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**Title:** Lessons Learned from Web and Social Media Based Educational Initiatives By Pulmonary, Critical Care & Sleep Societies

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**ABBREVIATIONS**

ATS: American Thoracic Society

CHEST: American College of Chest Physicians

SCCM: Society of Critical Care Medicine

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## INTRODUCTION

In today's digital world, web and social media based resources have become increasingly utilized by healthcare professionals for continuing medical education. Learners expect this content to be high quality, freely available on demand, and presented in such a way that they can engage in meaningful self-directed learning. In response to this demand, there is an enormous amount of medical education content made available online, and much of it produced by private individuals.

Academic medical societies also have a responsibility to provide digital content to educate their members and the public. In the areas of pulmonary, critical care, and sleep medicine, several members of the U.S. based Critical Care Societies Collaborative such as the Society of Critical Care Medicine (SCCM), the American Thoracic Society (ATS) and the American College of Chest Physicians (CHEST) have taken on this responsibility, and over the last few years are using web and social media based educational initiatives to provide original and curated content.

In this topical review, our goal is to raise awareness of these initiatives so that practicing clinicians and educators can better utilize these resources. Over the last several years, we have conducted research into the effectiveness of these initiatives. Even within the overlapping clinical areas, each society provides educational content in a slightly different manner. These differences provide an opportunity to learn about what makes a successful web-based initiative on different platforms. In this review, we will also describe the lessons learned from these initiatives, and attempt to develop some best practices that could be used to guide future efforts.

## HOW SOCIETIES APPROACH WEB AND SOCIAL MEDIA BASED EDUCATION

Social media, particularly Twitter, has been a major area of engagement by medical societies. Organizations are using social media to build online communities, to promote articles from their journals, and to live-tweet content from their annual conferences. The social media work groups and committees of these societies have experimented with different ways to increase engagement, to improve reach, and to involve more users with their social media efforts. CHEST was the first of these societies to start a Twitter chat, and built a multidisciplinary community of practicing clinicians, patients, and other medical societies (Figure 1). Since launching this hashtag in December 2013, there have been 28,058 tweets by 5,116 users resulting in more than 95 million impressions. Other educational initiatives conducted by these societies have included web-based live journal clubs, Instagram takeovers, Reddit Ask Me Anythings, Facebook Live events and educational videos on YouTube. Many of these events are moderated by volunteer medical professionals on behalf of the Societies and the scripts and plans for these educational initiatives are peer-reviewed prior to the live events.

## TWITTER USE AT ACADEMIC MEDICAL CONFERENCES

Tweeting lectures and other content presented at academic conferences has become an increasingly used strategy by medical societies and clinicians. Participants can join in the online conversation, whether or not they are present at the conference. To quantify this increase, we assessed the use of Twitter at conferences of SCCM, ATS, and CHEST over a four-year period between May 2013 and January 2017. The use of the main conference hashtag for each of these annual conferences was tracked and social media metrics were collected using Symplur analytic tools (Symplur, LLC, Upland, CA). These metrics included the number of impressions

(or views) of that hashtag, the number of tweets using that hashtag, and the number of participants who tweeted that hashtag during the conference. We then compared these metrics among the organizations and over time using non-parametric statistics (Kruskal-Wallis and Wilcoxon Rank Sum test).

When aggregating the data from all of the annual conferences of these societies, there were a total of 75,482 tweets by 15,394 participants resulting in 196,536,942 impressions. Over this time, there was significant growth in the median number of impressions, tweets and participants for each organization, and for the combined totals (Figure 2). Specifically, there was more than a 6-fold increase in the median number of tweets ( $p < 0.05$ ), a 5-fold increase in the number of participants ( $p < 0.05$ ), and an 8-fold increase in the number of impressions ( $p < 0.05$ ) between Year 1 and Year 4. However, during this period, the median number of in-person attendees remained relatively constant with no statistical differences (Figure 2).

When comparing organizations, ATS had the largest median number of impressions, tweets and participants compared to SCCM and CHEST, but this was not statistically significant.

Qualitatively, ATS hashtags had the largest overlap with other non-medical events that used the same hashtag during their conference period. Specifically, "All That Skate", a Korean Skating Competition held at the same time as the ATS International Conference, used the same hashtag as the ATS each year. This overlap made it difficult to differentiate the metrics for each of these events and likely resulted in an overestimation of the reach of the ATS International Conference. Unfortunately, quantifying the degree of this overestimation is not possible using the analytic tools available. This reinforces the importance of choosing a unique hashtag to accurately track engagement and reach.

## THE USE OF DUAL SESSION SPECIFIC HASHTAGS

In 2016, SCCM created hashtags specifically for certain educational sessions at the annual Critical Care Congress. These 'session specific' hashtags were meant to allow users to identify and separate conversations at larger medical conferences. These session specific hashtags were used in conjunction with the main conference hashtag, and users would include both of these hashtags in their tweets during that session. To assess the impact of this initiative, we tracked the use of session specific hashtags and examined who was using these hashtags in comparison with the main conference hashtag. Symplur analytic tools (Symplur, LLC, Upland, CA) were again used to provide metrics, and characteristics of each user were compared.

Eleven session specific hashtags were created for 2016 Critical Care Congress (Figure 3). The reach of these hashtags were compared to the main conference hashtags in 2015 and 2016 (#CCC44 and #CCC45 respectively). The median number of tweets for the session specific hashtags was 127 per session (25-75% IQR 86-289), median participants of 38 per session (25-75% IQR 29-70), and median number of impressions of 189,594 per session (25-75% IQR 37,226-363,012). These were markedly lower than the metrics for the main conference hashtag in 2016.

In 2016, between 10 and 50% (median 10%) of the top ten participants in the session specific hashtags were "new users" (with <100 followers), while none of the top ten participants in the main conference hashtags used in 2015 or 2016 were "new users" by this definition. This suggests that the use of session specific hashtags may allow a venue for newer social media users to better participate in more focused discussions even at large conferences.

## THE USE OF ANCILLARY SOCIAL MEDIA ACCOUNTS

Conventional social media wisdom says smaller ancillary accounts dilute the brand of the larger organization and may interfere with the organization's core social media presence. However, the Twitter strategy of the ATS challenges that assertion. The ATS membership is divided into Assemblies and Sections, each with interests in specialized areas. Clinician volunteers within the ATS encouraged development of Twitter feeds for these Assemblies, and this decision was endorsed by the society's leadership. While the main ATS Twitter account (@atscommunity) was managed by staff, these ancillary accounts were managed solely by clinician volunteers appointed by the ATS without any staff support.

We sought to determine whether splitting the ATS brand into smaller accounts would impact the ATS social media presence. A retrospective observational study was conducted using data collected manually from Twitter. Assembly and section Twitter accounts were stratified by frequency of tweeting (active vs. non-active accounts), and then social media metrics were compared between these two groups using a Wilcoxon Rank Sum test.

At the time of the analysis in October 2016, the main Twitter feed of the ATS (@atscommunity) had 8,082 tweets, followed 518 accounts and had 12,715 followers. There were 14 Assembly and Section Twitter accounts identified (Table 1 and Figure 4), which in total have 1,941 followers, and posted 2,765 tweets. Only 3 of the 14 accounts tweeted more than 2 times/week. The median rate of tweets for the other 11 non-active accounts was 4 tweets/month (25-75% IQR 2-7 tweets/month), compared with a median rate of tweets of 27 tweets/month (25-75% IQR 27-28 tweets/month) from the 3 more active accounts ( $p=0.01$ ).

When comparing the active accounts to the non-active accounts (Table 2), active accounts had more tweets, more followers, more followers that were healthcare providers, and more physician followers. Half of all the accounts tweeted during the ATS 2016 International Conference (3 of 3 active accounts, and 4 of 11 non-active accounts). During this conference, there were 10,650 tweets by 2,639 participants, of which 165 tweets came from the main @atscommunity account and 202 tweets from the ATS Assembly & Section accounts. Of these 202 tweets, 123 (61%) came from the 3 active accounts, and 79 came from the non-active accounts.

An obvious interpretation of the data is that more active accounts are more influential on social media. But this analysis also highlights the issue of sustainability and the use of clinician volunteers. The majority of the ATS Assembly & Section Twitter accounts were non-active and mainly tweeted during the ATS International Conference, without creating a consistent presence on social media. By its nature, Twitter is fast moving and tweets have a short lifespan. Organizations should provide professional staff support for their volunteer clinician experts if they would like a sustained presence on Twitter.

### **COMPARING SOCIAL MEDIA MODALITIES**

Educational initiatives from CHEST may provide insight into how to reach segmented audiences using different social media platforms. Recently, CHEST conducted three live educational campaigns on the topic of sepsis across three different social media platforms. These included a Twitter chat, a Facebook Live event, and a Reddit Ask Me Anything. In these live social media events, one of the authors (SQS), a subject matter expert on sepsis, was featured and users from each platform were presented with the opportunity to engage in discussion and ask questions. These discussions were facilitated by CHEST professional staff and volunteer

members of the Social Media Work Group of CHEST. Each of these sessions was promoted in advance by CHEST and conducted live at a pre-specified date and time.

Subsequently, we analyzed the social media metrics of each of these events using Symplur analytics and manual data collection directly from the social media platform. Characteristics of the users were also collected. Reach was defined as number of impressions (or views) for Twitter, the number of views on Facebook, and number of up-votes on Reddit. Engagement was defined as number of tweets and participants on Twitter, number of likes, comments and participants on Facebook, and number of comments and participants on Reddit.

We found that engagement was high and reach was broad for these events, with more 920,024 impressions on Twitter, 2,081 views on Facebook, and 792 up-votes on Reddit (Table 3). However even within the same clinical topic by the same organization, different social media platforms attracted unique audiences, and engagement varied by platform (Table 3). Twitter attracted a high percentage of physicians and participants who had previously interacted with CHEST. Reddit attracted a mix of layperson commenters, medical students, paramedics and other health-care providers outside of pulmonary and critical care medicine. Facebook attracted a high percentage of international users. Understanding the differences between platforms on the type of users engaging with these events may allow medical societies to tailor content to specific audiences in order to leverage their reach.

## CONTENT CURATION

Each of these medical societies has endeavored to aggregate content into a user-friendly format for their membership and for the public. Curating content can provide a method for societies to

give their endorsement and provide some oversight to existing content. There are several ways to curate content, commonly through blog posts such as the monthly CHEST Thought Leaders blog, or creating “Moments” on Twitter which collect a series of tweets into a grouping. However, content curation takes time by knowledgeable (and already busy) expert volunteer clinicians as well as significant support from medical society professional staff.

One example of a successful content curation initiative that had a broad reach is one conducted by CHEST using the Storify platform. Storify (Livefyre, Inc) was a social media platform made popular by news organizations to consolidate digital content and provide a cohesive timeline. Storify is no longer in operation, but the strategy of aggregating content with links, pictures, and texts can easily be replicated with blogs.

In this initiative, the leadership of the NetWorks of CHEST were each asked to gather content for the purpose of educating patients, caregivers, and clinicians on pulmonary, critical care, and sleep related topics that could be aggregated using Storify. Each of these “stories” had multiple collaborators authoring the pieces and was reviewed by the Steering Committee of that NetWork before being published by CHEST staff. Thirty eight stories were published between February 2016 and March 2017. There were a total of 19,892 views of these stories; 25 of these were pulmonary, 9 were critical care, 3 were sleep topics, and one focused on a topic unrelated to pulmonary, critical care, or sleep. The critical care stories were viewed more often than the pulmonary and sleep stories, although this was not statistically significant ( $p=0.08$  by Kruskal Wallis). Specifically, there were a median of 538 views (25-75% IQR 394-1077 views) of the critical care stories, compared to a median of 267 views (25-75% IQR 87-587 views) of the pulmonary stories, and a median of 258 views (25-75% IQR 87-476) of the sleep stories. Qualitatively, the stories that contained more links and shorter textual descriptions trended toward more reach as well.

## CONCLUSIONS

In this review, we have described several examples of web and social media based educational initiatives by pulmonary, critical care, and sleep medical societies. Medical societies have a responsibility to play a leading role in web and social media based medical educational initiatives. With more than one billion medical education links found on Google, it is crucial for these societies to help guide learners in choosing accurate and reliable content.

From these examples, there are several best practices that can be identified that might help guide future efforts. Specifically, these analyses suggests that (1) creating a hashtag is a good way to build an online community, (2) live-tweeting from conferences is an effective way to spread a organizational message, (3) creating session-specific hashtags may help pull newer users into conversations on Twitter, (4) the use of ancillary social media accounts does not necessarily adversely affect the main brand, and (5) that content curation is an effective way to provide oversight to medical educational materials online. However, there are pitfalls that societies should be aware of. When choosing a hashtag, care should be taken not to choose a hashtag already in use. Finally to remain successful, these initiatives require support from knowledgeable multimedia marketing staff who can partner with expert clinician volunteers to produce quality content.

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All authors have read and approved the final submission of this manuscript. CLC, NHD and TS conceived and designed this review. Data was collected by CLC, NSD, RK, WGC, IHG, BS and TS. CLC and NHD drafted the article and all authors performed critical revision. CLC is the corresponding author and assumes full responsibility for the integrity of the submission as a whole, from inception to published article. The authors have indicated that they have no financial interests relevant to this article to disclose and there are no potential conflicts of interest.

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**Table 1. Characteristics of the ATS Assembly & Section Twitter Accounts.** Data collected October 2016.

	<b>Tweets</b>	<b>Tweets/Month</b>	<b>Following</b>	<b>Followers</b>
<b>Active Accounts</b>				
@ATSCritCare	365	28.1	3	344
@ATS_RCMB	683	27.3	55	337
@ATS_BSHSR	458	26.9	80	155
<b>Non-Active Accounts</b>				
@ATSTOA	251	8.4	5	88
@ATS_PC	228	7.6	90	91
@PR_Assembly	212	7.1	196	414
@ATS_All	191	5.3	26	137
@ATS_MTPI	99	4.7	237	79
@ATS_GG	72	4.0	163	78
@ATSSRN	112	3.0	19	63
@ATSNursing	55	2.8	41	51
@ATSMedEd	26	1.6	21	54
@ATS_EOPH	4	0.6	59	14
@ATS_RSF	9	0.3	8	36

**Table 2. Comparing Active and Non-Active ATS Assembly Twitter Accounts.** Data presented as median (25-75% Interquartile range). Comparisons of Active to Other Accounts by Wilcoxon Rank Sum. Data collected October 2016.

	<b>Active Accounts (n=3)</b>	<b>Non-Active Accounts (n=11)</b>	<b>P-value</b>
<b>Tweets</b>	458 (365-683)	99 (26-212)	0.01
<b>Tweets/Month</b>	27 (27-28)	4 (2-7)	0.01
<b>Following</b>	55 (3-80)	41 (19-163)	0.59
<b>Followers</b>	337 (155-344)	78 (51-91)	0.04
<b>Followers that are Organizations</b>	43 (34-68)	18 (10-30)	0.05
<b>Percent Followers that are Organizations</b>	20% (12%-22%)	28% (20%-33%)	0.10
<b>Followers that are Individuals</b>	258 (112-285)	46 (27-54)	0.04
<b>Percent Followers that are Individuals</b>	77% (72%-83%)	64% (58%-71%)	0.02
<b>Followers that are Healthcare Providers</b>	117 (69-209)	27 (18-34)	0.03
<b>Percent Individual Followers who are Healthcare Providers</b>	62% (45%-73%)	63% (55%-76%)	0.81
<b>Followers that are Physicians</b>	85 (56-158)	22 (9-27)	0.02
<b>Percent Healthcare Provider Followers that are Physicians</b>	76% (73%-81%)	71% (50%-81%)	0.48

**Table 3. Comparing Social Media Reach and Engagement Across Platforms for A Sepsis Educational Initiative**

	<b>Reach</b>	<b>Engagement</b>
<b>Twitter</b>	920,024 Impressions	479 Tweets 73 Participants 14% (n=10/73) Organizations 86% (n=63/73) Individual Users 53% (n=35/63) Physicians 41% (n=30/73) had previously attended a Chest Twitter Chat
<b>Facebook</b>	2,081 Views	19 Comments Provided by 13 non-US based participants from 10 different countries 101 Likes 101 Participants 99% (n=100/101) Individual Users 36% (n=36/100) Physicians 49% (n=49/100) Non-US Based Users
<b>Reddit Ask Me Anything</b>	792 Up-votes	182 Comments 62 Participants 98% (n=61/62) Individual Users 16% (n=10/61) Physicians 20% (n=12/61) Other Healthcare Providers 66% (n=40/61) Patients or Caregivers

**Figure 1. Network Analysis of Users Most Commonly Tweeting with the #pulmcc hashtag.** The size of circle represents of number of tweets by that user, arrows represent connections between users, and arrow width represents number of interactions and the strength of connections between those users. Data collected between December 1, 2013-November 1, 2018.

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**Figure 2. Cumulative Social Media Metrics from Year 1 through Year 4 for SCCM, ATS, & CHEST.**

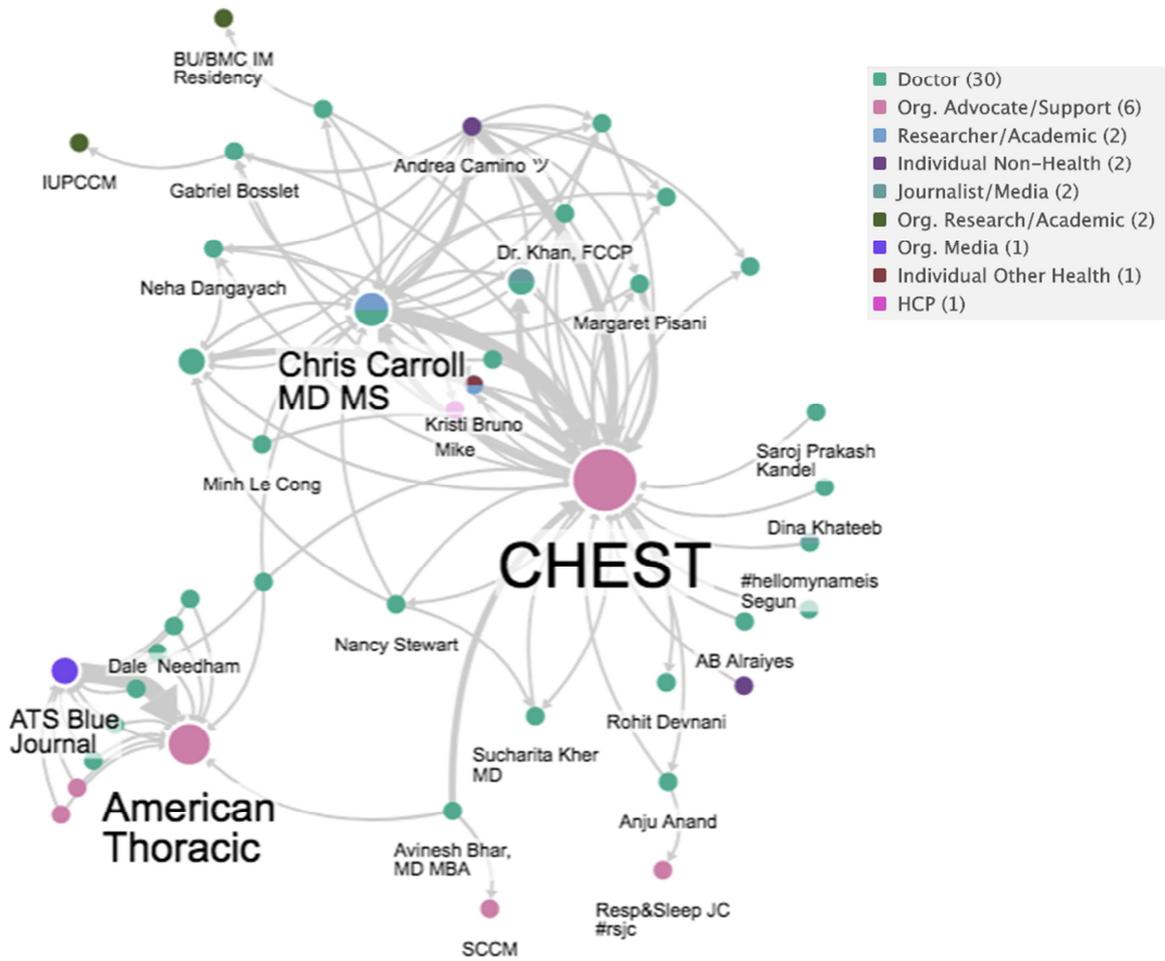
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**Figure 3. Social Media Metrics of Session Specific Hashtags on Metrics of the SCCM Critical Care Congress Compared to the main conference hashtag in 2015 and 2016 (#CCC44 and #CCC45 respectively).**

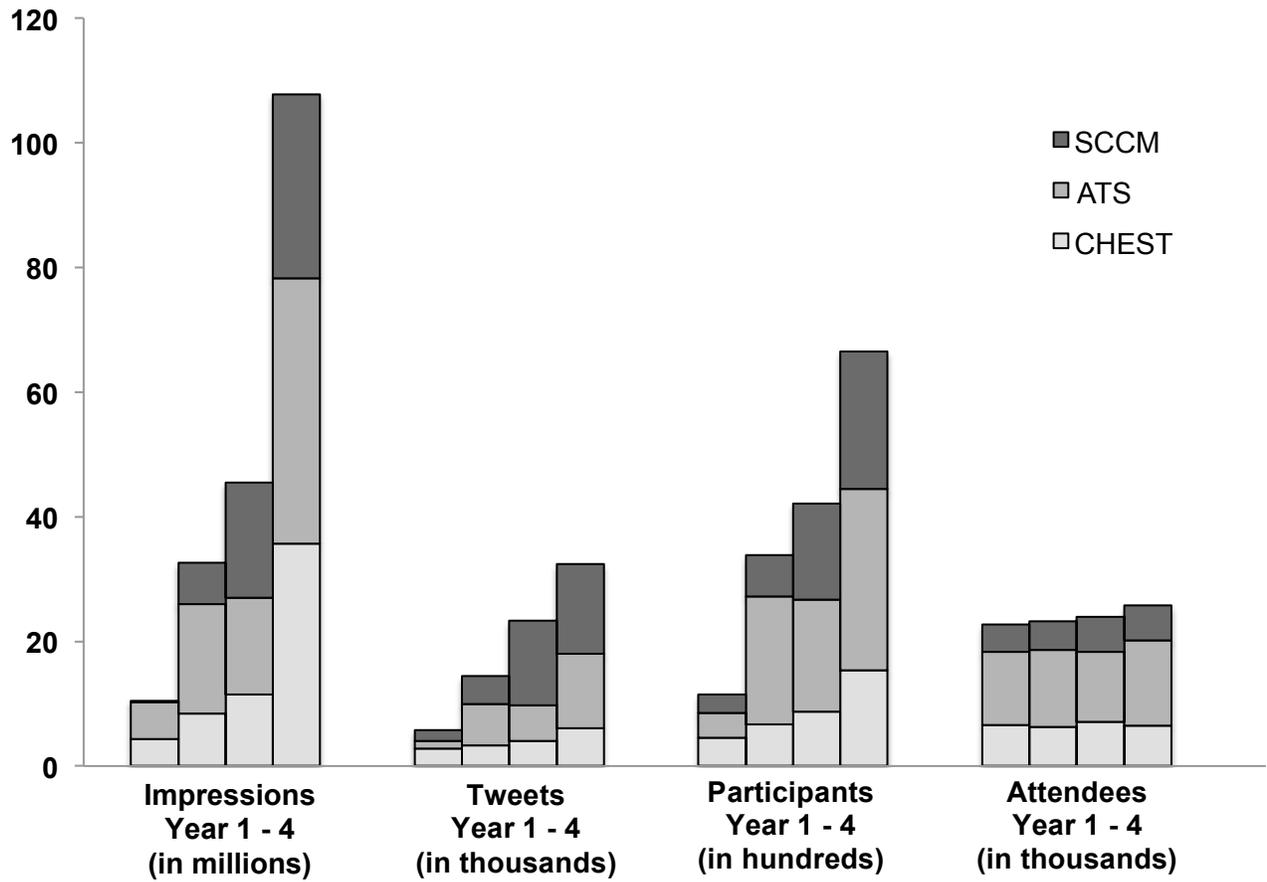
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**Figure 4. Characteristics of the Followers of the ATS Assembly & Section Twitter Accounts.** Data collected October 2016.

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