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Title: Tweetchats, disseminating information and sparking further scientific discussion with social media.

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Tweetchats and *tweetorials* can provide a wider forum for scholarly discussion than in-person journal clubs or printed commentaries. But, social media can distort conversations, selectively amplifying comments that curry favor rather than substantive ones. In 280 characters it is easier to “virtue signal” than communicate a complex or subtle thought. Curating *tweetchats* and *tweetorials* (collectively *tweet threads*) as well as linking these social media threads to primary sources provides an antidote to this distortion and leaves us with Twitter as a written record of discourse that is usually not written down. *Tweet threads* do not replace thoughtful detailed analysis. They do record the integration of new research findings into received medical knowledge.

Tweetchats and *tweetorials* are two ways of grouping tweets on Twitter. A *tweetchat* is a scheduled multi-person Twitter chats centered on specific topics. A *tweetorial* is a collection of thematically related tweets. The distinction between *tweetchats* and *tweetorials* is blurry and I refer to both of them as *tweet threads*. Tweets for a *tweetorial* may be grouped together by using a hashtag, just like tweets for a *tweetchat*, or each tweet in a *tweetorial* may be a reply to an earlier tweet. *Tweet threads* can draw attention to scholarly work that might otherwise be missed or lost in the deluge of daily publications. Anyone with access to Twitter can view the discussion in real time and (re)visit the thread later. Residencies in psychiatry[1], surgery[2,3], infectious disease[4], and emergency medicine[5] have used *tweetchats* and *tweetorials* to create asynchronous journal clubs.

Over the last two years, the American College of Medical Toxicology (ACMT) and editorial board of the *Journal of Medical Toxicology (JMT)* conducted quarterly *tweetchats* (#firesidetox) to discuss manuscripts published in *JMT*. For two most recent *firesidetox* chats, *JMT* collaborated with its publisher Springer Nature, to make the featured articles freely available via SharedIt for the week before and week after the *tweetchat*. These two *tweetchats* involved 23 and 26 accounts (more than one person can use the same account simultaneously), from the United States, Australia, Poland, and Qatar, and spanned 150 tweets [6].

Tweet threads harken back when scientific communications were letters among colleagues. History does indeed rhyme. Tweets, however, are shorter than letters. Each tweet can only be 280 characters, favoring succinct, perhaps simplistic statements that are easily read on a mobile device [7]. These quips may capture important criticism, support, or background information for manuscripts. Reading these tweets does not replace reading the full manuscript.

Alternative metrics (Altmetrics), such as the number of tweets, are designed to assess the impact of scholarly work via social media, which the canonical metric of article citations overlooks [13]. Altmetrics include counts of web page views, PDF downloads, comments posted on the journal web site, blogs, or web sites such as Wikipedia, Twitter, Facebook, ResearchGate, Academic as well as saves to online citation managers such as Mendeley, Zotero, CitULike. Some alternative metrics, like retweets, favor quantity and immediate activity over quality.

Twitter-based altmetrics (number of retweets, likes, or comments a post receives) can bias which tweets drive a conversation. Three quick tweets, each one a smiley face, count three times as much as one thoughtful tweet. Participants remain invisible unless they retweet, like,

or post a comment. Each post becomes a race for likes, retweets, or virtue signaling at the expense of critical thought or reflection [15]. This can encourage gamesmanship and sensationalism at the expense of reasoned debate [16]. The spread of “fake news” demonstrates the difficulty in verifying complex statements in real time and the lingering effect that even debunked tweets can have.

How much altmetrics and journal citations measure the same type of impact is an open issue. Journals that have their own Twitter account obtain more tweets but not more citations than journals without a dedicated account[8]. For the *Journal of Medical Internet Research*, the number of tweets predicts the number of citations in the first three days after publication[9], even though many of these tweets were duplicates or created by automated accounts (*bots*). The number of tweets an ecology article receives predicts the number of citations it will receive more accurately than the 5-year impact factor of the journal in which it was published[10]. But, there is no relationship between highly cited and highly tweeted articles in biology[11] or public health[12].

Alternative metrics can provide a fuller view of a researcher’s impact by including information distinct from citations. GitHub and Bitbucket are online repositories where computational researchers post source code. For each project GitHub tracks how many people have used the source code in another project, how many people have commented on the code, and how many people are watching the evolution of the repository. These metrics motivate computational researchers to be more transparent. I am more likely to cite the paper of someone whose code I can see, understand, and extend.

Activity on Twitter is, nevertheless, more used and more generally applicable than niche measures that track software use. The challenge for the academic physician is to use Twitter to articulate a pointer to a more articulate thought. Commenting with images or short movies gets around the information ceiling of 280 characters, even if images shape our perception in other ways. Images can powerfully convey an impression and avoid the temptation to argue fine points with out-of-context quotes. Linking to primary material and other web discussions may prevent the tweetchat or tweetorial from becoming an echo chamber. Web sites, such as StackExchange, Reddit, or ResearchGate host discussions on scientific topics, but usually not specific papers. ArXiv and BiorXiv are publicly accessible servers to which researchers can upload preliminary drafts of manuscripts (not peer-reviewed, not copy-edited) to share. Tox and the Hound, EM:RAP and many #FOAM (free open-access medical education) blogs provide longer form audio and written tutorials.

Academic physicians should recognize the limited role that activity on social media currently plays in promotion along the tenure track-- moving from instructor to assistant professor to associate professor to full professor-- and balance their engagement with social media accordingly. The most accepted metrics for scholarly impact are the number of publications or grants, not retweets or followers. Universities might consider activity on social media more in their decisions to promote a physician along the tenure track if research demonstrates that activity on social media improves unequivocal measures of scholarship. Some academic

institutions have guidelines for assessing the scholarly value of activity on social media for promotion [14].

Curating tweet threads could have scholarly value[17], producing a guided digest similar to Cosma Shalizi's online notebooks. Curating a tweet refers to responding to that tweet, after the tweetorial or tweetchat has finished, with a tweet that clarifies, provides, or links to more detail. Curating tweets gives a remedy against the necessarily incomplete nature of the immediate response and provides a means to periodically refresh the link between Twitter and in-real-life discussions.

Twitter may also have scholarly value as a conduit for knowledge transfer. Consider organizing threads around #acmt2020, #acep2020, or #choosingwisely. Polls could be embedded within tweetorials or tweetchats to assess comprehension or how likely the reader is to change his or her practice. These polls could operate longitudinally with minimal effort, potentially reaching a larger audience than traditional approaches. The engagement with ACMT's tweetchats (n=23, 26), even though they were only open for 90 minutes, suggest that barriers to realizing a larger sample size still exist.

Participants in tweetchats must be mindful of institutional policies on social media. Tweets are publicly available by default. There is a risk of inadvertently disclosing protected health information while discussing rare exposures. Fear of this risk should not halt discussion. One should follow journal and institutional standards for deidentification. Perhaps the patients or those who make health care decisions for the patient could be invited to join, turning concern over privacy and the public-facing nature of these discussions into a strength rather than a liability. Tweetchats on suicide prevention[18] and breast cancer patient education[19] included the public, clinicians, and scientists, although neither tweetchat discussed a specific case.

Tweeting by medical toxicologists can extend the traditional means of discussing and disseminating scholarly work. Tweet threads can embed graphics and polls to allow deeper discussion and ascertain impact. Curating tweet threads can stem Twitter's tendency to amplify clickbait. Academic physicians should recognize that some but not all appointments and promotions committees universities consider social media activity alongside accepted measures of scholarship (grants, publications). Communication on social media should be done mindful of but not fearful of institutional policies. Activity on social media should be a means to the end of creating impressions and linking discussions for academic physicians.

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