

The Evolution of the Journal Club: From Osler to Twitter

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Abstract

Journal clubs typically have been held within the walls of academic institutions, and in medicine have served the dual purpose of helping foster critical appraisal of literature and disseminate 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 deploying an online nephrology journal club based on twitter, NephJC.

Keywords: journal club; twitter; medical education; social media

Introduction

Journal clubs are widely used in medical education in part because they are so versatile. They aid in teaching the systematic evaluation and interpretation of the published literature and are a means to share the latest advances in medicine. The journal club is approaching 200 years of age, however, it continues to evolve to solve new problems and employ new technologies¹⁻³. The latest example of this is journal clubs using social media to discuss and debate the published literature. 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 of St Bartholomew’s Hospital in London from 1835-1854 where physicians socialized and read journals¹. However, it is William Osler who is credited with creating the modern journal club while at McGill University, Montreal in 1875. Osler encouraged collective reading of subscription journals in order to spread the prohibitively high cost of print periodicals¹. 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 twentieth century most departments in Hopkins were hosting their own monthly

journal clubs. These specialty specific journal clubs were typically held in the homes of participating physicians⁴. 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 critique⁵.

Mattingly reported the first peer-reviewed paper primarily about journal clubs in 1966⁶. He described the popularity of journal clubs “in the United States, where they are a regular and often compulsory feature of hospital life.”⁶ By the 1980s, a survey of internal medicine residency programs in New York demonstrated that 85% included a journal club⁷. Mattingly defined a journal club as “a group of doctors meeting regularly to discuss papers of interest in the current medical journals.”⁶ He added that though 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 The key was an engaged rather than passive audience⁶. 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 dialog to generate fulfilling two-way interactions. He thought that journal clubs should have no fewer than six participants and no more than twelve. 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}. Since 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* of the 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 adopted 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 frameworks (MAARIE framework) ¹². Gehlbach, et al. promoted the use of a formal 8 week evidence based medicine (EBM) curricula conducted in parallel with a journal club¹³. Linzer tested the ability of a journal club to improve EBM 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 EBM ¹⁴. Deenadayalan et al. 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 this data to establish a set of best practices for journal clubs¹⁵ (See box 1). Similarly, another systematic review, including 16 studies, reported an improvement in reading habits and critical appraisal skills in the attendees¹⁶.

From the classroom to the laptop

A number of factors contributed to the journal club transitioning from face-to-face interaction to online interaction:

1. The conversational nature of journal clubs allowed for the incorporation of existing online platforms such as Twitter, which were designed for conversational interaction, to facilitate rapid, real-time, dialog between learners.
2. Online tools allowed for learners from different locations to join in a virtual round table discussion. This is important for physicians who have graduated training and are no longer in academic medical centers.
3. Online journal clubs allow a variety of physicians, ancillary providers, patient advocates, authors, and content experts to participate.
4. An online presence allows flexibility in the time of the event.

The online journal club has gone through a number of iterations. Early online journal clubs were lacking the important interactive quality. *Kidney International* (KI) was among the first to form an online journal club, and it is still in use today. It consists of a series of expert summaries of selected articles from other journals¹⁷. 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. Lastly, the article specifies what this study adds to the established literature. Though these essays are called 'journal clubs' they lack any two-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 who 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 two-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 of 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 (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 didn't attract a dedicated or enthusiastic following. Many article had no comments at all. The journal club's last article was December 2015. (D. Goldfarb, Personal communication, April 4, 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 time 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 volume²⁰.

Though the use of online journal clubs has a checkered history, there is one domain in which they are flourishing, Twitter. Twitter is a open online publishing platform where users can post text, images, and links in small 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 (or 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 with any connection 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 Immunology²¹. This was the first documented use of Twitter in a journal club, but it may be more accurately described as using Twitter to extend a face-to-face journal club beyond the institution. 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 Club²². It 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 comment on the discussion, whether one followed that individual or not. 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. Following the success of Twitter Journal Club a number of other specialty specific journal clubs have emerged (table 1). Roberts et al. 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 is number of tweets multiplied by number of followers of the tweet author)²³.

The NephJC Experience

The authors of this article are the principal organizers of the online nephrology journal club, NephJC. All of the interactive discussions occur on Twitter. Over the past two and a half 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 participation rate and tweet statistics for any registered hashtag²⁴.

Participation in NephJC journal club tweetchats

Since the inception of NephJC (April 2014), 61 journal club discussions have been conducted (through November 2nd 2016). 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 forwards (see table 2 for details).

During this period, over 2,500 unique twitter handles have used the #NephJC hashtag in 40,802 tweets ²⁴. The median number of participants in a NephJC journal club is 61.6 (interquartile range, IQR, 41, 78). 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 healthcare providers, and patients. The median number of 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 3 and 4. Non-traditional topics for a journal club, such as discussing a review paper, a clinical practice guideline or a book club, also has 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
2. Summary of the article at NephJC.com

3. Invite content experts and authors. Correspond with the journal editors to request the article be made open access, if not already
4. Email newsletter
5. Chat one on Tuesday for the Americas at 9 PM Eastern Standard Time
6. Chat two on Wednesday for Africa and Europe at 8 PM Greenwich Mean Time
7. Publish an archive and a curated archive of the best tweets
8. Summary of the chats published to PubMed Commons

The selection committee

NephJC is conducted twice a month and has a work group that select the articles, consisting of fifteen nephrologists (including one pediatric nephrologist) from five 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 3. Some articles have been selected by using online opinion polls, by providing a short list to choose from. Relevant articles are selected not just from core nephrology journals, but general medical and other specialty journals as well, and the latter are associated with higher participation (see table 4).

The summary

A week before each Tweet chat a summary of the article is published to the NephJC website²⁵. These summaries usually run 800 to 1,200 words. In addition to summarizing the article, these posts detail the background of the study to put it in context and raise possible areas of discussion. These summaries also act as 'homepages' for the chats. This homepage is used to post future updates such as further background posts, editorials, archives, curated summaries, and reports on the participation in the chat.

Discussions that occur only in Twitter are fleeting and difficult to find in the future. The web presence anchors the discussion so that it can be indexed and more easily found for future reference.

Email newsletter

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

Invitation

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 under question often make better observations, have greater insights into the mechanisms and pathophysiology, and stimulate a higher level of discussion. Authors join in just over one third of the chats ²⁶. The presence of an author is associated with numerically higher participation rates and greater number of tweets (see table 4).

Chat 1

The chat is the central activity of the journal club. NephJC is a *synchronous chat* where 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. In contrast, several other journal clubs do *asynchronous* chats where people are instructed to discuss an article over a multi-day period. An example of this is the Urology Journal Club (@IUJC, #urojc). Their

discussion begins on Sunday and runs until Wednesday of the same week²⁷. 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 itself lasts one hour.

Chat 2

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 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 US and some individuals participate from there. The addition of the second chat has increased individual participation rates (see table 4).

Archives

After the chat, two 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 (<http://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 website²⁸

PubMed Commons

The National Library of Medicine (NLM) started PubMed Commons in December 2013 (The NCBI Staff, 2013). This allows any individual who has authored an article indexed in PubMed to non-anonymously comment on any article. A major impetus for PubMed Commons is promoting and documenting post publication peer review²⁹. Recognizing that journal clubs are a form of post-publication peer review, the NLM has provided commenting privileges to NephJC, among other online journal clubs^{30 31}. 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 articles' listing in the index. This is similar to links to letters about the article that are found on the parent article listing.

The eight steps highlighted above 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 (see table 1). 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

As can be seen above, the coordination and execution of an journal club requires a fair amount of work. Therefore, it is not surprising to note the attrition rate of active online journal clubs (see table 1 for examples). 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 already using social media. Advantages of social media based journal clubs is 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 needs of ongoing lifelong learning. NephJC has explored offering continued medical education (CME) credits. However this may require funding and would increase the workload, particularly if the CME needed to be offered for multiple countries.

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 of their own practice environment. In addition, online journal clubs allow for participation by experts in the topic at hand, frequently including author participation, 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 an informal environment. It is more than just a coincidence that journal clubs have thrived on social media compared to 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 doctors after graduation to keep abreast of medical advancements.

Figure legends

Figure 1: Examples of the back and forth conversation that drives the journal club.

1a A. Moderator/Host introducing the methods. B. Point raised about weakness in methodology. C. Reply from moderator, and inviting comment from author, Perry Wilson. D and E. Clarification from author

1b A. Participant calculating number needed to harm (NNH), and tweeting picture to show calculation. B. Clarification from moderator about correct calculation. C. Comment from author, arguing NNH redundant since medicine (in this case proton pump inhibitors) perhaps of no benefit. Smiley indicates this was made in jest. D. Reply to refute the authors assertion. E. Moderator asks for reference to back up the assertion above. F. Citation provided in response.

Figure 2: Graphical representation of tweets and participation in NephJC till Nov 2 2016. Line refers to number of participants (axis label on right side). Bar graph refers to participants: overall with subgroups based on color. The typewriter symbol refers to chats where there was author participation. The additional European chat started with chat labelled 'Rituximab ANCA'.

Box 1: Characteristics of a sustainable and effective journal club (from Deendayalan et al, used with permission)

Journal club attendance

- Establish a journal club group of members of the same discipline, or 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 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 as well as 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 towards its goals
- The leader can change from meeting to meeting, however he/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 pre-reading at a suitable time period prior to the journal club (may be up to a week prior). Participants should agree to the time frame for pre-reading. In some curriculum-based situations, assessment of whether pre-reading 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.

Table 1: A list of online, twitter-based medical journal clubs

Name	Date started	Twitter ID	Hashtag	Active/ Inactive (mm/yy)
Twitter Journal Club	May 2011	@twitjournalclub	#twitjc	Inactive (12/13)
Public Health Twitter Journal Club	August 2011	@PHTwitJC	#PHTwitJC	Inactive (8/13)
British Journal of Obstetrics and Gynaecology Journal Club	May 2012	@BlueJCHost	#bluejc	Active
Microbiology Twitter Journal Club	May 2012	@microtwjc	#microtwjc	Inactive (1/16)
St Emyr's Journal Club	October 2012	@JC_StE	#JC_StE	Inactive (9/14)
Urology Journal Club	November 2012	@iurojc	#urojc	Active
Evidence Based Nursing	January 2013	@EBNursingBMJ	#ebnjc	Active

Twitter Journal Club				
Hospice and Palliative Care medicine	February 2013	@hpmjc	#hpmjc	Active
Respiratory and Sleep Medicine Journal Club	October 2013	@respandsleepjc	#rsjc	Active
Academic Life in Emergency Medicine Journal Club	November 2013	@M_Lin	#ALiEMJC	Inactive (3/15)
General Surgery Journal Club	February 2014	@igsjc	#igsjc	Inactive (2/16)
Primary Care Medicine Journal Club	February 2014	@pcmjc	#pcmjc	Inactive (3/14)
Allergy Journal Club	March 2014	@allergyjc	#allergyjc	Inactive (3/14)
Nephrology Journal Club	April 2014	@nephjc	#nephjc	Active
Radiation Oncology	August 2014	@rad_nation	#radonc	Active
Geriatric Medicine Journal Club	August 2014	@GeriMedJC	#GeriMedJC	Active
International Psychiatric Journal Club	December 2014	@PsychiatryJC	#PsychJC	Inactive (6/15)
Duke Anesthesiology Journal Club	January 2015	@Duke_Anesthesia	#AnesJC	Active

Rheumatology Journal Club	February 2015	@RheumJC	#RheumJC	Active
Amyloidosis Journal Club	October 2015	@Amyloid_Planet	#amyloidosisJC	Inactive (3/16)
GIM Journal Club (General Internal Medicine)	December 2015	@GIMJClub	#GenMedJC	Active
General Practice Journal Club	January 2016	@GPjournalclub	#GPJC	Active
Pathology Journal Club	June 2016	@Path_JC	#PathJC	Active
Family Medicine Online Journal Club	August 2016	@familymedjc	#familymedjc	Active
International Pediatric Nephrology Journal Club	November 2016	@IPNA_PedNeph	#IPNAJJC	Active

Source: Wikipedia article on twitter based journal clubs ³²Last date of activity verified with hashtag on twitter on Nov 10 2016. Inactive journal clubs have last month of activity presented in parenthesis in month/year format

Table 2: Types of articles featured in NephJC discussions

Article types	Features	Examples
Original Clinical Research	Standard, most common version	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	These 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	DreamRCT, NephJC live,

	educational event (eg KidneyWk 2014 and NephJC Live; the DreamRCT initiative to promote new trial ideas in Nephrology)	Social Media in Medicine (Chisholm, 2015)
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Table 3: Details of NephJC journal club participation according to type of article being discussed

Type of Article	N	Participants (median, interquartile range)	Tweets(median, interquartile range)
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, 1090)
Reviews	3	39 (26, 72)	641 (213, 684)
Special Chats	3	65 (44, 126)	660 (252, 1005)

Table 4: Details about participation at NephJC journal club twitter chats based on certain key characteristics

Characteristics	N	Participants(median, interquartile range)	Tweets(median, interquartile range)
American chat alone	17	32 (24, 41.5)	270 (235.5, 333.5)
American + EU chats	44	65 (50.5, 83.25)	641 (532.75, 726.5)
Presence of Author	25	65 (50, 80)	641 (517, 714.5)
Absence of Author	36	50 (38, 75)	466.5 (281.75, 655.5)
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)

General Medical Journals	29	58 (41, 78)	565 (362.5, 719)
Nephrology Journals	20	50 (38.25, 94.25)	591 (346.75, 655.25)
Other specialty journals	8	64 (54.75, 80.75)	692 (500.25, 726.5)

References

1. Linzer M. The journal club and medical education: over one hundred years of unrecorded history. *Postgrad Med J* 1987;63(740):475-8.
2. Palan J, Roberts V, Bloch B, Kulkarni A, Bhowal B, Dias J. The use of a virtual learning environment in promoting virtual journal clubs and case-based discussions in trauma and orthopaedic postgraduate medical education: the Leicester experience. *J Bone Joint Surg Br* 2012;94(9):1170-5.
3. Sortedahl C. Effect of online journal club on evidence-based practice knowledge, intent, and utilization in school nurses. *Worldviews Evid Based Nurs* 2012;9(2):117-25.
4. Chesney AM. The contribution of the University of Maryland School of Medicine to the initial development of the Johns Hopkins Hospital and the Johns Hopkins University School of Medicine. *Bull Sch Med Univ Md* 1957;42(5):86-91.
5. Pittman J. Tinsley Randolph Harrison - The founding editor of Harrison's Principles of Internal Medicine, 2011. Webpage url: <http://www.doctorshangout.com/profiles/blogs/tinsley-randolph-harrison-the-founding-editor-harrisons-principle> Accessed on Nov 24, 2016
6. Mattingly D. Proceedings of the conference on the postgraduate medical centre. Journal clubs. *Postgrad Med J* 1966;42(484):120.
7. Linzer M, Mercado A, Hupart KH. Role of a medical journal club in residency training. *J Med Educ* 1986;61(6):471-3.
8. Lonsdale A, Sietsma Penington J, Rice T, Walker M, Dashnow H. Ten Simple Rules for a Bioinformatics Journal Club. *PLoS Comput Biol* 2016;12(1):e1004526.
9. Spillane AJ, Crowe PJ. The role of the journal club in surgical training. *Aust N Z J Surg* 1998;68(4):288-91.
10. Ahmadi N, McKenzie ME, Maclean A, Brown CJ, Mastracci T, McLeod RS. Teaching evidence based medicine to surgery residents-is journal club the best format? A systematic review of the literature. *J Surg Educ* 2012;69(1):91-100.
11. Shifflette V, Mitchell C, Mangram A, Dunn E. Current approaches to journal club by general surgery programs within the Southwestern surgical congress. *J Surg Educ* 2012;69(2):162-6.

12. Corcoran M. Using the MAARIE framework to read the research literature. *Am J Occup Ther* 2006;60(4):367-8.
13. Gehlbach SH, Bobula JA, Dickinson JC. Teaching residents to read the medical literature. *J Med Educ* 1980;55(4):362-5.
14. Linzer M, Brown JT, Frazier LM, DeLong ER, Siegel WC. Impact of a medical journal club on house-staff reading habits, knowledge, and critical appraisal skills. A randomized control trial. *JAMA* 1988;260(17):2537-41.
15. Deenadayalan Y, Grimmer-Somers K, Prior M, Kumar S. How to run an effective journal club: a systematic review. *J Eval Clin Pract* 2008;14(5):898-911.
16. Honey CP, Baker JA. Exploring the impact of journal clubs: a systematic review. *Nurse Educ Today* 2011;31(8):825-31.
17. De Broe M. Journal club. Methylation determines fibroblast activation and fibrogenesis in the kidney. *Kidney Int* 2010;78(5):430.
18. Bowen AC, Connell TG, Bryant PA. Evaluating a web-based paediatric infectious diseases journal club: more than just critical appraisal? *BMC Med Educ* 2014;14:242.
19. Goldfarb DS, Curhan GC. A new CJASN feature: CJASN's eJournal Club (eJC). *Clin J Am Soc Nephrol* 2012;7(1):2.
20. Plante TB, Iberri DJ, Coderre EL. Building a Modern Journal Club: The Wiki Journal Club Experience. *J Grad Med Educ* 2015;7(3):341-3.
21. The Utility of a Real-time Microblogging Service for Journal Club in Allergy and Immunology. *Annals Of Allergy Asthma & Immunology*; 2009. Amer Coll Allergy Asthma Immunology 85 West Algonquin Rd Suite 550, Arlington Hts, IL 60005 Usa.
22. Reich ES. Researchers tweet technical talk. *Nature* 2011;474(7352):431.
23. Roberts MJ, Perera M, Lawrentschuk N, Romanic D, Papa N, Bolton D. Globalization of continuing professional development by journal clubs via microblogging: a systematic review. *J Med Internet Res* 2015;17(4):e103.
24. Symplur Analytics. NephJC Analytics from Symplur Healthcare Hashtags Project. *Symplur Healthcare Hashtags Project*, 2016. Webpage url: <http://www.symplur.com/healthcare-hashtags/NephJC/> Accessed on Nov 24, 2016
25. Topf J, Hiremath S. The NephJC Homepage, 2016. Webpage url: <http://www.nephjc.com/> Accessed on Nov 24, 2016
26. Participation in the Open, Online, Twitter-Based, Nephrology Journal Club, #NephJC. American Society of Nephrology; 2015; San Diego. American Society of Nephrology.
27. Thangasamy IA, Leveridge M, Davies BJ, Finelli A, Stork B, Woo HH. International Urology Journal Club via Twitter: 12-month experience. *Eur Urol* 2014;66(1):112-7.
28. Madariaga H, Hiremath S, Topf J. Nephrology Journal Club's Social Stories, 2016. Webpage url: <https://storify.com/NephJC/> accessed on Nov 24, 2016
29. Slavov N. Making the most of peer review. *Elife* 2015;4.
30. Hiremath S. NephJC: Nephrology Journal Club: National Library of Medicine, 2015. Webpage url: <https://www.ncbi.nlm.nih.gov/myncbi/nephjc%20-%20nephrology.journal%20club.1/profile> Accessed on Nov 24, 2016
31. NCBI Staff. Meet PubMed Commons: The new comments forum in PubMed: National Library of Medicine, 2013. Webpage url: <https://pubmedcommonsblog.ncbi.nlm.nih.gov/2013/12/19/meet-pubmed-commons-the-new-comments-forum-in-pubmed/> Accessed on Nov 24, 2016
32. Wikipedia. Journal Club, 2016. Webpage url: https://en.wikipedia.org/wiki/Journal_club accessed on Nov 22, 2016