, and emphasis on visual graphics and photos.

Systematic Review of the Literature

To understand our findings within the context of the literature, we reviewed the prior literature that studied social media use at a medical conference. We searched Google Scholar and PubMed using keyword such as "academic conference," "meeting," "Twitter," and "social media" to identify relevant publications. The references of these publication were then searched to find additional publications. We reviewed 65 articles that were published between 2012 and 2019. Forty articles were analysis that pertained to a specific meeting, and these articles are summarized in Table 5. Twenty-five articles were on general issues relating to all meetings, and these articles are summarized in Table 6.

The articles that focused on specific meetings accumulatively covered 65 meetings from 2010 to 2018. The total number of tweets ranged from 36 (2011 Association of Anaesthetists of Great Britain and Ireland) to 56 823 (2018 European Society of Cardiology's Annual Congress). There was an increasing number of tweets in progressive years. This was particularly evident in the articles that covered annual meetings of the same society across several years. For example, Stukus published data about the meetings of the American Academy of Allergy, Asthma & Immunology over 2012 through 2015. Although 2012 had a modest 1200 tweets, the number approximately doubled each year and the trend ended in 2015 with 9700 tweets. Many of these articles studied the distribution of tweets and measured the percent of tweets that were informative and pertained to an academic discussion of enduring value, as opposed to tweets that described social interactions, requested help with logistical needs, or promoted a commercial product. These data cut to the heart of the educational value of Twitter and were of particular interest to the authors, therefore are tabulated in a dedicated column in Table 5. The average is 59%, indicating that the majority of tweets were informative. This underscores the value of social media as a tool for education.

The 25 articles on general issues that related to all meetings were of broad scope, and the study design and an item of interest for each are tabulated in Table 6. Many of them emphasized best practices for tweeting at meetings. Recommendations that were broadly emphasized include list the speaker's name, list the conference hashtag, differentiate between presenter's versus writer's views, prioritize quality over quantity with careful selection of high-impact content, include a photo of PowerPoint slides, include internet links to relevant articles, tag handles (Twitter accounts) of session speakers and other experts to encourage dialogue, include a photo and meaningful information about a user in the Twitter bio (public user profile), and encourage "tweet-ups" for individual Twitter users to meet each other in real life.

Limitations

Our study design had several limitations. Tweets that were not marked with the correct hashtag may have been missed. Tweets from 2018 and 2019 were collected via Tweetbinder reports that covered from July 12 to 22, 2018 and July 19 to 28, 2019. These time frames were thought to be reliable since the volume of tweets at the edges was very low, yet there may have been a small number of tweets outside the time frame that were missed. The tweets of 2017, in which a Tweetbinder report was not available, were collected manually. Since this method is different than that of 2018 and 2019, a small difference in results may be due to an unknown effect of the difference in method. Reach and Impressions were calculated by third-party companies that are thought to overestimate these figures.[36] This makes sense because the calculations assume that each follower of a contributor is a distinct person who is not counted among the followers of other contributors, whereas in real life,

Table 5. Review of the Literature That Pertain to a Specific Meeting.

Article	Meeting	Total tweets	Percent informative
Allen et al[14]	2016 Science of Dissemination and Implementation in Health	2639	51%
Alvarez-Perea et al[15]	2013 Spanish Society of Allergology and Clinical Immunology	198	NA
Alvarez-Perea et al 2018[15]	2014 Spanish Society of Allergology and Clinical Immunology	741	NA
Alvarez-Perea et al[15]	2015 Spanish Society of Allergology and Clinical Immunology	3016	NA
Alvarez-Perea et al[15]	2016 Spanish Society of Allergology and Clinical Immunology	7623	NA
Anderson et al[1]	2013 Australian Health Promotion Association	748	52%
Attai et al[16]	2013 American Society of Breast Surgeons	887	72%
Attai et al[16]	2014 American Society of Breast Surgeons	3743	70%
Attai et al[16]	2015 American Society of Breast Surgeons	4702	80%
Attai et al[16]	2016 American Society of Breast Surgeons	6207	80%
Awad and Cocchio[17]	2015 American Society of Health-System Pharmacists	1539	31%
Bert et al[18]	2014 European Public Health Conference	1066	60%
Borgmann et al[19]	2013 European Association of Urology Congress	1572	59%
Callister et al [20]	2014 American Headache Society Symposium	1942	NA
Callister et al[20]	2015 American Headache Society Annual Meeting	5967	NA
Callister et al[20]	2015 American Headache Society Symposium	4007	NA
Callister et al[20]	2016 American Headache Society Meeting	4579	NA
Callister et al[20]	2016 American Headache Society Symposium	3441	NA
Canvasser et al[21]	2013 World Congress of Endourology	335	63%
Chaudhry et al[22]	2010 American Society of Clinical Oncology	979	56%
Chaudhry 2012[22]	2011 American Society of Clinical Oncology	1477	60%
Cheung et al[23]	2015 Canadian Geriatrics Society	1491	56%
Christiansen et al[7]	2014 American Academy of Ophthalmology	4539	NA
Christiansen et al[7]	2015 American Academy of Ophthalmology	5065	66%
Cochran et al[3]	2013 Academic Surgical Congress	434	42%
Cohen et al[4]	2015 United States and Canadian Academy of Pathology	6524	NA
D'Anna et al[24]	2018 European Society of Neuroradiology	386	60%
Desai et al[25]	2011 American Society of Nephrology Kidney Week	993	29%
Ferguson et al[26]	2013 Cardiac Society of Australia and New Zealand	669	NA
Fuller and Roy-Chowdhuri[27]	2017 American Society of Cytopathology	2514	NA
Gomez-Rivas[28]	2016 National Congress of the Spanish Urological Association	1866	NA
Hawkins et al[29]	2011 Radiological Society of North America	4061	NA
Hawkins et al[29]	2012 Radiological Society of North America	5,630	NA
Hong et al[30]	2018 American Society of Colon and Rectal Surgeons	7,072	NA
Hudson and Mackenzie[31]	2018 European Society of Cardiology	56823	81%
Jackson et al[32]	2017 Florence Nightingale Faculty	215	NA
Jalali and Wood[33]	2013 Canadian Conference on Medical Education	3090	NA
Knoll et al[34]	2017 American Society of Radiation Oncology	3181	NA
Logghe et al[35]	2010 American College of Surgeons Clinical Congress	231	NA
Logghe et al[35]	2012 American College of Surgeons Clinical Congress	1881	NA
Matta et al[36]	2012 American Urological Association	753	22%
Matta et al[36]	2012 Canadian Urological Association	58	45%
Matta et al[36]	2013 American Urological Association	3956	30%
Matta 2014[36]	2013 Canadian Urological Association	635	39%
McKendrick 2012[37]	2011 Association of Anaesthetists of Great Britain and Ireland	36	69%
McKendrick et al[38]	2012 Association of Anaesthetists of Great Britain and Ireland	227	55%
Mishori et al[39]	2013 Society of Teachers of Family Medicine	1818	70%
Nason et al[40]	2014 Irish Society of Urology	798	55%
Neill et al[41]	2012 International Conference on Emergency Medicine	4500	74%
Nomura et al[42]	2010 American College of Emergency Physicians	846	79%
Nomura et al[42]	2011 Society for Academic Emergency Medicine	766	85%
Ovalle-Perandones and Navas-Martín[43]	2013 International Nursing Research Conferences	1723	NA
Ovalle-Perandones and Navas-Martín[44]	2014 International Nursing Research Conferences	2011	NA
Radmanesh and Kotsenas[44]	2014 American Society of Neuroradiology	410	49%
Salzmann[45]	2016 International Mental Health Nursing	1973	61%
Schwenk et al[46]	2015 American Society of Regional Anesthesia and Pain Medicine	811	77%
Schwenk et al[46]	2016 American Society of Regional Anesthesia and Pain Medicine	1519	73%
Soreide et al[47]	2018 European Society of Surgical Oncology	1495	NA
Stukus 2016[48]	2012 American Academy of Allergy, Asthma & Immunology	1200	NA
Stukus[48]	2013 American Academy of Allergy, Asthma & Immunology	3100	NA
Stukus[48]	2014 American Academy of Allergy, Asthma & Immunology	5900	NA
Stukus[48]	2015 American Academy of Allergy, Asthma & Immunology	9700	NA
Wilkinson et al[49]	2012 European Association of Urology	347	NA
Wilkinson et al[49]	2013 European Association of Urology	1762	NA
Wilkinson et al[49]	2014 European Association of Urology	5903	NA

Abbreviations: NA, Not available.

Table 6. Review of the Literature That Pertain Social Media at Meetings in General.

Article	Specialty	Design	Outcome or highlight of interest
Mackenzie[8]	Public health	Analysis of tweets using a specific public health hashtag for 3 consecutive years.	The percentage of tweets with an image, URL, and/or mention of another Twitter user increased during the period of study.
Bhargava[2]	Radiology	An author's personal experience using Twitter to amplify presence at an academic meeting.	Twitter broadens horizons and is an invaluable tool for learning and engagement.
Djuricich and Zee-Cheng[50]	General	Explores Twitter use at national conferences, grand rounds, Twitter chats, and journal clubs.	Provides a systematic review of 8 articles.
Ekins and Perlstein[51]	General	Formulated 10 rules of Twitter etiquette.	Keep questions short and on the science. Avoid grandstanding. Tweets should clearly differentiate between the speaker's viewpoint and the tweeter's viewpoint.
Groves[52]	General	Opinion piece	Conferences should project a live Twitter wall in each session to let the audience engage with the live debate in real time. Tweeting study results should not activate the Ingelfinger rule, which excludes for publication material that has been previously published.
Logan[53]	Hematology	Reviews Twitter use at subspecialty meeting and opinions about promoting the professional use of the platform.	Twitter enhances the learning value of academic conferences if done conscientiously and professionally.
Luc and Antonoff[54]	Surgery	How-to-guide for social media engagement at a specific meeting.	Publishing a step-by-step guide on Twitter use prior to the meeting increased attendee engagement.
Pemmaraju et al[55]	Hematology	Reviews Twitter use at academic conferences, emphasizing best practices and Twitter etiquette.	User bio/profiles of tweeters should contain a picture and meaningful information about the user. Empirical data show that this is associated with a greater likelihood that viewers will engage in your tweets.
Chapman et al[56]	General	Opinion piece regarding the ban on tweeting photographs of presented slides at the 2017 meeting of the American Diabetes Association.	The ban is likely to be viewed in the near future as a historical argument made by those who failed to recognize the importance of social media for medical professionals.
Chung and Woo[57]	Urology	Compares social media engagement at urological conferences to other surgical subspecialties.	Urological conferences had 3-fold more Twitter activity than nonurological surgical conferences in all parameters
Desai et al[58]	General	Evaluating Twitter influence of commercial entities vs unbiased authors.	The Twitter influence of commercial entities and individuals is roughly equal. The academic community must remain vigilant against the spread of biased information geared for profit during academic conferences.
Kalia et al[59]	Radiology	Opinion piece on the strategic use of Twitter at academic conferences, including tips and pointers on effective use.	Live polling and live tweeting changed how meeting attendees and nonattendees engaged.
Light et al[60]	General	Survey of surgeon's opinions regarding intellectual property ethics of audience members sharing photos of speaker's slide on social media	Respondents who use social media in their professional practice are more comfortable with the practice of sharing speaker's slides. General consensus is that conferences should be explicit about the rules on disseminating speaker's slides.
Loeb et al[61]	Urology	Survey on social media use to 4000 urologists, residents, and fellows.	Respondents widely use social media; most common use is personal use.
Loeb[62]	Urology	Editorial on making social media for urology meetings global.	Twitter activity at urology conferences is rising.
Mackenzie et al[63]	Sports medicine	Authors share experience and advice on social media at conferences.	Organizations should publish a hashtag prior to the meeting, include in preconference program, and provide links to high-quality images.
Mackenzie[64]	Infectious disease	Review	Review of Excel add-in called NodeXL that can be used to craft Twitter summary of specific conference.
Mitchell et al[65]	Infectious disease	Analysis of tweets at 4 specific meetings	Analyzed 23 718 tweets. Significant factors predicting a retweet included a link to a web address (OR = 2.0) and tweeting on topics such as *Clostridium difficile* (OR = 2.0).

Table 6. (continued)

Article	Specialty	Design	Outcome or highlight of interest
Mohammadi[66]	General	Discussion regarding the ban on tweeting photographs of presented slides at the 2017 meeting of the American Diabetes Association.	The ban was met with a huge, defiant, and largely humorous reaction, with many tweets comparing the policy with Orwellian censorship. The ban was a more popular topic of online conversation than anything presented at the meeting. One commentator pointed to the absurdity of not being able to share a photograph from a presentation about "open innovation."
Randviir et al[67]	General	Describes world's first Twitter-only research poster conference.	Tweeting effectively shared 80 research posters posted across the globe.
Roland et al[68]	General	Editorial on use of Twitter at academic conferences.	The outcome of Twitter use at conferences remains undetermined, but Twitter use clearing helps shape content, reach, and meeting participants' engagement.
Roland et al[69]	Emergency medicine	Establish the accuracy of key educational messages disseminated by conference delegates via Twitter.	Most speakers were pleased to have key messages tweeted. Most tweets (34/37) were accurate.
Tomlinson et al[70]	Emergency medicine	Discusses creation and outcome of Presenter Initiated and Generated Live Educational Tweets (PIGLETs), in which tweets that are composed by the author are tweeted during the presentation, with the goal to broaden the reach of educational conferences.	Presenter Initiated and Generated Live Educational Tweets (PIGLETs) allow the presenter to reach a larger number of learners compared to the traditional conference workshop experience. The presenter can ensure that tweets are accurate and high quality, compared to learner-generated live tweeting, which is more prone to error and inaccuracies.
Yeh[5]	Cardiology	Discusses Twitter as an academic platform for content sharing, discussion, debate, and interactions with industry.	Twitter in particular gave academically minded cardiologists of all ranks a voice, created a platform for instantaneous research dissemination and increased connectivity among communities.

Abbreviations: OR, Odds ratio.

it is likely that there is substantial overlap. In addition, the calculations assume that all followers regularly view all the tweets that appear in their Twitter feed, and this might also not be true. In addition, in defining which tweets were informative with respect to the literature review shown in Table 5, it was observed that all the articles had the same general scope but differed in several nuances.

Conclusion

Our findings suggest that social media is an increasingly powerful tool that cultivates meaningful discussion and is of particular value at academic meetings. This is recognized and discussed in peer-review literature across many medical specialties. The formation of a dedicated social media committee is an underutilized strategy that can provide valuable benefits. Analysis of tweets is a useful way for conference organizers to gauge topics of interest among social media followers. Topics that were outstanding in the social media dialogue at the 2018 and 2019 APC meetings include Diversity, Undergraduate Education, Resident Education, Pathology Pipeline, Artificial Intelligence, and Mentor Models.

Authors' Note

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Supplemental Material

Supplemental material for this article is available online.

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