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Perspective

The Evolution of the Journal Club: From Osler to Twitter

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Journal clubs have typically been held within the walls of academic institutions and in medicine have served the dual purpose of fostering critical appraisal of literature and disseminating new findings. In the last decade and especially the last few years, online and virtual journal clubs have been started and are flourishing, especially those harnessing the advantages of social media tools and customs. This article reviews the history and recent innovations of journal clubs. In addition, the authors describe their experience developing and implementing NephJC, an online nephrology journal club conducted on Twitter.
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Journal clubs are widely used as a versatile tool in medical education. They aid in teaching the systematic evaluation and interpretation of the published literature and serve as a means to share the latest advances in medical science. The journal club is approaching 200 years of age, but it continues to evolve to solve new problems and use new technologies.[1-3] The latest example of this is journal clubs using social media to discuss and debate the scholarly publications. Numerous journal clubs meet virtually to discuss new and high-impact articles with participants from around the world. One such online journal club, Nephrology Journal Club (NephJC), meets twice a month to discuss the contemporary nephrology literature. This article reviews the history and scholarly research performed on journal clubs, describes the characteristics of modern online journal clubs, and provides data from the NephJC experience.

The History of Journal Clubs

The first use of the term "journal club" is in the memoirs and letters of James Paget. Dr Paget described a lounge outside St Bartholomew's Hospital in London, where from 1835 to 1854, physicians socialized and read journals.[1] However, it is William Osler who is credited with creating the modern journal club while at McGill University in Montreal in 1875. Osler encouraged collective reading of subscription journals in order to spread the prohibitively high cost of print periodicals.[1] The McGill journal club model was widely imitated. Johns Hopkins held its first journal club in 1889, and by the first few decades of the 20th century, most departments in Johns Hopkins were hosting their own monthly journal clubs. These specialty-specific journal clubs were typically held in the homes of participating physicians.[4] Tinsley Harrison (creator of *Harrison's Principles of Internal Medicine*) used to host a journal club at his house twice a month at which one participant would present a paper and the assembled audience would critique.[5]

Mattingly[6] published the first peer-reviewed paper primarily about journal clubs in 1966. He described

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the popularity of journal clubs in the United States, characterizing them as "a regular and often compulsory feature of hospital life."[6,p120] By the 1980s, a survey of internal medicine residency programs in New York demonstrated that 85% included a journal club.[7] Mattingly defined a journal club as "a group of doctors meeting regularly to discuss papers of interest in the current medical journals."[6,p120] He added that although different members of the club have different goals, "The essential feature of any journal club, however, is that all the members should present papers at one time or another and take part in the subsequent discussions."[6,p120] The key was an engaged rather than passive audience.[6] Mattingly thought that having an engaged interactive discussion put restrictions on the size of the journal club; too many people and not everyone can participate, too few and there is insufficient dialogue to generate fulfilling 2-way interactions. He thought that journal clubs should have no fewer than 6 participants and no more than 12.

A recurring theme in narrative descriptions of various journal clubs is practices that reduce formalities in order to make the environment more casual. These include hosting the event outside the hospital campus and adding food and drinks to the event.[8,9] Because journal clubs are one of the few examples in traditional medical education with peer-to-peer teaching, steps that enhance informality could potentially stimulate interaction. Leaving the hospital grounds may serve to de-emphasize the normal educational hierarchy. This characteristic was in play in the very first journal club, which was held outside St Bartholomew's Hospital.[1] Recent work has suggested that this informality adds to the acceptance of the journal club itself.[8]

The journal club has evolved to serve various medical education needs. For example, the journal club has been adapted to teach the fundamentals of critically appraising the literature.[10,11] Riegelman encouraged the use of a structured format when presenting articles. This is described by the Method, Assignment, Assessment, Results, Interpretation, Extrapolation (MAARIE) framework.[12] Gehlbach et al[13] promoted the use of a formal 8-week evidence-based medicine curriculum conducted in parallel with a journal club. Linzer et al[14] tested the ability of a journal club to improve evidence-based medicine education in a randomized controlled trial and reported that a journal club–based curriculum was better than a weekly faculty-administered lecture at teaching the principles of evidence-based medicine. Deenadayalan et al[15] performed a systematic review of the literature on journal clubs and found 12 studies that objectively attempted to characterize and measure the effectiveness of journal clubs. They used these data to establish a set of best practices for journal clubs[15] (Box 1). Similarly, another systematic review including 16 studies reported an improvement in reading habits and critical appraisal skills in the attendees.[16]

From the Classroom to the Laptop

A number of factors contributed to the journal club transitioning from a face-to-face to an online interaction. First, the conversational nature of journal clubs fit well into emerging online platforms such as Twitter, which were designed to facilitate rapid real-time dialogue between learners. Second, online tools allowed for learners from different locations to join in a virtual round table discussion. This is important for physicians who have completed training and are no longer in academic medical centers. Third, online journal clubs allow a variety of physicians, ancillary providers, patient advocates, authors, and content experts to participate. Fourth, an online format provides greater flexibility in the scheduling of the event.

The online journal club has gone through a number of iterations. Early online journal clubs were lacking the important interactive quality and were simply journal articles that were available online. *Kidney International* (*KI*) was among the first to form an online journal club of this kind, and it is still in use today. It consists of a series of expert summaries of selected articles from other journals.[17] The summaries are written by experts in the field and contextualize the article by discussing prior research. The summary addresses controversies in the study design, and the article specifies what this study adds to the established literature. Though these essays are called journal clubs, they lack 2-way interactive discussion. A journal club dedicated to pediatric infectious disease followed a similar model, with consultants submitting a critical appraisal to the pediatric special interest group of the Australian Society of Infectious Diseases, which posted it on a dedicated website. This model was popular and the organizers found a 6-fold increase in web traffic with the journal club.[18] However, like *KI*, the lack of a 2-way information exchange makes this more of a literature appraisal and less an interactive journal club.

The *Clinical Journal of the American Society of Nephrology* (*CJASN*) started an online monthly journal club in September 2011 called the *CJASN* eJournal Club (eJC).[19] The *CJASN* eJC model included an initial critical appraisal of a selected article in the form of a text summary or a slide presentation. This was prepared by a rotating group of individuals from various nephrology divisions. The actual discussion then occurred in a forum, with questions and replies threaded together. Authors were encouraged to participate and reply to questions. *CJASN* made the article and its associated editorial available to anyone with a free eJC account

Box 1. Characteristics of a Sustainable and Effective Journal Club

Journal club attendance
- Establish a journal club group of members of the same discipline or with similar interests within a clinical specialty

Journal club purpose
- Have an established and agreed overarching goal for the long-term journal club intervention. The overarching journal club purpose should be reviewed regularly and agreed on by participants
- Establish the purpose of each journal club meeting and link this to the paper being read or the skill acquisition being addressed

Structure of an effective journal club
- Regular attendance should be expected and recorded. Attendance may be mandatory, particularly if the journal club has a curriculum-based format
- Conduct journal clubs at regular predictable intervals (suggest monthly)
- Conduct journal club at an appropriate times of the day for all participants
- Provide incentives to attend, such as food (which is shown to increase attendance and the conviviality of the occasion)

Leading journal club
- Journal clubs appear to be more effective if they have a leader. The journal club leader should be responsible for identifying relevant articles for discussion; however, the final choice needs to be decided by the journal club members
- Train the leader/facilitator of the journal club in relevant research design and/or statistical knowledge so as to appropriately direct group discussions and assist the group to work toward its goals
- The leader can change from meeting to meeting; however, he or she needs to have the skills to present the paper under discussion and lead the group adequately. It is a fine balance between choosing a leader of high academic standing whose expertise may stifle discussion or choosing a leader from peers who may not have the requisite understanding of the paper under discussion
- Provide access to a statistician to assist the leader in preparing for journal club and to answer questions that may arise from the journal club discussion

Choosing articles for discussion
- Choose relevant case-based or clinical articles for discussion. These papers should be of interest to all participants. Articles should be chosen in line with the overarching purpose of the journal club
- Identify one journal club member (either the designated leader or a member) who has the responsibility for identifying the literature to be discussed for each meeting. This person should also lead the discussion on the article at the journal club

Circulating articles for discussion
- Provide all participants for each journal club (in addition to the leader) with prereading at a suitable period prior to the journal club (may be up to a week prior). Participants should agree to the time frame for prereading. In some curriculum-based situations, assessment of whether prereading has occurred may be appropriate
- Use the internet as a means of distributing articles prior to the meeting, maintaining journal club resources, and optimizing use of time and resources

Efficiently running the journal club
- Use established critical appraisal approaches and structured worksheets during the journal club session, which leads to healthy and productive discussion
- Formally conclude each journal club by putting the article in context of clinical practice

Journal club effectiveness
- Depending on the journal club purpose, it may be appropriate to evaluate knowledge uptake formally or informally
- Evaluation should specifically relate to the article(s) for discussion, critical appraisal, understanding of biostatistics reported in the paper, and translating evidence into practice

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(no subscription to *CJASN* was necessary). The *CJASN* eJC covered 48 articles and generated 434 comments over 4 years. Though the articles that were made free were widely downloaded, the interactive forum did not attract a dedicated or enthusiastic following. Many articles had no comments at all. The journal club's last article was December 2015 (D. Goldfarb, personal communication, April 2016).

Another approach to an online journal club is the Wiki Journal Club (WJC), which leverages the software that underlies Wikipedia to build an encyclopedia of high-impact clinical trials. WJC contributors collectively write summaries and critical appraisals of important trials. What differentiates this from the *KI* journal club or the Australian Society of Infectious Diseases' effort is that the process is open to any interested participant, and what ultimately gets published comes after a considered period of discussion. As of April 2015, WJC had reviewed 284 articles, 31 focused on nephrology, making WJC the most prolific online journal club in terms of volume.[20]

Though the use of online journal clubs has a checkered history, there is one domain in which they are flourishing: Twitter. Twitter is an open online

publishing platform on which users can post text, images, and links in 140-character posts. The posts are broadcast to anyone who chooses to "follow" the user. The Twitter "handle" refers to a user account and begins with an "@" symbol (eg, @NephJC is the handle of the nephrology journal club). A hashtag (pound) symbol followed by a string (eg, #NephJC) serves as a label or metadata tag to help users find messages with a particular theme. The first medical journal club connected to Twitter was conducted on December 11, 2008, by Dr Ves Dimov. In this instance, Twitter was used to publish notes and comments from a live in-person journal club at Creighton University's Division of Allergy and Immunology, thus extending a face-to-face journal club beyond the institution.[21]

The first journal club to use Twitter as the primary means of interaction was in 2011 when Drs Natalie Silvey and Fi Douglas started The Twitter Journal Club.[22] This was a general internal medicine journal club and it established a number of precedents for subsequent Twitter journal clubs. A week or so prior to the journal club, the organizers posted a summary of the article on a dedicated website. In order to be part of the conversation, each tweet needed to include the hashtag #TwitJC. Searching for the hashtag allowed participants to read everyone's comments on the discussion, regardless of whether one followed that individual. This hashtag system had previously been used for discussions around a topic. The Twitter Journal Club simply exploited an existing feature in an existing social network to achieve a workable facsimile of a face-to-face journal club. Following the discussion, the organizers posted a summary of the discussion to the journal club's website.

After the success of Twitter Journal Club, a number of specialty-specific journal clubs have emerged.[23] Roberts et al[24] did a systematic review of Twitter journal clubs. Of the 24 Twitter journal clubs analyzed, NephJC had the highest number of tweets and the greatest impressions per month, a reflection of the reach of the journal club (impressions are the number of tweets multiplied by number of followers of the tweet author).[24]

The NephJC Experience

Overview

The authors of this article are the principal organizers of the online nephrology journal club NephJC, for which all interactive discussions occur on Twitter. During the past 2.5 years, NephJC has evolved various practices to encourage attendance and interaction with the journal club. In the following section, we describe data on participation obtained from Symplur, which is a service that collects and makes available data on the participation rate and tweet statistics for any registered hashtag.[25]

Participation in NephJC Tweetchats

Since the inception of NephJC (April 2014) and as of November 2016, a total of 61 journal club discussions have been conducted. NephJC primarily reviews original clinical research but has committed to a wider scope to better reflect the diversity of documents that guide the field of nephrology forward (see Table 1 for details).

During this period, more than 2,500 unique twitter handles have used the #NephJC hashtag in 40,802 tweets.[25] In NephJC, a median of 61.6 (interquartile range [IQR], 41-78) individuals participate. Given the open nature of the tweetchat, the typical active chat participant is commonly a practicing nephrologist, but also includes residents and trainees, physicians from other specialties, other interested health care providers, and patients. The median number of

Table 1. Types of articles featured in NephJC discussions

Article Types	Features	Examples
Original clinical research	Most common type of discussion	Clinical research: trials, observational studies, meta-analyses
Biomedical research	Greater discussion of methods, author participation more common	Animal models of human disease
Book club	Multiple blog posts summarizing each chapter leading up to a tweet chat about the book	*Being Mortal* by Atul Gawande, *The Patient Will See You Now* by Eric Topol
Guidelines and reviews	Serve to discuss the strengths and weaknesses of a particular guideline and also as knowledge translation to make users aware and understand new guidelines	ACP Nephrolithiasis Guidelines; European Hyponatremia Guidelines, Extracorporeal Treatment In Poisoning (EXTRIP) guidelines
Special chats	Built around a special educational event	DreamRCT (an initiative to promote new trial ideas in nephrology), NephJC Live at Kidney Week 2014, Social Media in Medicine (Chisholm, 2015[33])

individual tweets at a particular NephJC session is 577 (IQR, 382.5-696.5). Additional data about chat participation grouped according to key select characteristics are presented in Tables 2 and 3. Nontraditional topics for a journal club, such as discussing a review paper, a clinical practice guideline, or a book club, also have been well received in terms of participation.

The NephJC Model

The cycle of events that mark each NephJC can be divided into 8 steps: (1) selecting an article (and corresponding with the journal editors to request the article be made freely available, if not already), (2) posting a summary of the article at NephJC.com, (3) inviting content experts and authors to participate, (4) e-mailing a newsletter promoting the event, (5) conducting chat 1 for the American audience at 9 PM Eastern Standard Time on a Tuesday; (6) conducting chat 2 for the Africa and Europe audiences at 8 PM Greenwich Mean Time on a Wednesday; (7) publishing an archive and a curated archive of the best tweets, and (8) posting a summary of the chats to PubMed Commons.

The Selection Committee

NephJC is conducted twice a month and has a work group that selects the articles, consisting of 15 nephrologists (including 1 pediatric nephrologist) from 5 countries. The work group selects high-impact and controversial articles, primarily in clinical nephrology, based on expert consensus. Other discussions are special events, as detailed in Table 1. Some articles have been selected by using online opinion polls in which respondents are offered a short list from which to choose. Relevant articles are selected not just from core nephrology journals, but general medical and other specialty journals as well (the latter are associated with higher participation; see Table 3).

Table 2. Details of NephJC Participation According to Type of Article Being Discussed

Type of Article	No. of Chats	Participants	Tweets
All	61	58 [41-78]	577 [382.5-696.5]
Original clinical research	47	58 [43-79]	577 [398-717]
Biomedical research	3	53 [38-60]	453 [276-677]
Book club	2	52.5 [44-61]	454.5 [445-464]
Guidelines	3	73 [38-148]	686 [340-1,090]
Reviews	3	39 [26-72]	641 [213-684]
Special chats	3	65 [44-126]	660 [252-1,005]

Note: Except where indicated, values are given as median [interquartile range].

The Summary

A week before each Tweet chat, a summary of the article is published to the NephJC website.[26] These summaries usually run 800 to 1,200 words. In addition to summarizing the article, these posts detail the background of the study, put it in context, and raise possible areas of discussion. These summaries also act as "homepages" for the chats. The homepage is used to post future updates, such as additional background material, editorials, archives, curated summaries, and reports on participation in the chat. Discussions that occur only in Twitter are fleeting and difficult to find. The web presence anchors the discussion so that it can be indexed and more easily found for future reference.

Invitation of Content Experts to Participate

Content experts and/or authors are invited to join the discussion. The presence of a content expert makes the journal club a richer educational experience. People with deep familiarity with the area being reviewed often make better observations, have greater insights into the mechanisms and pathophysiology, and stimulate a higher level of discussion. Authors join in just more than one-third of the chats.[27] The presence of an author is associated with numerically higher participation rates and a greater number of tweets (Table 3).

E-Mail Newsletter

NephJC has a weekly e-mail that is delivered to individuals who have requested it. Currently, the e-mail is sent to 671 e-mail accounts once a week. The e-mail promotes the upcoming journal clubs, summarizes the previous chats, and publicizes other nephrology events.

The Chat

The chat is the central activity of the journal club. NephJC is a synchronous chat, in which people meet to discuss the article at one time. This allows a real-time back and forth conversation much more like a face-to-face meeting (Fig 1). In contrast, several other journal clubs do asynchronous chats, in which people are instructed to discuss an article over a multiday period. An example of this is the Urology Journal Club (@IUJC, #urojc). Their discussion begins on Sunday and runs until Wednesday of the same week.[28] The synchronous model of NephJC generates more tweets per participant, but can exclude people from time zones that do not line up with a convenient time. The NephJC chat lasts 1 hour.

For the first 8 months of NephJC, a single chat per article was the norm. However, the timing of this chat, 9 PM Eastern, corresponds to 2 AM in London. This inconvenient time for people in Europe

Table 3. Details About Participation at NephJC Twitter Chats Based on Certain Key Characteristics

Characteristics	No. of Chats	Participants	Tweets
Second (European) chat			
Yes	44	65 [50.5-83.25]	641 [532.75-726.5]
No	17	32 [24-41.5]	270 [235.5-333.5]
Presence of author			
Yes	25	65 [50-80]	641 [517-714.5]
No	36	50 [38-75]	466.5 [281.75-655.5]
Topic type			
Core nephrology topic	40	54 [40-75.75]	591 [374.75-672.75]
Involvement of other specialties	21	65 [41.5-80]	540 [386-759.5]
Journal type			
General medical	29	58 [41-78]	565 [362.5-719]
Nephrology	20	50 [38.25-94.25]	591 [346.75-655.25]
Other specialty	8	64 [54.75-80.75]	692 [500.25-726.5]

Note: Except where indicated, values are given as median [interquartile range].

stimulated demand for a second NephJC chat to better serve Africa and Europe. This chat runs Wednesdays at 8 PM (Greenwich Mean Time). Conveniently, this corresponds to noon on the West Coast of the United States, and some individuals participate from there. The addition of the second chat has increased individual participation rates (Table 3 and Fig 2).

Archives

After the chat, 2 archives of the proceedings are made available on the NephJC website. One is an archive of every tweet that incorporates the tag #NephJC. This archive is produced by Symplur (www.symplur.com), a company that provides Twitter analytics and tracks health-related hashtags. The second archive is a curated archive that includes selected tweets, along with some article links, pictures, and other important information. The curation allows the tweets to be reordered so it is easier to read through them. Related conversations are kept together, and low-value tweets are dropped. The curated digest is created with a free online tool called Storify and is posted on the NephJC website, as well as being available on the NephJC Storify website.[29]

PubMed Commons

The National Library of Medicine started PubMed Commons in December 2013 to allow any individual who has authored an article indexed in PubMed to nonanonymously comment on any article. A major impetus for PubMed Commons is promoting and documenting postpublication peer review.[30] Recognizing that journal clubs are a form of postpublication peer review, the National Library of Medicine has provided commenting privileges to NephJC, among other online journal clubs.[31,32] The NephJC work group composes a short summary of the NephJC discussion with links to the full and curated archives for all of the tweet chats and posts them as comments on the article's record in the index. This is similar to links to letters about the article that are found on the parent article listing.

Summing Up the NephJC Experience

The 8 steps highlighted in the previous sections are repeated twice a month and form the core of NephJC. There are other ways to organize a Twitter journal club, but the choices the NephJC work group made were intended to help build a robust, academically minded nephrology community on Twitter. To this goal, both the newsletter and the website are particularly important. The newsletter extends the reach of NephJC beyond people already engaged with social media. The website provides permanence in a social media world that is defined by a short shelf-life. Moreover, the NephJC website provides a location for people to reference the chat in the future. For example, in the comments on PubMed Commons, NephJC links to the website rather than individual tweets. Another factor in the success of NephJC is the large number of people on the work group. Many online journal clubs have had a short lifespan. For example, the original Twitter journal club innovator, TwitJC, is no longer active. The NephJC work group has 15 people and is growing to keep the workload sustainable.

Challenges Facing Online Journal Clubs

As can be seen from the preceding discussion, the coordination and execution of a journal club

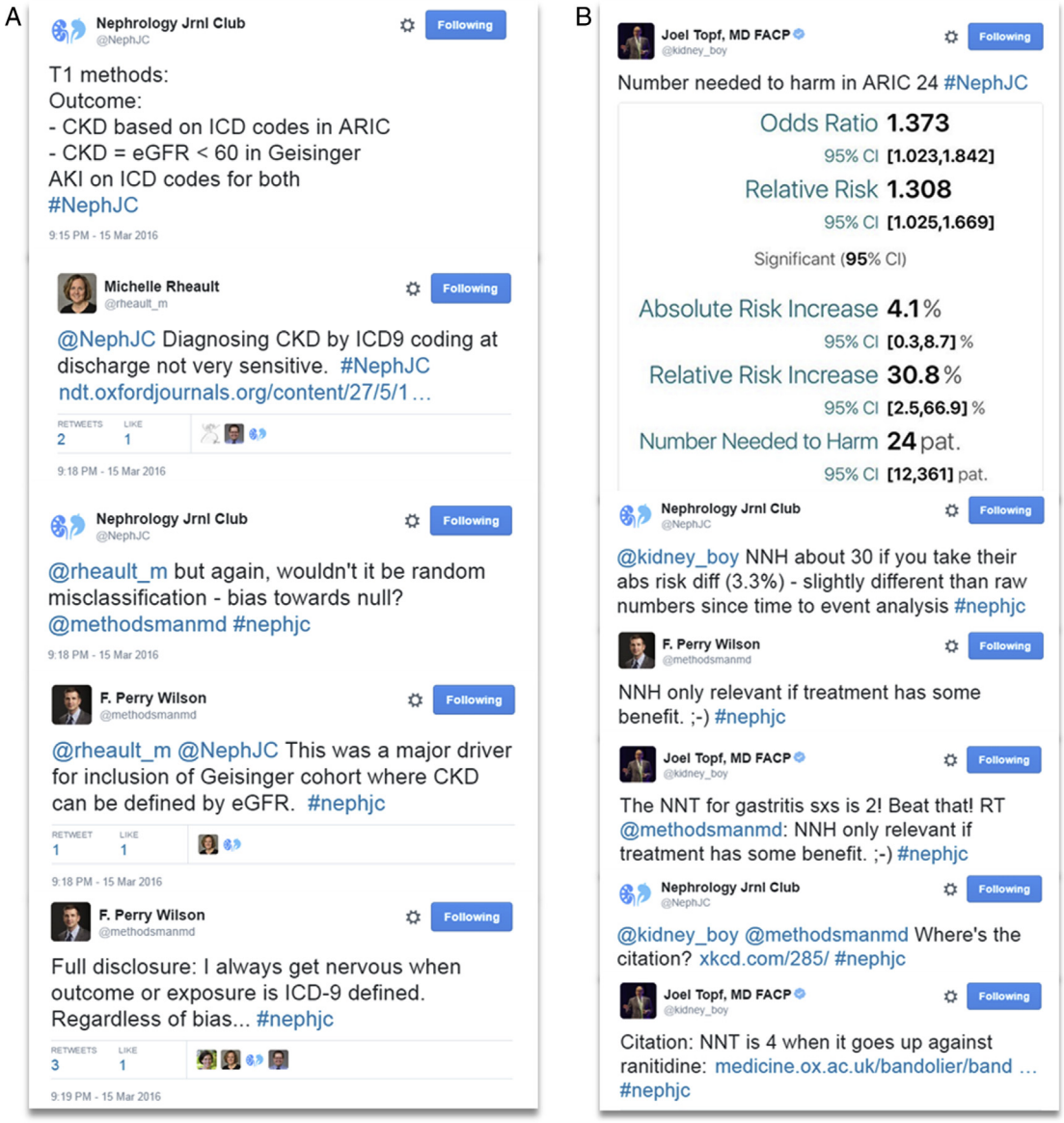

Figure 1. Examples of the back and forth conversation that drives the journal club. (A) Tweets include the moderator/host introducing the methods, a participant raising a point about a weakness in methodology, a reply from moderator, inviting comment from the author (Perry Wilson), who provides clarification. (B) Tweets include a participant calculating number needed to harm (NNH) and tweeting a picture to show the calculation, the moderator offering a clarification to correct the calculation, the author making the argument that the NNH is redundant because the medication (in this case proton pump inhibitors) is perhaps of no benefit (a smiley indicates this was made in jest), a reply to refute the author's assertion, a request from the moderator for a reference to back up the assertion, and a citation provided in response.

requires a fair amount of work. Therefore, it is not surprising to note the attrition rate of online journal clubs.[23] Additionally, the timing of the live chat, usually in the evening after work hours, may make it more convenient for some but may intrude on family time for others. Most importantly, this form of a journal club is primarily useful for those who are already using social media. Advantages of social media–based journal clubs are that they allow individuals outside academia and formal training programs to connect and learn. Social media–based medical education may have an important role in meeting the needs of ongoing lifelong learning. NephJC has explored offering continued medical education (CME) credits, though this may require funding and increase the workload, particularly if the CME needed to be offered for multiple countries.

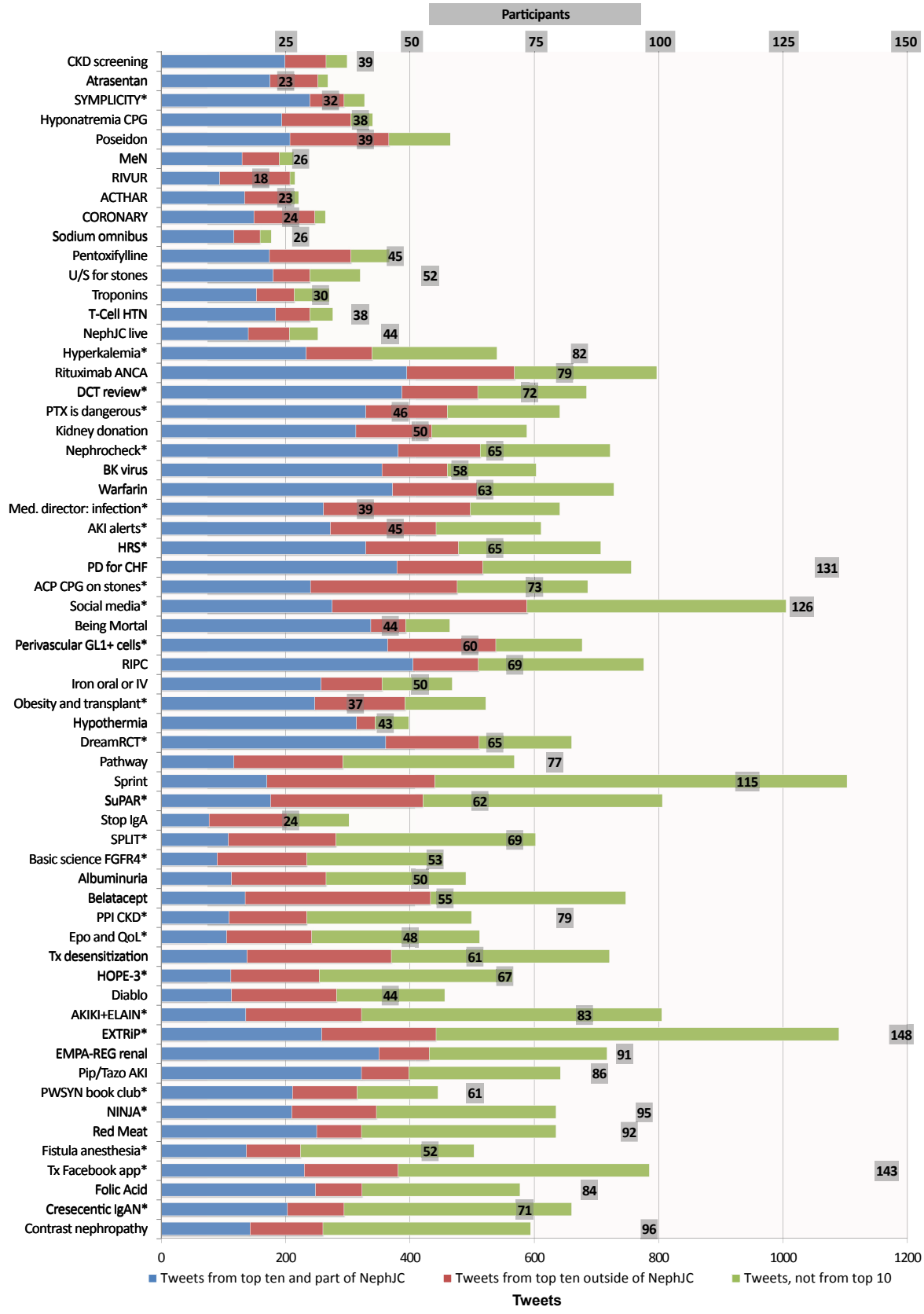

Figure 2. Graph of tweets and participation in NephJC through November 2, 2016. Top axis refers to number of participants (points are gray boxes with actual value listed inside). Stacked bar graph refers to tweets, with subgroups based on color (see legend at bottom). An asterisk after the NephJC topic name denotes chats that had author participation. The second (European) chats started as of the "Rituximab ANCA" NephJC.

Conclusions

There are many advantages to an online journal club that can facilitate ongoing medical education by allowing participants to be exposed to opinions from outside their own practice environment. In addition, online journal clubs allow for participation by experts in the topic at hand, frequently including the author, to provide insight into the article discussed that may not have otherwise been apparent. The informal nature of social media pairs well with a journal club that thrives in a casual environment. It is more than just a coincidence that journal clubs have thrived on social media compared with other online systems.

The journal club is approaching 200 years of age. It is a durable component of medical education because it has been able to adapt to serve different purposes and use different technologies. Today, the journal club is adapting to social media with some success. By freeing the journal club from the academic teaching center, the online journal club can be used by physicians in diverse locations to keep abreast of medical advancements.

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