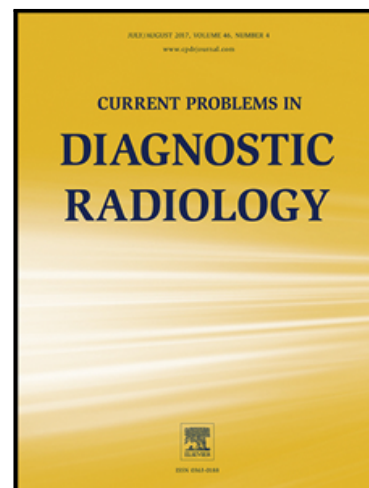# Journal Pre-proof

Social Media Growth at Annual Medical Society Meetings: A Comparative Analysis of Diagnostic and Interventional Radiology to Other Medical Specialties

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Highlights

- The ACR Twitter population consistently displayed high levels of activity through the study period, maintaining one of the greatest number of tweets/user, retweets/user, and impressions/user compared to other specialties.
- SIR was the only studied conference with statistically significant growth in number of tweets and users (1032.8 tweets/year (p=0.008) and 212.5 users/year (p=0.007)).
- The #IRad user population is growing at a statistically significant rate of 1309.5 users/year (p=0.003).
- To boost ACR's social media membership and utilization, JACR could consider adopting some of the Twitter tactics utilized by JVIR, including strategically engaging with users in the morning, increasing the number of visuals shared, and spreading awareness of the specific Twitter hashtag to be used at each annual conference.

Social Media Growth at Annual Medical Society Meetings: A Comparative Analysis of Diagnostic and Interventional Radiology to Other Medical Specialties

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Objective

To understand social media growth in both diagnostic and interventional radiology compared to other related specialties by quantifying and comparing hashtag utilization at annual medical conferences.

Methods

Official annual conference hashtags for SIR, ACR, RSNA, ACC, AHA, and ASCO were analyzed from 2015 to 2019, along with the IR hashtag #IRad. Twitter analytics were obtained with the use of Symplur Signals, a healthcare social media analytics platform. Linear regression analysis was performed on the number of tweets and users for each hashtag.

Results

For annual ACR meetings, the number of tweets/user (6.96 in 2019), retweets/user (4.39 in 2019), and impressions/user (40,051 in 2019) were among the highest of all the specialties studied. This trend was observed despite a smaller number of users among ACR than most other conferences.

SIR tweets increased significantly at a rate of 1032.8 tweets/year ($p = 0.008$) while users also significantly grew at a rate of 212.5 users/years ($p = 0.007$). #IRad tweets are also growing at a rate of 13234.8 tweets/year ($p = 0.026$) while #IRad users are growing at a rate of 1309.5 users/year ($p = 0.003$). RSNA users were significantly decreasing at -1207.1 users/year ($p = 0.018$).

Conclusion

ACR consistently had one of the highest counts of tweets/user, retweets/user, and impressions/user compared to the other studied specialties, suggesting that ACR's Twitter users are more active than users outside of the field of radiology. SIR was the only studied specialty conference that had statistically significant increases in the number of tweets and users.

Introduction:

Social media's use in healthcare has created a new route for communication and collaboration among patients, physicians, and researchers.[1] From utilization of applications like Twitter (Twitter.com, San Francisco, California) for disease surveillance to teaching online science courses, social media is still being explored as a way to promote interaction regardless of geographic location.[2,3] With regards to medical conferences, Twitter use is now encouraged at many large medical meetings.[4,5,6] The radiology community specifically has seen growth in social media use, and a recent survey revealed that almost 60% of radiologists use social media for professional purposes.[7]

Although social media use in interventional radiology (IR) has been shown to increase over the previous years, the rate at which IR has grown in social media has not been compared to that of other specialties or other fields within radiology.[8] As the IR community continues to increase its social media use at medical conferences, many questions regarding the field's Twitter activity, users, and extent of social media engagement remain. Further analysis on this topic may therefore help educate practitioners and patients about the field, increasing attention to and interest in radiology. Thus, this study sought to understand how the field of diagnostic radiology and its IR counterpart have grown compared to other related specialties by comparing Twitter utilization at annual medical conferences as a marker for professional networking. By analyzing Twitter activity metrics of annual Society of Interventional Radiology (SIR), American College of Radiology (ACR), Radiological Society of North America (RSNA), American College of Cardiology (ACC), American Heart Association (AHA), and American Society of Clinical Oncology (ASCO) meetings, the purpose of this study was to directly quantify ACR and IR associated social media use and compare this with other related medical specialties.

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Methods:

Twitter Metrics:

This study did not require institutional review board approval. Twitter analytics, including engagement and activity metrics were obtained with the use of Symplur Signals (Symplur, Upland, California), a healthcare social media analytics platform. Engagement metrics included the number of tweets, retweets, mentions, followers, and likes. Impressions were calculated by multiplying the total number of tweets containing a specific hashtag by the number of followers for each individual user and then summing these up across users. Tweet content, including the number of visuals and articles shared, were also gathered.

Hashtag Search:

The study period began in 2015 to account for the first use of #IRad, which was on January 8, 2015. #IRad is an IR related hashtag included in the Radiology hashtag ontology that is used as a measure of overall IR Twitter activity.[9] SIR and RSNA were chosen as the primary candidates for annual IR and diagnostic radiology conferences, respectively, while the ACR conference is an overall measure of the field of radiology as a whole. ACC, AHA, and ASCO were used as benchmarks to assess social media activity of other larger vascular or oncology related specialties.

For each conference, all tweets were retrieved beginning from 7 days before the start of the conference and ending 7 days after the end of the conference based on methodology from similar studies. [4,6,10] [e.g. For the SIR conference from March 23 through 28, 2019, tweets were collected from March 16 through April 4, 2019.]

The official hashtag of each conference was compiled using promotional information associated with each society. These hashtags were used to identify relevant tweets. The study period included meetings

that occurred in 2015 and up until November 30, 2019. The conference hashtags studied are shown in Table 1.

Additionally, the interventional radiology related hashtag #IRad was studied as an internal control to compare the growth rate of the SIR hashtag to another commonly used hashtag in interventional radiology. Data for these tweets were similarly collected between January 1, 2015 through November 30, 2019.

Statistical Analysis:

Twitter analytics were conducted through Symplur Signals. Growth rates, along with Compound Annual Growth Rates (CAGR), were calculated using Excel (Microsoft, Redmond, Washington). Linear regression analytics were performed using Stata (StataCorp, College Station, Texas). Linear regression analyses and CAGR calculations for RSNA only include data from 2015-2018 because the 2019 conference did not occur prior to data collection. Similarly, the CAGR analysis for #IRad only includes data from 2015-2018 because the full year of 2019 is not included in the study period. The amounts for #IRad 2019 metrics include data up until November 30, 2019.

Results:

Conference Hashtags

A summary of Twitter data for each conference is provided in Table 2. The total number of tweets, retweets, users, impressions, articles, and visuals for each year from 2015-2019 are shown, along with each metric's CAGR.

From this data, the annual ACR meetings are seen to have one of the highest numbers of tweets/user (6.96 in 2019), retweets/user (4.39 in 2019), and impressions/user (40,051 in 2019) out of all the specialties studied (Figures 1, 2, and 4, respectively).

Linear Regression Analysis

Using linear regression analysis, the number of tweets and users for each hashtag were evaluated for trends from 2015 to 2019. It was found that the year could statistically significantly predict the number of SIR tweets, $F(1, 3) = 38.98$, $p = 0.008$ and the year of SIR's tweets accounted for 90.5% of the explained variability in total tweet number. This regression equation was: predicted SIR total tweets = -2078669 + 1032.8*(year). It was also found that the year could statistically significantly predict the number of SIR users, $F(1, 3) = 44.19$, $p = 0.007$ and the year accounted for 91.5% of the explained variability in the number of SIR users. This regression equation was: predicted SIR users = -427821.1 + 212.5*(year).

Additionally, a linear regression established that the year could statistically significantly predict #IRad number of tweets, $F(1, 3) = 17.15$, $p = 0.026$ and the year accounted for 80.1% of the explained variability in the number of #IRad tweets. This regression equation was: predicted #IRad total tweets = -2.67×10^7 + 13234.8*(year). It was also found that the year could statistically significantly predict the number of #IRad users, $F(1, 3) = 80.79$, $p = 0.003$ and the year accounted for 95.2% of the explained variability in

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the number of #IRad users. This regression equation was: predicted #IRad users = -2637492 + 1309.5 *(year).

The coefficients for the independent variable of year for SIR tweets (1032.8), SIR users (212.5), #IRad tweets (13234.8), and #IRad users (1309.5) represent the rates of growth of these categories. These rates show that #IRad is growing faster than SIR in both the number of tweets and users per year.

Linear regression also revealed that the year could statistically significantly predict a decreasing number of RSNA users, $F(1, 2) = 55.61$, $p = 0.018$ and the year accounted for 94.8% of the explained variability in RSNA users. The regression equation was: RSNA users = 2442180 - 1207.1*(year).

Other hashtags were not found to trend significantly for tweets or users per year.

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Discussion:

By crossing many geographic boundaries, social media in healthcare has led to research dissemination, increased engagement among physicians, and growth across professional networks.[5] This increased collaboration and discussion between healthcare providers, patients, and advocates can improve the quality of care provided by physicians worldwide.[1] Additionally, social media networking has been shown to have a positive impact on physicians' practices by creating a new communication route between patients and providers and by increasing both national and international referrals to physicians.[11] However, with social media use, physicians should be careful to remain professional, follow HIPAA regulations, and be cautious of the information that they choose to propagate.[1]

Through Twitter, medical professionals continue to disseminate content on an international scale using conference hashtags, healthcare tweet chats, and general microblogging. From the data available between 2015-2019, the total impressions for each conference hashtag had a positive CAGR, suggesting an increase in medical professional engagement on Twitter (Table 2). For the field of radiology, efforts such as the monthly JACR tweet chats and the #RadWomen initiative have fostered networking through social media, creating new avenues for radiologists to debate and learn.[12,13] Previously, it was found that Twitter usage increased between the 2011 to 2012 RSNA annual meetings by at least 30% in metrics such as total number of tweets and users.[14] In the years since then, other fields within radiology have grown in their Twitter usage, especially interventional radiology.

A previous study of social media use in the field of interventional radiology analyzed the Twitter hashtag #IRad from January 2015 to October 2017.[8] The number of tweets, users, and impressions all increased over this time period, demonstrating that the use of social media in IR has been growing over the past few years.[8] Most users were shown to be physicians from the United States, although media accounts,

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journalism accounts, and patients also composed tweets during this time period.[8] IR journals such as the Journal of Vascular and Interventional Radiology (JVIR) have also been engaging with Twitter members, with the highest user engagement occurring with tweets published in the morning or with an image.[15]

A recent study of Twitter usage by DR and IR societies also revealed increasing engagement metrics for both groups from 2017-2019. Despite having fewer Twitter followers overall, IR societies had larger increases in their number of followers and had similar engagement rates compared to DR groups.[16] These results support the findings of the current study, which showed significant growth in the SIR annual conference engagement and #IRad Twitter metrics. We expand upon these findings by comparing IR Twitter activity to that of medical specialties beyond the field of radiology.

While absolute values gauging SIR Twitter activity are smaller than those of other conferences due to the smaller volume of healthcare professionals in IR compared to other specialties, when measured on a per user basis, SIR was seen to have a larger volume of tweets per user compared to other annual conferences (Figure 1). For the remaining activity metrics, SIR is comparable to the other conferences that were evaluated and at times surpassed their social media engagement (Figures 2-7).

In the current report, SIR was the only conference with statistically significant growth rates in the number of tweets and users (1032.8% and 212.5%, respectively). This rapid growth may be augmented by increased involvement of medical students and the general public in IR related discussions.[17] Recent changes allowing IR to have integrated residency programs may have increased the number of young Twitter users that attend conferences like SIR, contributing to this social media advancement.[18] Additionally, IR medical journals have increased their presence on Twitter, with JVIR being the most active radiology journal on Twitter.[12]

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In order to confirm that IR conference growth was not an isolated finding, #IRad was also tracked. #IRad has been suggested to be a hashtag that includes most of Twitter's tagged IR discussions, making it the most reliable hashtag to determine IR Twitter involvement.[8,9] Statistically significant increases were seen in the growth rates for #IRad number of tweets and users per year (13234.8% and 1309.5%, respectively). When looking at Twitter activity metrics per user, #IRad has a consistently larger volume of tweets, retweets, articles, and visuals compared to the other studied hashtags (Figures 1, 2, 5, and 6, respectively). These findings are overall suggestive that growth associated with SIR conferences may be a result of an overall increase in IR Twitter activity.

Although other radiology conferences such as the annual ACR meetings have not shown significant growth, their activity on Twitter remains one of the highest. For ACR, the number of tweets/user, retweets/user, and impressions/user are consistently one of the highest counts out of all the specialties studied (Figures 1, 2, and 4, respectively). This trend is seen despite ACR having a smaller number of users than RSNA, ACC, AHA, and ASCO (Figure 3). This finding suggests that the Twitter users at ACR's conferences are much more active than users of the other analyzed specialties conferences. To boost ACR's social media membership and utilization, DR journals could consider adopting some of the Twitter tactics utilized by IR journals. These include strategically engaging with users in the morning, increasing the number of visuals shared, and spreading awareness of the specific Twitter hashtag to be used at each annual conference (Figure 6).[15]

Potential limitations of this study include the use of variant hashtags that differ from official hashtags for the conferences. For instance, SIR 2019's official hashtag was #SIR19ATX, so if a user instead had a tweet with #SIR19 or spelled the hashtag incorrectly, that tweet was not included in this study. Other hashtags beyond #IRad, such as #TwittIR, may be used in IR Twitter discussions, limiting the total IR tweets that were captured and analyzed in this report. Users could also use a hashtag without intending to relate it to the medical field, so those tweets would erroneously be included in this study. It should also be

noted that fake Twitter accounts exist, commonly consisting of robots that tweet or retweet. Despite Twitter's efforts to delete these accounts, some could be tweeting with the hashtags used in this study.[19] Additionally, not everyone in the medical field uses social media, so findings based on Twitter could have a systematic bias toward younger physicians and students.[14] This could be further explored by studying the age demographics of specific fields compared with their social media growth.

In conclusion, this report demonstrates ACR consistently shows an active Twitter network through the metrics that were studied. However, the SIR conference and #IRad were the only studied hashtags that showed significant growth in the number of tweets and users. Continued efforts to expand both the DR and IR network in this arena may contribute to expanding avenues of communication and awareness for both healthcare providers and patients.

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Table 1: Summary of Hashtags Studied

Conference:	2015	2016	2017	2018	2019
SIR	#SIR15ATL	#SIR16VAN	#SIR17DC	#SIR18LA	#SIR19ATX
RSNA	#RSNA15	#RSNA16	#RSNA17	#RSNA18	X
ACC	#ACC15	#ACC16	#ACC17	#ACC18	#ACC19
AHA	#AHA15	#AHA16	#AHA17	#AHA18	#AHA19
ASCO	#ASCO15	#ASCO16	#ASCO17	#ASCO18	#ASCO19
ACR	#ACR2015	#ACR2016	#ACR2017	#ACR2018	#ACR2019

Table 1. The conference hashtags for SIR, RSNA, ACC, AHA, ASCO, and ACR that were studied are shown. An "X" marks conferences that had not occurred at the time the study was conducted.

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Table 2. Data Summary of Twitter Results

Conference or Hashtag	2015	2016	2017	2018	2019	CAGR (%)
SIR						
Total Tweets	2,576	2,826	5,080	5,612	6,347	25.29
Retweets	1,133	1,558	3,098	3,957	4,354	40.01
Users	361	489	914	1,050	1,143	33.39
Impressions	4,214,195	4,892,774	22,627,593	8,801,185	16,871,224	41.45
Articles	562	525	1,058	787	890	12.18
Visuals	1,015	1,542	4,211	5,969	6,195	57.18
RSNA						
Total Tweets	31,791	41,858	41,374	29,649	X	-2.30
Retweets	20,138	25,043	27,625	18,705	X	-2.43
Users	9,641	8,861	7,770	5,981	X	-14.71
Impressions	120,936,136	218,146,397	256,457,021	166,781,912	X	11.31
Articles	15,481	14,496	14,569	10,149	X	-13.13
Visuals	15,540	29,597	27,046	22,210	X	12.64
ACC						
Total Tweets	19,169	28,937	65,113	43,088	52,832	28.85
Retweets	12,334	20,538	47,912	29,422	38,358	32.80
Users	5,009	9,184	20,476	8,433	10,536	20.43
Impressions	88,424,018	188,502,425	325,664,553	310,930,349	402,494,488	46.07
Articles	7,780	12,302	17,109	11,193	13,852	15.51
Visuals	6,256	13,371	42,461	34,878	47,908	66.35
AHA						
Total Tweets	19,701	39,532	54,151	40,980	54,742	29.11
Retweets	12,830	28,632	36,297	28,803	38,615	31.71
Users	5,754	14,184	14,877	9,797	13,766	24.37

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Impressions	163,536,929	310,921,661	310,880,501	236,923,897	497,390,063	32.06
Articles	10,805	15,640	14,921	15,030	15,280	9.05
Visuals	7,611	24,882	39,138	36,722	47,450	58.02
ASCO						
Total Tweets	66,852	79,332	104,524	91,789	95,698	9.38
Retweets	44,141	54,782	71,261	64,816	64,850	10.09
Users	13,997	18,077	19,200	18,306	17,774	6.15
Impressions	297,724,516	406,329,021	440,582,051	527,751,430	484,384,016	12.94
Articles	32,072	32,201	38,595	32,711	29,841	-1.79
Visuals	20,826	37,564	66,923	72,016	82,294	40.99
#IRad						
Total Tweets	5,643	17,606	44,344	58,074	51,583*	117.52
Retweets	3,091	11,319	31,245	43,319	35,730*	141.10
Users	1,020	2,251	4,101	5,566	5,910*	76.05
Impressions	9,001,480	28,337,884	58,560,231	100,390,764	99,088,200*	123.42
Articles	2,646	6,577	11,312	17,380	12,385*	87.28
Visuals	2,279	13,680	58,079	75,625	57,753*	221.35
ACR						
Total Tweets	7,317	11,542	15,379	7,905	8,488	3.78
Retweets	3,426	7,237	9,858	5,638	5,350	11.79
Users	689	1,244	1,852	1,248	1,219	15.33
Impressions	11,536,862	44,095,376	75,750,977	42,116,273	48,822,145	43.43
Articles	1,417	1,759	2,564	1,257	1,508	1.57
Visuals	1,847	3,982	6,901	4,758	5,069	28.71

Table 2. Data summary for SIR, RSNA, ACC, AHA, ASCO, #IRad, and ACR from 2015-2019. An "x" marks conferences that had not occurred at the time the study was conducted.

CAGR = Compound Annual Growth Rate. CAGR calculations for RSNA and #IRad only include data from 2015-2018.

* indicates that the total number shown is not a complete representation of data from that year. Data was collected until November 30, 2019.

References:

[1] Pershad, Y., Hangge, P. T., Albadawi, H., & Oklu, R. (2018). Social Medicine: Twitter in Healthcare. *Journal of Clinical Medicine*, *7*(6). https://doi.org/10.3390/jcm7060121

[2] Masri, S., Jia, J., Li, C., Zhou, G., Lee, M.-C., Yan, G., & Wu, J. (2019). Use of Twitter data to improve Zika virus surveillance in the United States during the 2016 epidemic. *BMC Public Health*, *19*(1), 761. https://doi.org/10.1186/s12889-019-7103-8

[3] López-Goñi, I., Giner-Lamia, J., Álvarez-Ordoñez, A., Benitez-Páez, A., Claessen, D., Cortesao, M., … Zapotoczna, M. (2019). #EUROmicroMOOC: using Twitter to share trends in Microbiology worldwide. *FEMS Microbiology Letters*, *366*(11). https://doi.org/10.1093/femsle/fnz141

[4] D'Anna, G., Chen, M. M., McCarty, J. L., Radmanesh, A., & Kotsenas, A. L. (2019). The Continued Rise in Professional Use of Social Media at Scientific Meetings: An Analysis of Twitter Use during the ASNR 2018 Annual Meeting. *American Journal of Neuroradiology*, *40*(6), 935–937. https://doi.org/10.3174/ajnr.A6064

[5] Kalia, V., Ortiz, D. A., Patel, A. K., Moriarity, A. K., Canon, C. L., & Duszak, R. (2018). Leveraging Twitter to Maximize the Radiology Meeting Experience. *Journal of the American College of Radiology: JACR*, *15*(1 Pt B), 177–183. https://doi.org/10.1016/j.jacr.2017.10.022

[6] Schwenk, E. S., Jaremko, K. M., Park, B. H., Stiegler, M. A., Gamble, J. G., Chu, L. F., … Mariano, E. R. (2019). I Tweet, Therefore I Learn: An Analysis of Twitter Use Across Anesthesiology Conferences. *Anesthesia and Analgesia*. https://doi.org/10.1213/ANE.0000000000004036

[7] Patel, S. S., Hawkins, C. M., Rawson, J. V., & Hoang, J. K. (2017). Professional Social Networking in Radiology: Who Is There and What Are They Doing? *Academic Radiology*, *24*(5), 574–579. https://doi.org/10.1016/j.acra.2016.09.026

[8] Hage, A. N., Chick, J. F. B., Jeffers, B., Srinivasa, R. N., Gemmete, J. J., & Srinivasa, R. N. (2018). #InterventionalRadiology. *Journal of Vascular and Interventional Radiology: JVIR*, *29*(5), 669–675. https://doi.org/10.1016/j.jvir.2017.12.023

[9] Hawkins, C. M. (2016). Radiology's Social Media Hashtag Ontology: Codifying Online Data. *Journal of the American College of Radiology*, *13*(1), 111–113. https://doi.org/10.1016/j.jacr.2015.08.028

[10] Nason, G. J., O'Kelly, F., Bouchier-Hayes, D., Quinlan, D. M., & Manecksha, R. P. (2015). Twitter expands the reach and engagement of a national scientific meeting: The Irish Society of Urology. *Irish Journal of Medical Science*, *184*(3), 685–689. https://doi.org/10.1007/s11845-015-1277-6

[11] Turnipseed, W. D. (2013). The Social Media: Its Impact on a Vascular Surgery Practice. *Vascular and Endovascular Surgery*, *47*(3), 169–171. https://doi.org/10.1177/1538574413478471

[12] Retrouvey, M., Keefe, B., Kotsenas, A., McGinty, G., & Patel, A. K. (2018). Women in Radiology: Creating a Global Mentorship Network Through Social Media. *Journal of the American College of Radiology*, *15*(1, Part B), 229–232. https://doi.org/10.1016/j.jacr.2017.09.029

[13] Hillman, B. J. (2013). Making an Impression. *Journal of the American College of Radiology*, *10*(11), 810. https://doi.org/10.1016/j.jacr.2013.08.006

[14] Hawkins, C. M., Duszak, R., & Rawson, J. V. (2014). Social Media in Radiology: Early Trends in Twitter Microblogging at Radiology's Largest International Meeting. *Journal of the American College of Radiology*, *11*(4), 387–390. https://doi.org/10.1016/j.jacr.2013.07.015

[15] Wadhwa, V., Devgan, A., Patel, M. V., Bourgeois, A. C., & Ahmed, O. (2018). Factors Increasing Tweet Engagement Rate for the Journal of Vascular and Interventional Radiology Twitter Feed. *Journal of Vascular and Interventional Radiology*, *29*(7), 1057–1059. https://doi.org/10.1016/j.jvir.2018.03.004

[16] Rostampour, S., Hamady, M. S., & Alsafi, A. (2020). To Tweet or Not to Tweet? A Look at Radiology Societies' Use of Twitter. *CardioVascular and Interventional Radiology*. https://doi.org/10.1007/s00270-020-02437-1

[17] Wadhwa, V., Brandis, A., Madassery, K., Horner, P. E., Dhand, S., Bream, P., … Ryu, R. K. (2018). #TwittIR: Understanding and Establishing a Twitter Ecosystem for Interventional Radiologists and Their Practices. *Journal of the American College of Radiology: JACR*, *15*(1 Pt B), 218–223. https://doi.org/10.1016/j.jacr.2017.09.011

[18] Di Marco, L., & Anderson, M. B. (2016). The new Interventional Radiology/Diagnostic Radiology dual certificate: "Higher standards, better education." *Insights into Imaging*, *7*(1), 163–165. https://doi.org/10.1007/s13244-015-0450-9

[19] Dardas, L. A., Woodward, A., Scott, J., Xu, H., & Sawair, F. A. (2019). Measuring the social impact of nursing research: An insight into altmetrics. *Journal of Advanced Nursing*, *75*(7), 1394–1405. https://doi.org/10.1111/jan.13921
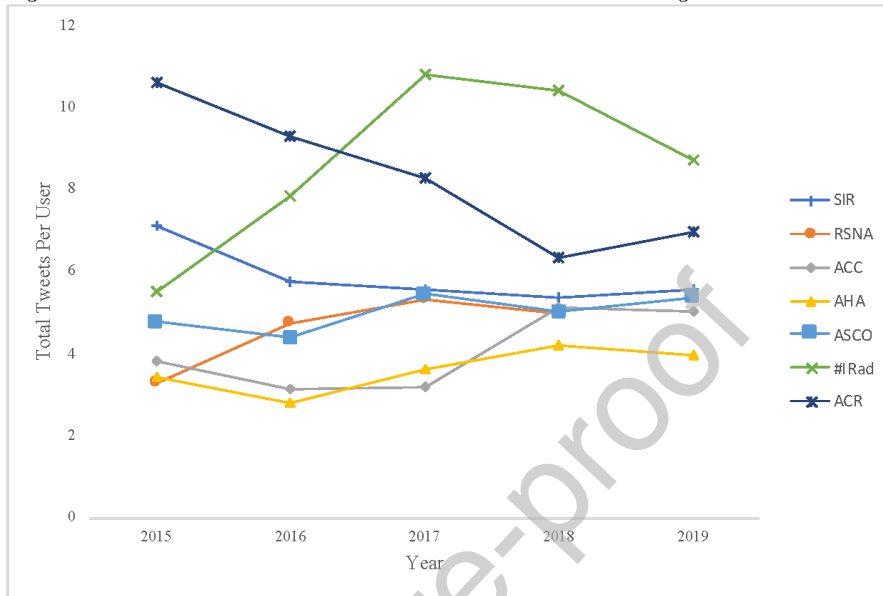
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Figure 1: Tweet Volume Per User Per Year for Conferences and Hashtags

Figure 1. Number of tweets per user during the study period pertaining to each conference or hashtag.
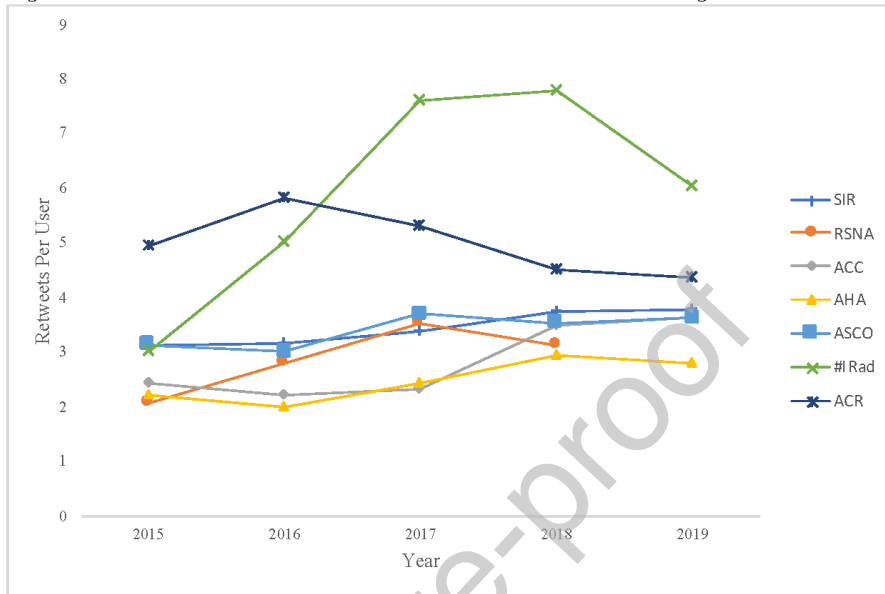
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Figure 2: Retweet Volume Per User Per Year for Conferences and Hashtags

Figure 2. Average number of retweets per user each year containing the hashtag related to the respective conference each year.
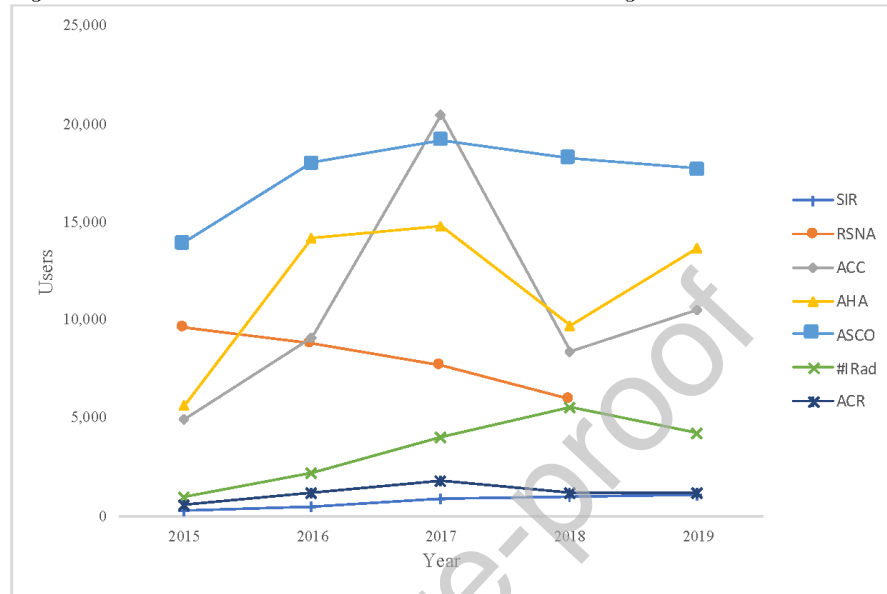
Figure 3: Number of Users Per Year For Conferences and Hashtags

Figure 3. Absolute number of unique twitter handles (users) associated with each conference hashtag during the study period.
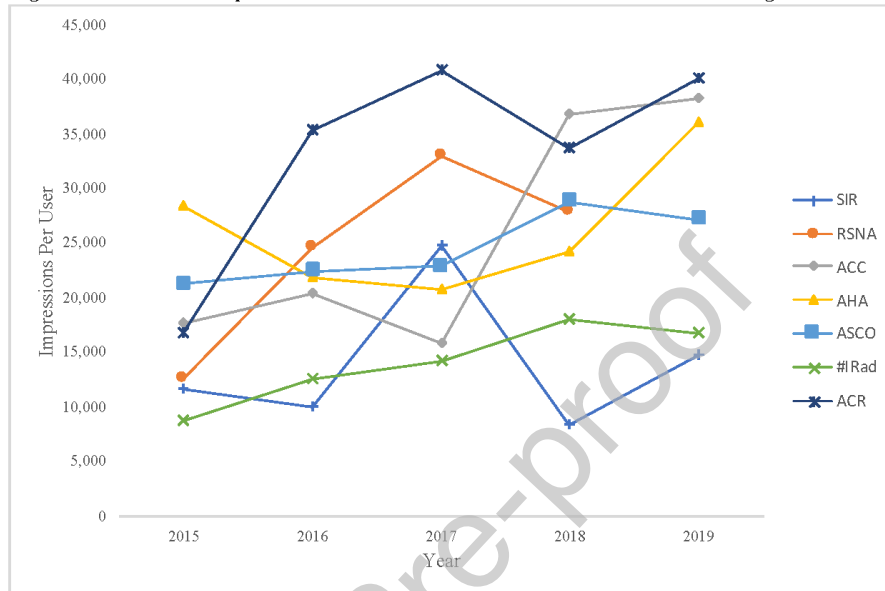
Figure 4: Number of Impressions Per User Per Year for Conferences and Hashtags

Figure 4. Average number of impressions per user associated with each hashtag or conference. The number of impressions were calculated by multiplying total tweets by total number of followers for each user.

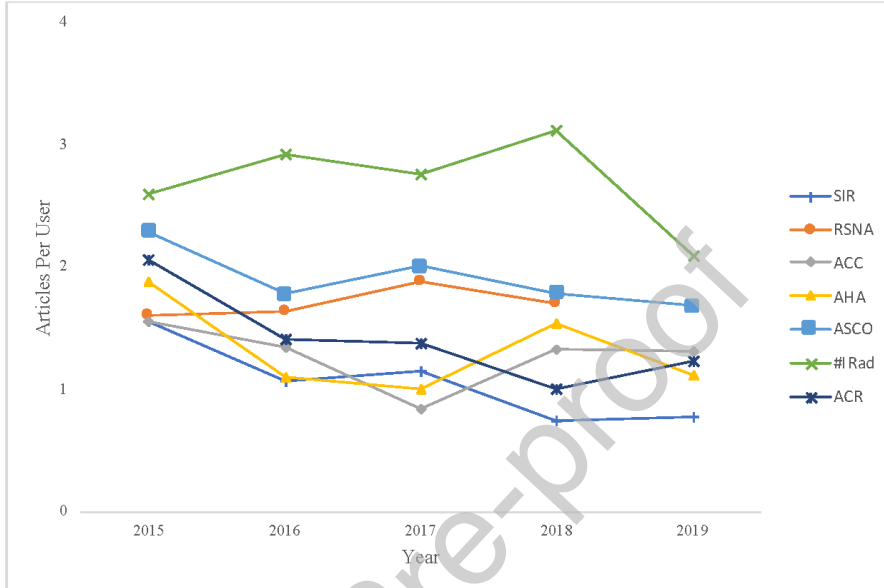**Figure 5: Number of Articles Cited Per User for Conferences and Hashtags**

Figure 5. Number of tweets per user containing links/urls to articles. This metric excludes tweets containing links to other tweets
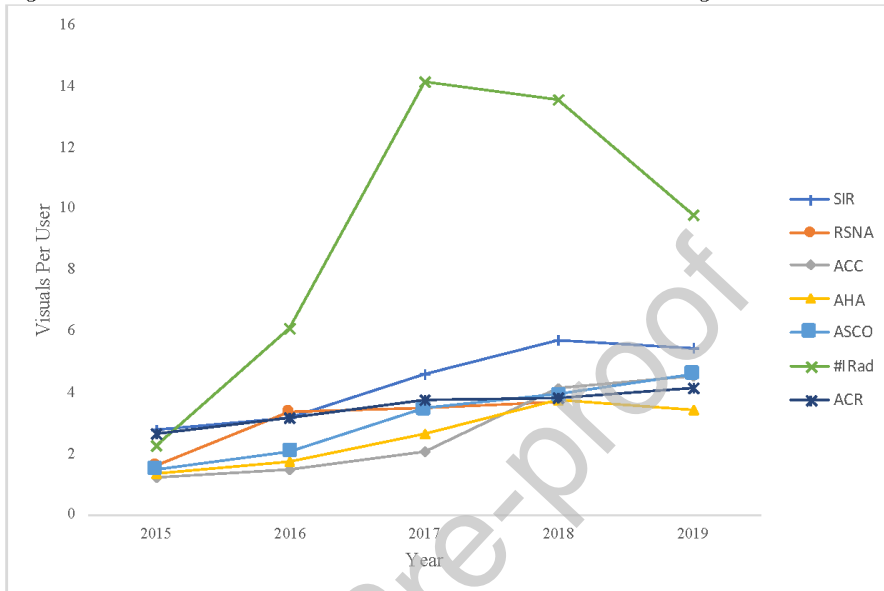
Figure 6: Number of Visuals Shared Per User for Conferences and Hashtags

Figure 6. Average number of visuals used by each user associated with a conference or hashtag each year.

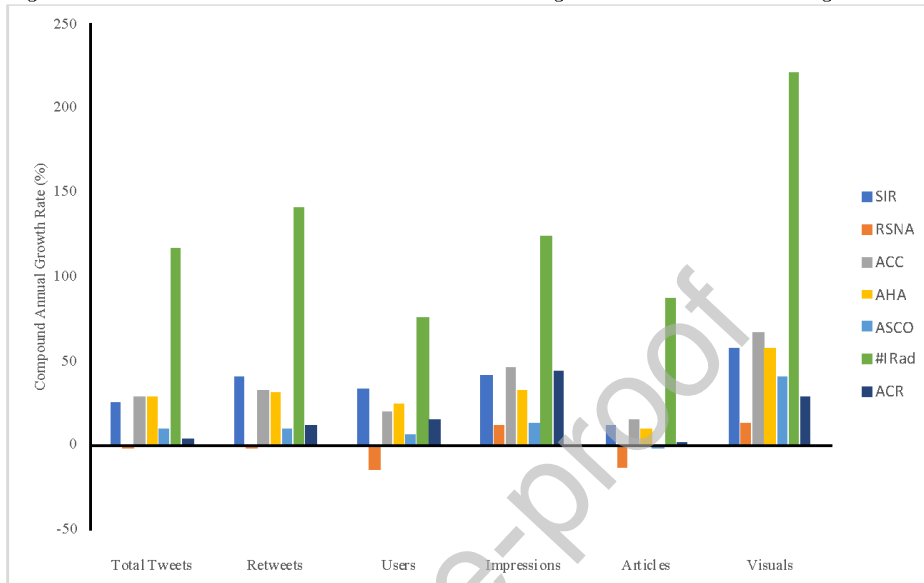**Figure 7: CAGR Values for Each Twitter Metric According to Conferences and Hashtags**

Figure 7. Compound Annual Growth Rate (CAGR) values of total tweets, retweets, users, impressions, articles, and visuals for each conference and hashtag studied.