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ABSTRACT

BACKGROUND AND PURPOSE: Social media has made inroads in medical education. We report the creation and 3-year (2018–2021) longitudinal assessment of the American Society of Head and Neck Radiology Case of the Week (#ASHNRCOTW), assessing viewership, engagement, and impact of the coronavirus disease 2019 (COVID-19) pandemic on this Twitter-based education initiative.

MATERIALS AND METHODS: Unknown cases were tweeted from the American Society of Head and Neck Radiology account weekly. Tweet impressions (number of times seen), engagements (number of interactions), and new followers were tabulated. A social media marketing platform identified worldwide distribution of Twitter followers. Summary and t test statistics were performed.

RESULTS: #ASHNRCOTW was highly visible with 2,082,280 impressions and 203,137 engagements. There were significantly greater mean case impressions (9917 versus 6346), mean case engagements (1305 versus 474), case engagement rates (13.06% versus 7.76%), mean answer impressions (8760 versus 5556), mean answer engagements (908 versus 436), answer engagement rates (10.38% versus 7.87%), mean total (case + answer) impressions (18,677 versus 11,912), mean total engagements (2214 versus 910), and total engagement rates (11.79% versus 7.69%) for cases published after the pandemic started (all P values < .001). There was a significant increase in monthly new followers after starting #ASHNRCOTW (mean, 134 versus 6; P < .001) and significantly increased monthly new followers after the pandemic started compared with prepandemic (mean, 178 versus 101; P = .003). The American Society of Head and Neck Radiology has 7564 Twitter followers throughout 130 countries (66% outside the United States).

CONCLUSIONS: Social media affords substantial visibility, engagement, and global outreach for radiology education. #ASHNRCOTW viewership and engagement increased significantly during the COVID-19 pandemic.

ABBREVIATIONS: ASHNR = American Society of Head and Neck Radiology; #ASHNRCOTW = ASHNR Case of the Week hashtag; @ASHNRSociety = ASHNR Twitter account handle; ER = engagement rate; GIF = Graphics Interchange Format; COVID-19 = coronavirus disease 2019

Social media is pervasive in modern life with 72% of Americans reporting using social media in 2021, up from 65% in 2015 and just 7% in 2005.[1,2] Using such platforms as Twitter, Facebook, YouTube, Instagram, TikTok, and LinkedIn, social media offers a widely available, easily accessible, highly portable, and free networking infrastructure that can be accessed via mobile smartphones and tablets, in addition to traditional online computer access. Particularly in a time of social distancing related to the coronavirus disease 2019 (COVID-19) pandemic, social media has many attributes that make it an attractive instrument for radiology education, including the ability to rapidly disseminate image-rich content in a free open-access model, low (or no) overhead costs, ease of cross-institutional and multidisciplinary collaboration, lack of geographic boundaries, pre-existing networks of engaged users, and a general lack of hierarchical and social barriers that might otherwise inhibit interactions.[3,4]
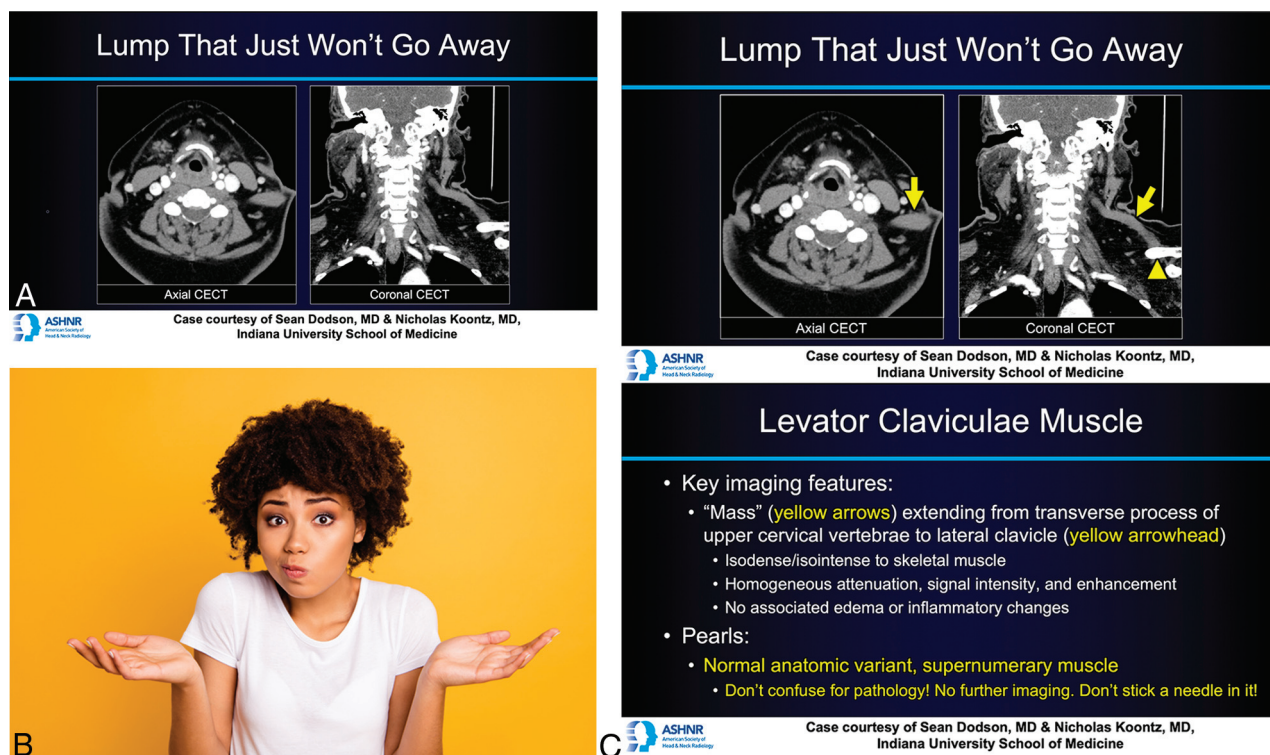
FIG 1. Representative #ASHNRCOTW. Each Wednesday, a new unknown case is tweeted by the @ASHNRSociety Twitter account, including a brief clinical history and 2–3 representative images (*A*). Participants are allowed a 24-hour response period, during which they reply to the original tweet by submitting an appropriate, thematically relevant, animated GIF image (*B*). Thus, users participate in the edutainment without spoiling the answer for other participants. Moreover, GIFs allow learners to form a "guidepost" memory affiliated with the case content with the intent to improve learning and increase future clinical accuracy performance as a radiologist. In this case of an accessory levator claviculae muscle, a learner submitted an animated GIF of a woman shrugging her shoulders to hint at the correct response. After the 24-hour response period, the case answer is tweeted by the ASHNR, including annotated images and a summary slide with key points (*C*).

Several prior publications have described the potential roles of social media for radiology education, detailing the experiences of individual and departmental accounts.[4-14] Others have detailed the value of social media by radiology departments for engaging faculty members,[4,15] by national medical societies for increasing engagement of members during national meetings,[16-22] and for increasing readership and engagement of medical journals.[23-27] During the past 4 years, multiple neuroradiology societies have implemented social media–based educational outreach initiatives, the earliest being the American Society of Head and Neck Radiology (ASHNR), which launched a weekly case-based education initiative in 2018 using Twitter as the primary vehicle for content dissemination. These social media–based, free open-access medical education initiatives serve the purposes of carrying out societal education missions, increasing global outreach, engaging members, advertising the society, and increasing society membership. However, no published studies have evaluated the implementation and outcomes of social media–based education initiatives by radiology societies.

We report the development, implementation, and longitudinal assessment of the ASHNR Case of the Week (#ASHNRCOTW) education initiative, detailing the viewership and engagement trends of this new social media–based educational offering during its first 3 years of existence (2018–2021), as well as comparing viewership and engagement trends before and during the COVID-19 pandemic.

MATERIALS AND METHODS

This investigation was compliant with Health Insurance Portability and Accountability Act standards. All protected health information regarding this educational initiative and study was carefully monitored by the principal investigator, and topical or time-sensitive case material was intentionally excluded to maintain compliance and safeguard protected health information.

#ASHNRCOTW Overview

On March 21, 2018, the ASHNR launched a new radiology education initiative using social media and gamified learning as the vehicles for delivering image-rich, case-based head and neck imaging content to participants. This new education offering was proposed by members of the ASHNR Website Committee and ad hoc Social Media Committee, approved by a vote of the Executive Committee, and remains an ongoing educational offering overseen by the subsequently formalized ASHNR Website and Social Media Committee. The educational content is disseminated via Twitter from the official ASHNR account (@ASHNRSociety) and uses a standard 3-step format: 1) tweeting an unknown case with salient history, 2) a 24-hour response period during which participants can submit responses, and 3) tweeting the case answer and summary content the following day (Fig 1). Participants are registered Twitter users who engage the content by replying directly to the tweet.

Content Design

Case material is compiled and vetted by the chair of the ASHNR Website and Social Media Committee, an attending neuroradiologist and a subspecialty head and neck imager with >7 years' postfellowship experience, who additionally creates and solicits case content using a standard PowerPoint (Microsoft) template. This standard template is used for maintaining a consistent appearance, style, and organizational branding for the #ASHNRCOTW. Case content is provided by volunteer ASHNR members, all of whom are attending neuroradiologists with head and neck imaging subspecialty expertise. To facilitate the development of content, encourage society membership, promote engagement among trainees, and foster mentor-mentee relationships, volunteer faculty are encouraged to partner with and mentor residents and fellows with case-content generation.

Content Dissemination

Each Wednesday at noon Eastern Daylight Time (EDT), an unknown case is tweeted via the official Twitter account of the ASHNR using TweetDeck (https://tweetdeck.twitter.com/), a social media dashboard application that allows clients to schedule tweets in advance. Core content of each case includes a brief clinical history; a collage of 2–3 salient images labeled with plane, technique, and, when indicated, sequence modifiers (Fig 1A); a designation of the case contributors and their home institution; and instructions to answer the case by replying to the tweet with a thematically relevant and appropriate animated Graphics Interchange Format (GIF) image. A standard hashtag (#ASHNRCOTW) is used for referencing and archiving the content in perpetuity on Twitter, making the case database searchable by any online user. Several society members who are active on Twitter are tagged using their respective Twitter handles to encourage case discussion and to amplify viewership by retweeting the case of the week, the number of which varies each week to conform to the 280-character limit for tweets.

The purpose of using an animated GIF response (Fig 1B) is 3-fold: 1) It allows users to participate in the learning instrument without "giving away" the specific answer to other users, 2) it acts as an engaging vehicle to gamify the educational content (so-called "edutainment") resulting in increased online discussion, and 3) it allows learners to develop a unique "guidepost" memory affiliated with the case content with the intent to improve learning and increase future clinical accuracy performance as a radiologist. To ensure that submitted GIFs are appropriate and professional, the chair and other members of the ASHNR Website and Social Media Committee monitor responses closely. If submitted GIFs are deemed inappropriate or offensive or if a learner submits the answer in text form (giving away the answer), his or her tweet is hidden using the "hide reply" functionality in Twitter. Repeat offenses or unprofessional conduct results in users being blocked by the @ASHNRSociety Twitter account.

Twitter followers are allowed 24 hours to publicly submit responses to the unknown case by replying to the original tweet, at which point the follow-up case answer is then tweeted by the official ASHNR Twitter account via a scheduled tweet from the TweetDeck application. This follow-up includes the answer to the unknown case, an annotated version of the original 2- to 3-image collage with arrows denoting salient findings, a summary slide containing key facts and imaging pearls regarding the diagnosis, and a designation of the contributors and their home institution (Fig 1C). The answer tweet is tagged with the #ASHNRCOTW hashtag to facilitate searchability, and multiple society members are again tagged using their respective Twitter handles up to the 280-character limit for tweets.

Case and answer pairs are tweeted weekly on Wednesday and Thursday at noon Eastern Daylight Time, respectively, except for certain holiday weeks each year. This schedule allows the material to be available for review during "routine business hours" across the continental United States, irrespective of a learner's time zone.

Data Collection

For the primary aim of this study, we used the analytics functionality of Twitter to tabulate impressions (defined as "times people saw a tweet on Twitter") and engagements (defined as "times people interacted with a tweet," for example retweeting content, "liking" a tweet, clicking on media to enlarge pictures, following the @ASHNRSociety, or clicking a hashtag embedded in the tweet) for both the case and the answer tweets during the first 3 years of the #ASHNRCOTW postings (from March 21, 2018, through March 17, 2021). With these data, we extrapolated an engagement rate (ER) defined as $\frac{Number\ of\ Engagements}{Number\ of\ Impressions}$. As a secondary outcome, we used Twitter analytics to tabulate the number of new monthly followers of the official ASHNR Twitter account. Last, to quantify the extent of international scope, we used a third-party social media marketing platform (Tweepsmap; https://tweepsmap.com/) to determine the geographic distribution of followers. All data are current through January 19, 2022.

Statistical Analysis

Statistical analysis was performed using Excel (Microsoft), including summary statistics, F-test of the equality of variances, (Student) t test, and (Welch) t test of unequal variances when appropriate. P values < .05 are considered statistically significant.

RESULTS

Twitter Viewership and Engagement

One hundred forty-three unique #ASHNRCOTW cases were created and disseminated during the first 3 years of this initiative. Content spanned the breadth of the head and neck imaging domain, including pediatric/congenital, infectious/inflammatory, oncology, trauma, temporal bone, sinonasal, skull base, orbits, glands, dental, vascular, suprahyoid and infrahyoid neck, upper aerodigestive tract, visceral space, sellar/parasellar, and cervical spine/musculoskeletal cases. A complete list of diagnoses can be found in the Online Supplemental Data. During the first 3 years, 26 neuroradiology/head and neck imaging faculty from 21 different institutions contributed case material for the #ASHNRCOTW initiative, mentoring 38 trainees in a total of 70 of the cases.

During its first 3 years, the #ASHNRCOTW cases demonstrated high visibility on Twitter with case tweets garnering a total of 1,107,464 impressions (mean, 7745 [SD = 2857]; range, 2310–17,159) (Fig 2). In addition to being seen >1.1 million times, interaction with the #ASHNRCOTW case tweets was high with 114,351 case tweet engagements (mean, 800 [SD, 520]; range,
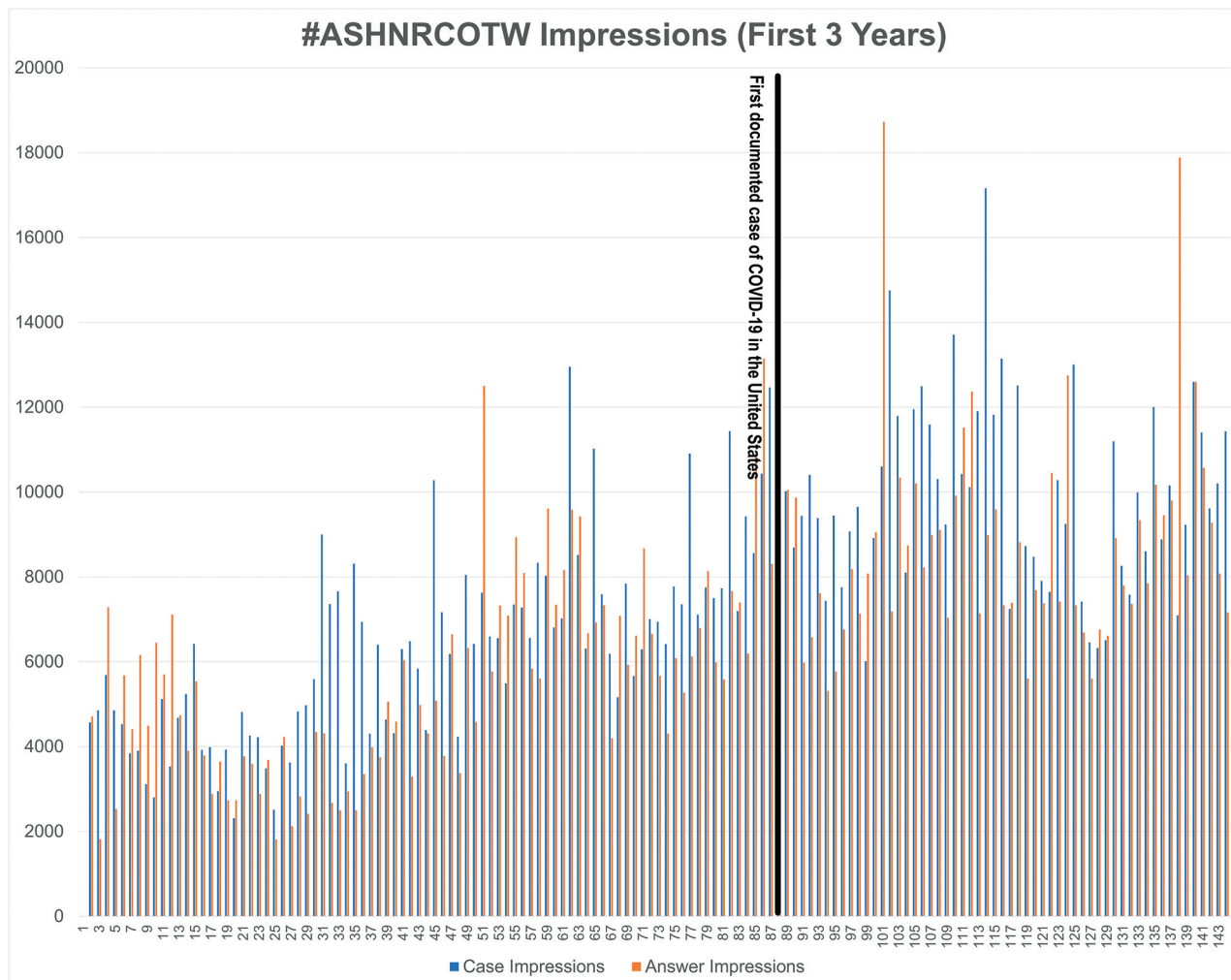
FIG 2. #ASHNRCOTW tweet impressions during the first 3 years. Case impressions (number of times seen) are recorded in blue, and answer impressions are recorded in orange. Note growth of the Twitter viewership during the first 3 years, which was significantly greater after the onset of the COVID-19 pandemic compared with prepandemic (*P* < .001).

200–2576) and a mean engagement rate of 9.8% (SD, 0.035; range, 4%–21.5%), indicating that approximately 10% of people who saw the case on Twitter interacted with it (Fig 3). During the same time interval, the #ASHNRCOTW answer tweets were slightly less visible on Twitter, garnering a total of 974,816 impressions (mean, 6817 [SD, 2879]; range, 1808–18,727) (Fig 2). Answer tweets also demonstrated fewer interactions with a total of 88,786 engagements (mean, 621 [SD, 336]; range, 105–1945), yielding a mean engagement rate of 8.9% (SD , 0.019; range, 4.4%–15.3%) (Fig 3).

When one considers case and answer tweets together, the #ASHNRCOTW was highly visible during the first 3 years with 2,082,280 total impressions (mean, 14,561 [SD, 5131]; range, 4318–29,329). In addition to being seen nearly 2.1 million times, interaction with #ASHNRCOTW was high with 203,137 total engagements (mean, 1421 [SD, 797]; range, 366–3866) and a mean engagement rate of 9.3% (SD, 0.026; range, 5%–17.4%).

Using the date of the first reported case of COVID-19 in the United States (January 20, 2020)[28] as a separation point, 87 cases were designated in the pre-COVID era and 56 cases were designated in the post-COVID era. There were significantly greater mean case impressions (9917 versus 6346), mean case engagements

(1305 versus 474), case engagement rates (13.06% versus 7.76%), mean answer impressions (8760 versus 5556), mean answer engagements (908 versus 436), answer engagement rates (10.38% versus 7.87%), mean total (case + answer) impressions (18,677 versus 11,912), mean total (case + answer) engagements (2214 versus 910), and total (case + answer) engagement rates (11.79% versus 7.69%) for #ASHNRCOTW tweets posted after the start of the COVID-19 pandemic in the United States compared with those posted before the start of the COVID-19 pandemic (all *P* values < .001) (Online Supplemental Data).

Twitter Followers

Before the #ASHNRCOTW education initiative (July 2016 to February 2018), the ASHNR official Twitter account amassed a total of 130 new Twitter followers during 20 months, amounting to a mean of 6.5 (SD, 9.04) new followers per month (range, 0–37). Following the start of the #ASHNRCOTW (March 2018 to March 2021), ASHNR accumulated 4811 new followers during 36 months, yielding a mean of 134.6 (SD, 64.1) new followers per month (range, 48–374). This increase in mean monthly new Twitter followers was statistically significant (*P* < .001). In a subset analysis of
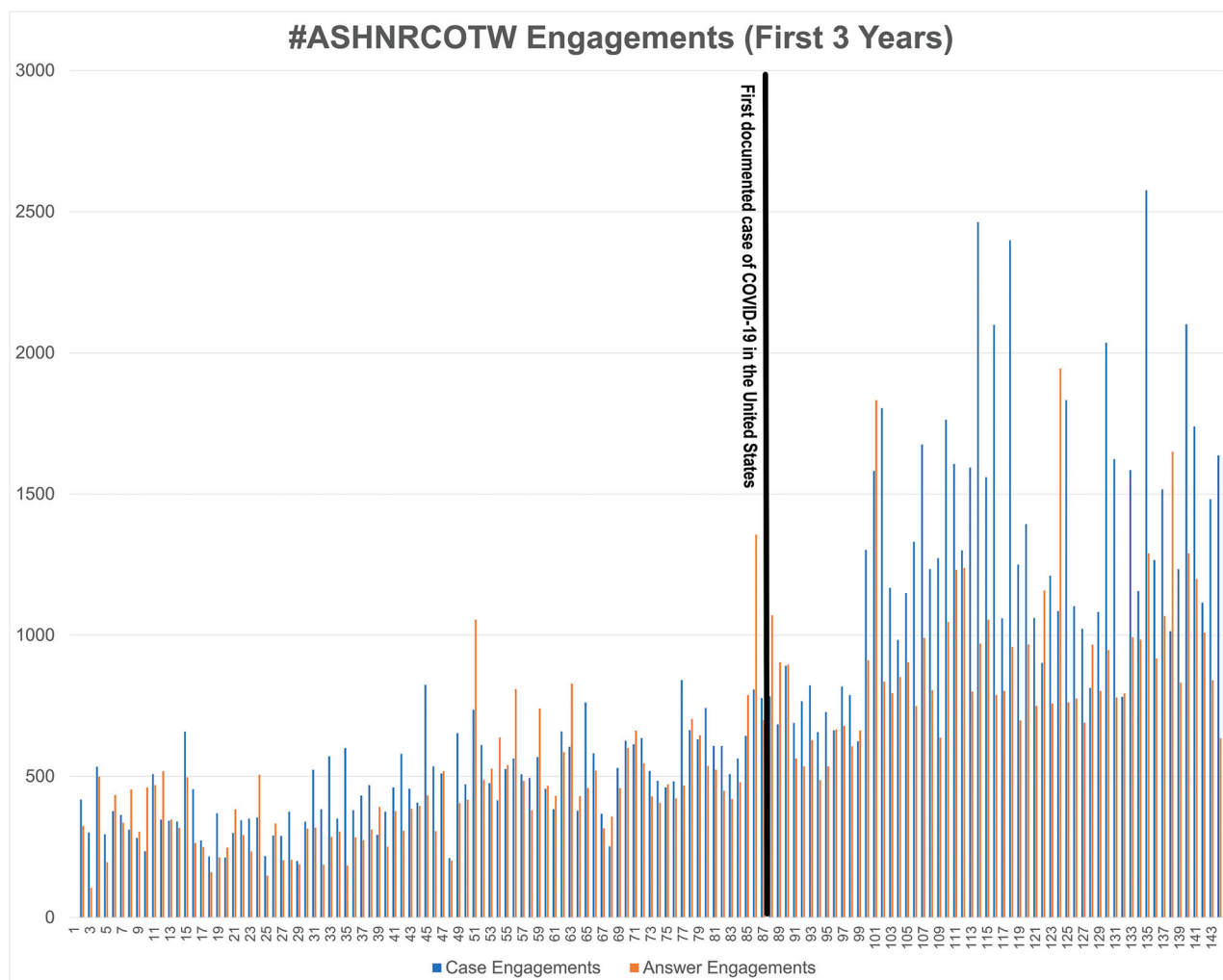
FIG 3. #ASHNRCOTW tweet engagements during the first 3 years. Case engagements (number of times interacted with) are recorded in blue and answer engagements are recorded in orange. There was also growth of the Twitter engagement over the first 3 years, which was significantly greater after the onset of the COVID-19 pandemic compared with prepandemic ($P < .001$).

monthly mean new Twitter followers after the implementation of the #ASHNRCOTW, there was a statistically significant increase in mean monthly new Twitter followers after the start of the COVID-19 pandemic (mean, 178 [SD, 77.9]; range , 90–374) compared with before the COVID-19 pandemic (mean, 101 [SD, 25.4]; range, 48–176) ($P = .003$).

International Scope

At the time of this research, the official Twitter account of the ASHNR (@ASHNRSociety) has 7564 followers throughout 130 countries worldwide. The largest cohort of followers originates from the United States ($n = 2584$, 34.16%), followed by India ($n = 897$, 11.86%), the United Kingdom ($n = 436$, 5.77%), Saudi Arabia ($n = 344$, 4.55%), Brazil ($n = 201$, 2.66%), Mexico ($n = 199$, 2.63%), Spain ($n = 194$, 2.57%), Canada ($n = 180$, 2.38%), Egypt ($n = 164$, 2.17%), Turkey ($n = 154$, 2.03%), and Australia ($n = 116$, 1.54%).

DISCUSSION

We report the design, implementation, and 3-year longitudinal assessment of a new social media–based educational initiative

sponsored by the ASHNR. This new initiative is used by radiology learners of all levels of training (medical students, interns, residents, fellows, and practicing radiologists), as well as nonradiologist physicians (eg, otolaryngologists) and nonphysician health care providers (eg, dentists) worldwide. We found Twitter to be a highly visible and engaging tool for radiology education, as evidenced by the >2 million views and >200,000 interactions during the first 3 years of the #ASHNRCOTW initiative (Figs 2 and 3). We also found Twitter to be particularly well-suited for the delivery of education/edutainment content during the COVID-19 pandemic, as evidenced by the statistically significant increase in all viewership and engagement metrics during the pandemic compared with prepandemic levels (Online Supplemental Data). During this era of social distancing and lack of in-person societal meetings, social media provided a forum for society members to continue to interact and network, benefitting from an international form of asynchronous interactive transmedia storytelling to continue educational efforts alongside virtual conferences and online webinars. We also observed a statistically significant increase in mean new monthly followers of the @ASHNRSociety Twitter

account during the pandemic compared with prepandemic levels, as well as a 5718% increase in total followers when comparing post-#ASHNRCOTW (7564 followers) to pre-#ASHNRCOTW (130 followers) levels. This growth in @ASHNRSociety Twitter followers outpaced the general growth of overall Twitter users during the same time period, which increased 41% from 122 million users in the second quarter of 2018 to 206 million users in the second quarter of 2021.[29] Most important, we note the potential for global radiology education outreach with this platform, as evidenced by the 7564 Twitter followers of ASHNR distributed throughout 130 countries, 66% of whom reside outside the United States.

Before the implementation of the #ASHNRCOTW, the @ASHNRSociety Twitter account was primarily used to advertise the annual meeting and provide occasional member updates regarding society news. Thus, viewership and visibility were limited, and content was directed primarily at existing society members. By establishing an ad hoc social media committee (and, subsequently, merging it with the pre-existing website committee), the ASHNR empowered a group of society members to design, implement, and oversee what has grown into a long-running, highly visible, and engaging educational initiative. This translates into an established outward-facing advertisement of the society's educational offerings that is powered by the volunteer effort of engaged society members, incurs essentially no financial cost to the society, and uses an educational delivery vehicle that has previously been shown to appeal greatly to younger generations of learners.[4] This initiative has also increased the society's outreach and mentoring efforts, connecting head and neck radiologists internationally with a platform to interact and educate with novel edutainment technology.

The concept of using social media as a platform for medical education is not a new one, dating back to the first published medical literature description of a microbiology blog in 2010.[30] Multiple authors have previously detailed potential strengths and applications of using social media as a tool for radiology education, but these are largely limited to editorials and perspectives with few data-driven or outcomes-based investigations of this novel education tool. In a 2021 study from radiologists at Johns Hopkins, the authors found Twitter to be a useful tool for disseminating radiology education with scroll-through videos offering the highest level per tweet impressions and case images offering the highest level of per tweet engagements in their study.[8] In a 2018 study from radiologists at Indiana University School of Medicine, the authors detailed a departmental social media–based radiology education initiative, documenting a linear growth trend of increased per-case Twitter impressions and engagements during its first year of implementation.[13] In comparison, our study shows a growth trend in both Twitter impressions and engagements over a longer study duration (3 years), including a statistically significant increase in Twitter viewership and participation during the COVID-19 pandemic compared with prepandemic cases. The reasons for the increase in #ASHNRCOTW participation during the pandemic are not resolved by this study but may relate to the transient decrease in imaging volumes, leading to more available time for education or an increased desire for professional interaction during this time of social distancing and isolation. Similar to the results of the Indiana University study,[13] we also found that the unknown #ASHNRCOTW case tweets had greater mean engagements than the answer tweets. This difference in overall interaction with the answer tweets is likely due to the gamified learning fostered by this educational initiative.

A key element of the #ASHNRCOTW education initiative was the explicit use of gamification, in this case, soliciting participants to submit answers to the unknown cases in the form of GIF images, to increase engagement and improve learning. Gamification refers to the integration of game elements into a nongaming environment, a concept that has increasingly been applied to medical education during the past decade with the goal of improving learning outcomes.[31] A growing body of literature suggests that gamification is a valuable tool for medical education, contributing to increased learner engagement, increased use of education resources, increased learner satisfaction, and improved learning outcomes.[31-35] Gamified learning strategies have made inroads in radiology education, including such tools as in-lecture audience response systems, resident or fellow leaderboards, game fiction scenarios and role-playing, and positive reinforcement with performance rewards for trainees.[36-39]

We intentionally gamified the #ASHNRCOTW initiative to rely on audience submission of GIF images as the primary means of participation. The benefits of using GIF images are 3-fold: 1) Participants can drop hints at the correct answer without spoiling it for other participants, 2) participants weave a storylike tapestry of memorable GIF images that combine narrative and flashbulb episodic memory with factual medical information (semantic memory) to augment learning, and 3) GIF images offer a light-hearted and often comical vehicle for approaching learning, which adds to the enjoyment of participation. This unique interactive edutainment allows participants to make connections they might not otherwise contemplate between the unknown cases and their answers using GIF images, fostering interactivity and potentially increasing the knowledge retention and understanding of complex head and neck anatomy and pathology. This asynchronous interactivity allows our educational effort to expand internationally and continuously throughout the year, expanding our audience from traditional academic radiology in-person annual conferences alone.

This study does have a few important limitations. First, we used Twitter analytics data to assess #ASHNRCOTW viewership and engagement but did not explicitly assess learning. Thus, we can demonstrate significant increases in viewership, engagement, and account followers after the establishment of the #ASHNRCOTW, but we cannot be certain that participants improved their head and neck radiology knowledge base or retention. Second, Twitter viewership data may be exaggerated due to the presence of social robots ("bots"), which are automated programs that generate or share content on social media with the intent of influencing users. Bots are estimated to account for 9%–15% of active Twitter accounts,[40] creating uncertainty in the exact number of human eyes our cases reached. The influence of bots on the niche Twitter demographic of head and neck imagers is likely small and probably has a limited effect on #ASHNRCOTW viewership. Third, we did not directly survey participants about their perceptions of this educational initiative. Thus, we cannot be certain whether participants found #ASHNRCOTW to be useful for their learning needs, though the high engagement rate (9.3%) suggests that they found it valuable.

For reference, Twitter engagement rates of >1% are considered strong.[41] Last, we observed a significant increase in #ASHNRCOTW Twitter viewership, engagement, and account followers corresponding with the COVID-19 pandemic. We cannot be certain whether these increases represent durable trends or a transient effect of pandemic era learning, which would require long-term studies of post-pandemic viewership trends.

CONCLUSIONS

Social media affords substantial visibility, engagement, and global outreach for radiology education. Despite logistic and social challenges posed by COVID-19, the ASHNR engaged learners during the pandemic with its Case of the Week edutainment initiative on Twitter, which significantly increased viewership and learner engagement during the pandemic. As we evolve into our postpandemic "new normal," social media–based education initiatives and similar transmedia storytelling efforts may be beneficial for interactive teaching, learning, and education beyond the traditional annual conferences of academic medical societies.

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