



Next-Generation Scholarship: Rebranding Hematopathology Using Twitter: The MD Anderson Experience

Siba El Hussein¹ · Joseph D. Khoury¹ · Kirill A. Lyapichev¹ · Mehrnoosh Tashakori¹ · Mahsa Khanlari¹ · Roberto N. Miranda¹ · Rashmi Kanagal-Shamanna¹ · Sa A. Wang¹ · Aadil Ahmed² · Kamran M. Mirza³ · Genevieve M. Crane⁴ · L. Jeffrey Medeiros¹ · Sanam Loghavi¹

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Abstract

Hematopathologists are witnessing very exciting times, as a new era of unsurpassed technological advances is unfolding exponentially, enhancing our understanding of diseases at the genomic and molecular levels. In the evolving field of precision medicine, our contributions as hematopathologists to medical practice are of paramount importance. Social media platforms such as Twitter have helped facilitate and enrich our professional interactions and collaborations with others in our field and in other medical disciplines leading to a more holistic approach to patient care. These platforms also have created a novel means for instantaneous dissemination of new findings and recent publications, and are proving to be increasingly useful tools that can be harnessed to expand our knowledge and amplify our presence in the medical community. In this Editorial, we share our experience as hematopathologists with Twitter, and how we leveraged this platform to boost scholarly activities within and beyond our subspecialty, and as a powerful medium for worldwide dissemination of educational material and to promote our remote teaching activities during the COVID-19 pandemic.

Recent advances in technology have provided 21st century scholars with a plethora of tools to harness and remodel our skills and interests, and to optimize our career paths [1]. Social media have provided medical professionals with a novel platform for real-time interaction, education, patient engagement, collaborations, and networking [2]. Such applications, spanning the healthcare continuum, are further

enhanced by worldwide accessibility inherent in the virtual nature of social media platforms [3–7].

These advantages have been harnessed particularly well by specialties that rely heavily on visual information, such as diagnostic pathology. Indeed, with an explosion in information spanning disease pathogenesis, molecular genomics, and targeted therapies, social media have provided an avenue to bolster subspecialty information and gain access to informal second-opinion resources, educational content, and multidisciplinary specialty niches. Together, these factors have helped pathologists assimilate and disseminate knowledge within the healthcare professional community as well as patient communities through the use of social media platforms [8–12].

Among pathology subspecialties, hematopathology has long been regarded as a complex subspecialty in view of the need to integrate clinical data, morphology, immunophenotyping, molecular, and cytogenetic data for baseline diagnostic assessment as well as disease follow up. While other subspecialty areas have in the past few years been increasingly incorporating molecular genomic criteria into their tumor classification schemes, this has been the case in hematopathology for over two decades. Furthermore, the complexity of hematopathology has increased substantially

✉ Siba El Hussein
elhusseinsiba@gmail.com

✉ Sanam Loghavi
Sloghavi@mdanderson.org

¹ Department of Hematopathology, The University of Texas MD Anderson Cancer Center, Houston, TX, USA

² Department of Pathology and Laboratory Medicine, The University of Arkansas for Medical Sciences, Little Rock, AR, USA

³ Department of Pathology and Laboratory Medicine, Loyola University Health System, Maywood, IL, USA

⁴ Robert J. Tomsich Pathology and Laboratory Medicine Institute, Cleveland Clinic, Cleveland, OH, USA

over the past decade with the advent of next-generation sequencing and the incorporation of mutation profiling in the classification, risk stratification, and therapy selection for patients with hematolymphoid malignancies.

The Department of Hematopathology at The University of Texas MD Anderson Cancer Center (MDACC) is the largest of its kind within the United States and across the world with 36 faculty and 9 fellowship training spots offering subspecialty training in hematopathology and molecular pathology disciplines. We had long considered establishing an educational course sponsored by the Department of Hematopathology at MDACC predominantly, focused on bringing the latest of knowledge to community-based and academic hematopathologists. Our department brought this concept to fruition in April of 2019. As we were preparing to advertise our MDACC-sponsored course “Current Concepts in Diagnostic Hematopathology,” we were advised by a colleague to post the announcement for the conference on Twitter and invite potential Twitter influencers to “live-tweet” the conference in order to maximize the reach of our sessions. We welcomed the idea and invited Drs Genevieve Crane (@evemariecrane) and Adam Booth (@ALBoothMD) to participate in the conference and live-tweet during the meeting. They in turn advised us to create a unique hashtag for the meeting to facilitate obtaining online metrics for this activity, resulting in the hashtag #MDAHP19 being specifically registered for this conference. The conference was held on April 27, 2019 and was attended by a total of 75 participants including 66 registered guests and 9 speakers. #MDAHP19 engaged 200 unique users generating 1560 Tweets resulting in 3.7 million potential impressions between March 1 and May 1, 2019 (<https://www.symplur.com>).

This conference marked the beginning of our involvement with the online hematopathology community on Twitter, which would later become one of our strongest tools for teaching hematopathology across the world during the COVID-19 pandemic. We have since realized that social media, and in particular Twitter, will be shaping medicine

and hematopathology in ways beyond what we had ever imagined. We hope to use this editorial to share some of these extraordinary experiences with the readership.

We created the hashtag #hemepathMDA to link Tweets and discussions pertaining to the educational activities of our department on September 04, 2019. We sought to determine the impact of our educational activities within the hematopathology community using #hemepathMDA as it pertains to Twitter users, characteristics of content generated, and number of potential impressions by analyzing Twitter conversations during the study period (9/24/2019 to 8/30/2020). Analysis was performed using Symplur’s Healthcare Hashtag and Symplur Signals Projects, which assist in organizing datasets available on Twitter [13]. Categorization of stakeholders was based strictly on publicly available information in the Twitter users’ profiles.

Table 1 provides a glossary of terminology commonly used on Social Media, in particular on Twitter.

From September 4, 2019, we found 862 unique users who tweeted using #hemepathMDA generating a total of 3827 Tweets and 3378 retweets (RT) resulting in over six million (6800,131) potential impressions across Twitter during the study period (Table 2). Symplur computes total potential impressions by multiplying the number of Tweets per participant to number of followers a given a participant or Tweeter currently has. Several members of our own department including faculty and trainees as well as those from other institutions became actively engaged in creating and promoting educational materials using this hashtag. (Table 3 and Fig. 1A).

The peak use day of #HemepathMDA during the study interval was October 9, 2019, featuring 99 unique Tweets. The Tweet with the most RT/and potential impressions under #hemepathMDA (<https://www.symplur.com>) featured a series of bone marrow aspirate smears demonstrating various forms of erythroid dysplasia (Fig. 2). We believe that high level of engagement with this Tweet was a result of several key factors: (1) the Tweet demonstrated a key teaching point relevant to basic hematopathology training

Table 1 Glossary of terminology commonly used on Twitter.

Terminology	Definition
Hashtag	A hashtag is any word or phrase immediately preceded by the # symbol. By clicking on a hashtag the user has the ability to see other Tweets containing the same keyword or topic.
Follower	A follower is another Twitter account that has followed you to receive your Tweets in their Home timeline.
Tweet	The act of sending a Tweet. Tweets get shown in Twitter timelines or are embedded in websites and blogs.
Retweet	The act of forwarding a Tweet to one’s followers. Often used to pass along news or other valuable discoveries on Twitter.
Impression	A total tally of all the times a Tweet has been seen.
Handle	A user’s “Twitter handle” is the username they have selected.
Thread	A series of connected Tweets from one person in which the user can provide additional context, an update, or an extended point by connecting multiple Tweets together.

that is often difficult to verbally communicate; (2) the visual content was original and easy to understand; and (3) the key teaching points were accompanied by a highly cited article

Table 2 Twitter metrics for #hemepathMDA; data obtained from Symlur’s Healthcare Hashtag and Symlur Signals Projects.

Metric	Value	Percent
Total tweets	3827	100%
Tweets with mentions	3573	93.40%
Retweets	3378	88.30%
Tweets with media	2937	76.70%
Tweets with links	1152	30.10%
Tweets with replies	67	1.75%
Users	862	
Impressions	6800,131	

Table 3 Top ten influencers of #hemepathMDA 09/04/2019-08/30/2020.

Name	Twitter handle	Institution
Sanam Loghavi	@sanamloghavi	MDACC
Siba El Hussein	@SibaElHussein	MDACC
Kirill Lyapichev	@KirillLyapichev	MDACC
Joseph D. Khoury	@JoeKhouryMD	MDACC
Mehrnoosh Tashakori	@TashakoriM	MDACC
Sa A. Wang	@SaWangMD	MDACC
L. Jeffrey Medeiros	@ljmedirosMD	MDACC
Roberto N. Miranda	@RMirandaMD	MDACC
Rashmi Kanagal-Shamanna	@kanagalshamanna	MDACC
Mahsa Khanlari	@MahsaKhanlari	MDACC
Kamran Mirza	@KMirza	Loyola Pathology
Genevieve Crane	@evemariecrane	Cleveland Clinic

MDACC MD Anderson Cancer Center.

that supported the elements featured in the Tweet. This Tweet was retweeted 104 times, received 182 likes, and there were a total of 25,991 potential impressions (<https://twitter.com/sanamloghavi/status/1181796778242445318>).

Analysis of words and phrases used most frequently in association with #hemepathMDA revealed an expected heterogeneous mix of terms/abbreviations (Fig. 1B). These included various types of lymphoid and myeloid neoplasms, ancillary testing methods commonly used in hematopathology, and hematopathology specimen types. The results are largely a reflection of Twitter discussion threads formed by the hematopathology community through which

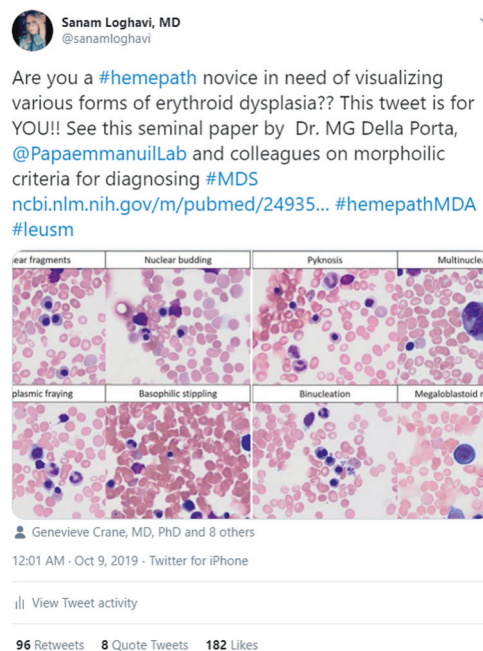


Fig. 2 Leveraging visual aids for hematopathology education. A screenshot image of an educational Tweet using #hemepathMDA, which generated the most number of retweets.

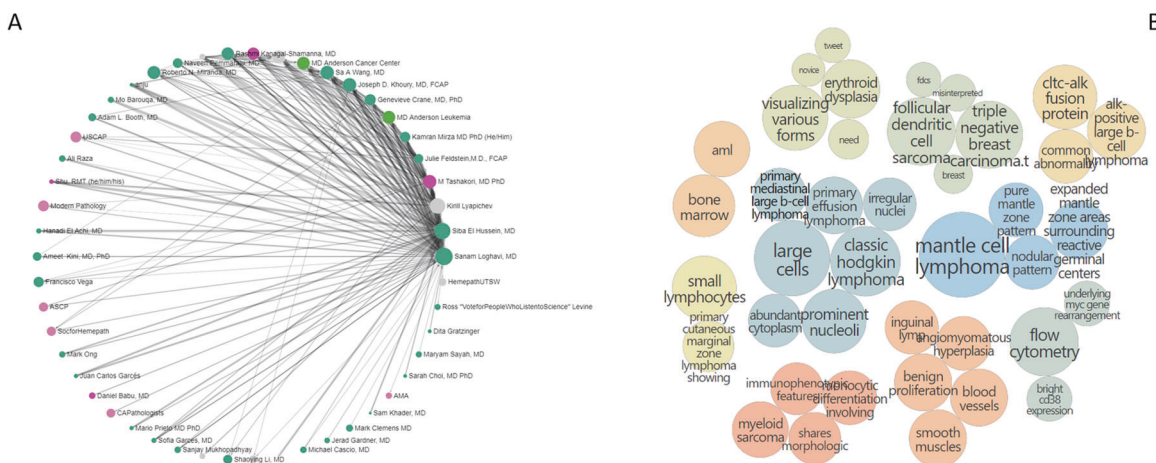


Fig. 1 #HemepathMDA engagement across Twitter. **A** Top users engaging with #HemepathMDA. **B** Terms frequently associated with #HemepathMDA. We used Symlur’s “Associated Terms” view, in which related terms are grouped together in clusters, each with its own unique color.

users actively engage with each other to discuss cases posted on this platform and those presented at our departmental Lymphoma (#LJMFridayUnknowns) and Bone Marrow Unknown conferences.

Twitter provides an optimal platform for archiving visual examples and photomicrographs of cases that can later be harnessed as teaching material for pathology educators and trainees. Members of our group and the hematopathology community on Twitter regularly contribute to this resource by posting classic examples of cases or those that are more challenging and difficult to classify. The hashtags #hemepath, #leusm (leukemia social media), #lymsm (lymphoma social media), and other relevant hashtags are used in

association with these posts to facilitate archiving and later retrieval through search on Twitter and third party search engines such as Google. These posts are often accompanied by links to additional reading materials such as peer-reviewed articles to provide the reader with further educational resources on this topic. Figure 3 provides a summary of visuals with highest engagements posted using #hemepathMDA. The Twitter links for these posts and a more detailed summary of their respective contents are provided in Table 4.

Ancillary testing is increasingly used for accurate diagnosis and predicting prognosis of hematolymphoid disorders. This type of data is rapidly evolving as new biomarkers are

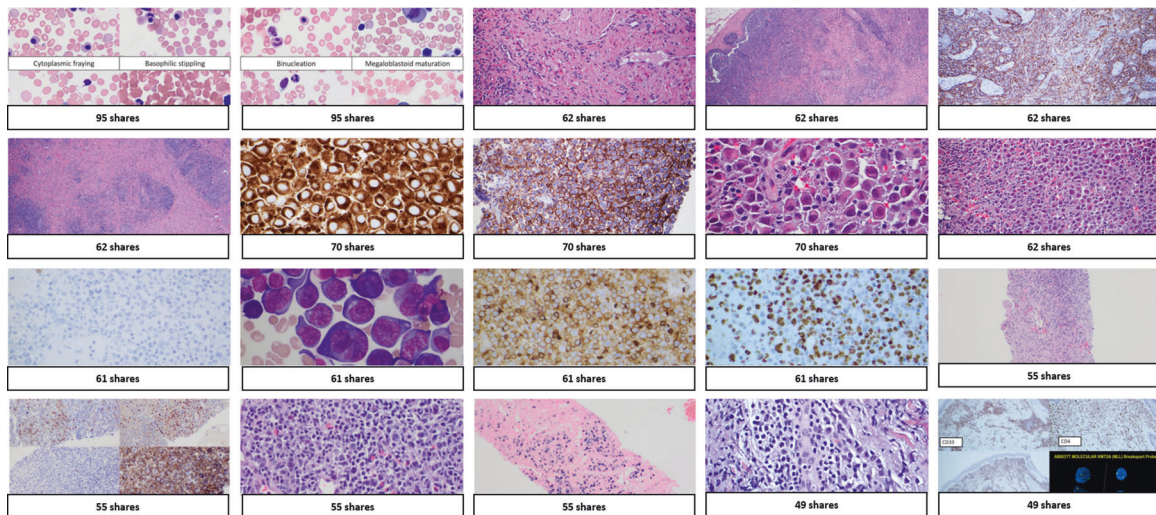


Fig. 3 A summarized view of visual posts associated with #hemepathMDA attracting the most number of engagements (see Table 4 for detailed content). These cases represent daily clinical cases encountered by some of the co-authors, with valuable educational points to share with the public.

Table 4 Details of cases presented using visual content, photomicrographs +/- article links, in association with #hemepathMDA attracting the highest number of engagements.

Twitter link	Content	Other associated hashtags	Link to article	Article altmetrics (altmetrics score)
t.co/IRXkGpgGny	Erythroid dysplasia	#Hemepath #HemepathMDA #leusm	https://pubmed.ncbi.nlm.nih.gov/24935723/	https://www.altmetric.com/details/3835289?src=bookmarklet (80)
t.co/P5vsnM6m2J	Angiomyomatous hyperplasia	#Hemepath #HemepathMDA #LJMFridayUnknowns #endcancer	N/A	N/A
t.co/8BL0qxFMKY	ALK-positive large B-cell lymphoma	#LJMFridayUnknowns #HemepathMDA #Hemepath #Lymsm #endcancer #Molpath	N/A	
t.co/QPHU8uaTrS	Primary effusion lymphoma	#Hemepath #HemepathMDA	N/A	N/A
t.co/xYTrd5pChj	EBV+ diffuse large B-cell lymphoma	#hemepath #hemepathMDA #lymsm	https://onlinelibrary.wiley.com/doi/full/10.1002/ajh.25112	https://www.altmetric.com/details/45464288?src=bookmarklet (46)
t.co/MK6IXmWVQi	Myeloid sarcoma	#Hemepath #HemepathMDA #Leusm #endcancer #dermpath	N/A	N/A

N/A not available.

characterized. This data is thus of great interest to the pathology community to disseminate and discuss over social media. The fact that the analysis and results of many of these testing modalities are image-based and computer-assisted, renders them easily shareable through online social media platforms. Several Twitter pages have been created and dedicated to sharing classic examples of various disease entities with beginners and trainees, as well as sharing challenging cases to in order to heighten awareness of certain interpretational pitfalls that may lead to clinically relevant consequences. We actively engage with other educational organizations across the hematopathology community and contribute educational materials to these websites. Table 5 shows a list of organizations most frequently associated with #hemepathMDA and their respective Twitter handles and Symplur ranks as it pertains to #hemepathMDA.

The relative ease of hematopathology data-sharing has opened many doors to reshape and adapt the concept of continuous medical education to a more modern and structured model.

This modernized model meets the needs of an ever growing field in terms of genetic advances, and our understanding of the biology of certain hematopoietic

neoplasms. Instant and wide literature dissemination is a staggering phenomenon that is granting our medical community an unprecedented scholar advantage [14].

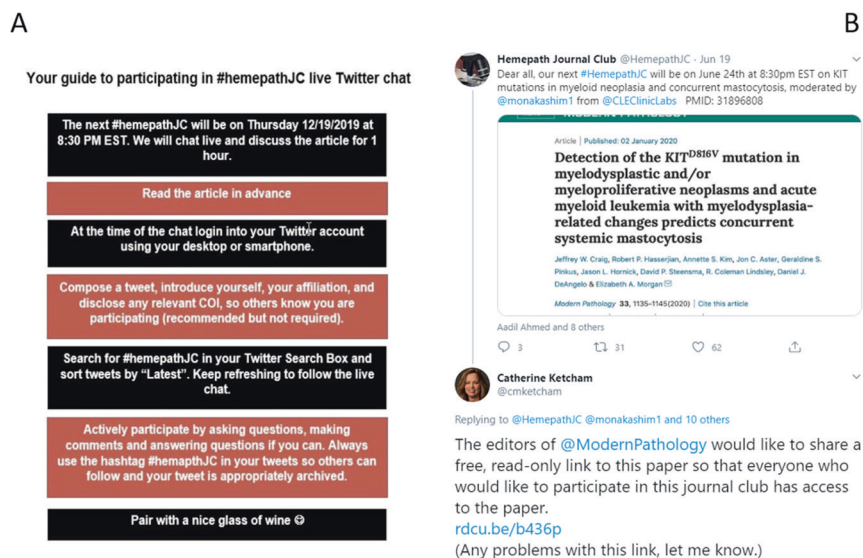
Today, for instance, it is easier to keep-up with new cutting-edge investigations and discoveries by following the accounts of leading journals, or experts in the field, or by keeping in tune with the #hemepath community. Twitter hematopathology “journal club” is a trending event that is gaining popularity (@HemepathJC and #HemepathJC). Credits go to Aadil Ahmed, MD (@AadilAhmedMD) who really has brought this idea to fruition. The idea is to recruit a hematopathologist with expertise in a specific area or topic to moderate #hemepathJC as participants discuss the article of interest live on Twitter (Fig. 4A). Article authors are invited and encouraged to participate in the live event. The journal club alternates between lymphoid and myeloid topics and is held on a monthly basis, with events garnering >1 million Tweet views surrounding the conversation. The event has also garnered support from journals with the June 2020 article being made freely available on Twitter by Modern Pathology (Fig. 4B).

This virtual experience is superb, as it gives hematopathologists a chance to inquire about laboratory techniques

Table 5 Educational organizations most commonly associated with #HemepathMDA 09/04/2019 to 08/30/2020.

Name	Twitter handle	Symplur rank
United States and Canadian Academy of Pathology	@TheUSCAP	48.16
Modern Pathology	@ModernPathology	47.7
American Society of Clinical Pathology	@ASCP_Chicago	37.6
Society for Hematopathology	@SocforHemepath	37.39
College of American Pathologists	@Pathologists	35.16
American Society of Hematology	@ASH_hematology	28.41
American Medical Association	@AmerMedicalAssn	22.7
ICCS Education	@ICCS_Education	20.9

Fig. 4 #hemepathJC. **A** Tweet by @HemepathJC sharing guidelines for participation in the journal club dedicated to hematopathology on Twitter, using #hemepathJC; **B** Tweet by Modern Pathology announcing the availability of a “free” link to an article discussed on #hemepathJC, and retweet by @HemepathJC to spread the word to the #hemepath community.



used in the study, the rationale behind the investigation and the applicability of the findings to clinical day-to-day settings, among other valuable questions. #hemepathMDA is an active contributor to this powerful social-media platform, which to date has engaged 273 unique Twitter users, and has generated over 3000 Tweets and over ten million potential impressions (<https://www.symplur.com>). #hemepathJC has opened doors for spontaneous collaborations between investigators at different institutions by facilitating sharing of ideas and brainstorming on Twitter. This Twitter-based journal club trend is not unique to hematopathology, as it is seen across several medical specialties, and this trend has stimulated the publication of articles providing guidelines for setting up an online journal club [15].

The COVID-19 pandemic was an unfortunate incident by all accounts, but did result in rapid dissemination of medical education through social-media outlets [16, 17]. Our department also used this opportunity and the virtual resources that rapidly became available due to these unusual circumstances to further our educational mission. We leveraged Twitter to make users aware of our weekly educational conferences that were made available to the public using the online meeting platform WebEx. With easy access to full cases online, our group pioneered an online educational platform by sharing weekly digital slide links with its vast national and international online audience. This enormous undertaking was possible using customized hashtags such as #hemepath #hemepathMDA #virtualhemepathMDA, through which pathologists from all over the globe can review the digitized slides beforehand, and access our weekly online slide conferences. As part of these conferences, we have now made hundreds of whole-slide pathology teaching images publicly available using the whole-slide imaging platform PathPresenter.net. Using these hashtags, we have engaged 483 unique Twitter users, with over 2407 Tweets and over 3.5 million potential impressions (<https://www.symplur.com>) via active participation of an international audience of hematopathologists, pathologists, and trainees across the globe.

In recent years, social media has become an increasingly utilized tool among medical professionals, including hematologists and oncologists [18, 19]. Using disease-specific hashtags (#), several medical communities in hematology and oncology have been created through Twitter, for online communication and dissemination of knowledge with respect to hematologic malignancies [13, 20].

Applications of these hashtags vary widely and include, but are not restricted to, the following activities: announcement of conferences, summarizing highlights of key presentations at annual society meetings such as the American Society of Clinical Oncology and the American Society of Hematology annual meetings and other educational conferences, and announcement of recent publications by

authors or journals [21–25]. With such practices becoming increasingly trendy, “tweeting etiquette” has been a subject of discussion in several publications, by providing tips, strategies, and limitations, to optimize the deployment of social media in the medical community [26–28].

In addition, many hematologist and oncologists are using social-media platforms to educate the public about various medical procedures and diseases. For example, Twitter is used in the hematopoietic stem cell transplantation community [29], and in rare disease communities, thereby providing information via trusted sources [30–35]. In addition, social media has been used to recruit cancer survivors to participate in web-based interventions and clinical trials [36].

In the same spirit of virtual education, virtual mentorships emerge online, beautifully portraying the magic of social media in aligning two minds to seek continuous growth together [37]. Similar fostered relationships have resulted in the creation of spontaneous collaborations online, resulting in several projects and publications. Twitter provides a powerful medium with global reach and incredible visibility for immediate exchange of ideas as well as more long-term collaborations between investigators and authors that may otherwise have never had the opportunity to meet or collaborate with one another. Many of these collaborations have resulted in successful publications from multi-institutional studies spanning different countries and continents across the world [38–44].

One of the major benefits of social-media engagement by hematopathologists is the enhanced interaction and exposure to the medical community in general, and the hematology–oncology community in particular. Some hematopathologists take initiatives regularly to explain certain elements or features of the pathology of a certain disease, by creating Tweets and extended “Threads.” A Thread refers to a series of connected Tweets from one person in which the user can provide additional context, an update, or an extended point by connecting multiple Tweets together. One such example can be found at <https://twitter.com/hematogones/status/1022523417180954624> in which the user, Dr Chandra Krishnan (@hematogones) uses a series of educational Tweets describing various forms of lymph node pathology. These efforts undoubtedly help to clarify many misconceptions, and open doors for a richer conversation between clinicians and hematopathologists to optimize many aspects of patient care and management. These efforts also have led, in many instances, to increased collaboration between the teams on the clinical and research level, in addition to reciprocal promotions of the investigational efforts of the two parties.

Our group has been heavily involved on Twitter by posting educational cases, concepts, and announcing recent publications via #hemepath and #hemepathMDA. These

efforts have resulted in overwhelmingly positive feedback from the international community (<https://twitter.com/anueru432/status/1268578219059408897>; <https://twitter.com/anueru432/status/1272549960433590272>), as cases encountered at our institution encompass a broad spectrum of hematological diseases, including cases rarely seen at other smaller medical centers, giving us the opportunity to be at the front of peer education and knowledge exchange. Creating and sharing hematopathology content online has been the fruit of the efforts of several attending hematopathologists and fellows alike.

As we delve into a new era of unsurpassed technological advances, our role as hematopathologists is more crucial than ever. The model for our diagnoses is evolving constantly into a more comprehensive one, integrating the results of multiple ancillary studies including immunophenotyping, cytogenetic, and molecular studies among others, in addition to light microscopy. This evolution of our practice puts a greater responsibility on our shoulders in terms of continuous medical education, and is a great incentive to enhance our collaborative efforts with our clinical colleagues in order to maximize our contribution to patient care and well-being. Deploying social-media platforms to our benefit is a great method to grow our learning resources and harness the role and contributions of hematopathology to the medical community.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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