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ORIGINAL ARTICLE

Following the crowd: patterns of crowdsourcing on Twitter among urologists

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Abstract

Purpose To examine patterns of crowdsourcing on the social media platform Twitter among urologists.

Methods Urologists' public Twitter accounts were reviewed for original posts seeking clinical advice or feedback, and associated reply posts, before and after the 140-character-limit expansion in 2017. Predictors of responses to crowdsourcing requests were determined using multivariable regression. When patient data were posted, we noted whether consent was documented.

Results A total of 276 posts in 23 crowdsourcing requests prior to character-limit expansion were analyzed. Reasons for crowdsourcing included requesting solutions to a clinical dilemma (82 posts, 30%); advice seeking about a surgical plan (77 posts, 28%); surveying colleagues' experiences with a new product (64 posts, 23%); and soliciting feedback about a proposed course of action (53 posts, 19%). Recent completion of training (as a proxy for inexperience) did not appear to disproportionately motivate crowdsourcing; authors' median time in practice was 7 years, and authors practicing for ≤ 7 years initiated 57% of requests. 22 (96%) crowdsourcing requests received ≥ 1 reply. Of 15 requests about a specific patient, eight included imaging, but only one cited patient consent. A second analysis of 184 posts in 17 crowdsourcing requests initiated after character-limit expansion demonstrated significantly more authors replying per request ($P = 0.01$), but no change in the frequency of patient-specific crowdsourcing or citation of consent.

Conclusions Urologists are leveraging Twitter for crowdsourcing clinical guidance and experiential knowledge. Nearly all requests were answered, suggesting low barriers to entry for novice users. Even after character-limit expansion, dissemination of potentially identifiable patient data remains a concern.

Keywords Crowdsourcing · Social media · Twitter · Internet · Education

Introduction

Use of social media by urologists continues to expand. A recent survey of US urologists found that three of four urologists regularly use at least one social media account [1], most commonly Facebook, but also the "micro-blogging" platform Twitter. International studies have confirmed similar prevalence of use and engagement patterns among urologists worldwide [2–4]. Twitter has been proposed as a more accessible and streamlined platform for realizing the potential advantages of social media in a professional context [5, 6].

Established functions of Twitter in urology include professional networking [7], online journal clubs [8], academic conferences [3, 9], and dissemination of new research [10, 11] and clinical practice guidelines [12]. A frequently articulated, but less studied use of Twitter is the exchange of knowledge and patient-specific clinical advice among urologists. This kind of discourse, known as "crowdsourcing," has the potential to facilitate rapid, community-oriented communication and develop common solutions to local challenges. While standardized disease-centered hashtags (e.g., #blcsm for bladder cancer) have been developed to

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facilitate discussion [13], the way urologists engage with crowdsourcing on Twitter and the characteristics and quality of the discourse have been unclear.

We aimed to examine the patterns and functions of crowdsourcing on Twitter among urologists, focusing on the characteristics of the participants, content of the inquiries, and extent of community engagement.

Methods

A public list of urologists with Twitter accounts is maintained by the American Urological Association (AUA) on its Twitter page [14]. This list, while not comprehensive, is an extensive index of US urologists on Twitter. The list was reviewed, and accounts belonging to urologists practicing in the US were included in the initial sample. The public Twitter profile of each urologist on the list was reviewed for original and reply crowdsourcing posts in November, 2016.

Crowdsourcing posts were defined as those seeking clinical advice, input, or response about any aspect of urological care. The solicitation of response, such as by posing a question or requesting feedback, was a required element to be considered as crowdsourcing. Original posts (OP) were defined as those originally authored by the user, not as replies to other users or re-posts of existing content. Reply posts were defined as those linked to advice-seeking OPs, usually denoted by the OP author's Twitter handle at the start of the post. Each user's 50 most recent posts were reviewed. When a crowdsourcing post was identified, any linked reply posts (in the case of OPs) or the index OP (in the case of reply posts) was subsequently included for analysis. Posts created using the Twitter poll function, in which respondents choose from a predefined set of responses instead of generating their own, were excluded. To capture representative breadth in the crowdsourcing posts, and to account for urologists on Twitter who were not on the AUA's list, the Twitter accounts of replying authors who had not been included in the initial sample were then reviewed using the methods described above and added to the sample.

Authors' demographic data, such as the year of completion of training, were collected from public online sources. The Klout Score, a metric of influence on Twitter akin to journal impact factors, was also assessed for each user using the Klout browser plug-in. Two independent reviewers conducted the content analysis of posts, which included the nature of the OPs, whether the post pertained to a specific patient or case, whether photographs or radiographs were included, and whether patient-identifying information was present. Differences were resolved by consensus.

To determine which factors influence responses to crowdsourcing OPs, multivariable regression analysis was performed using the Microsoft Excel Data Analysis Tool. A social network analysis assessing Twitter interconnectedness among authors was performed using NodeXL software, and the network connectivity graph was generated using the Fruchterman–Reingold graph layout algorithms in NodeXL [15].

Two significant changes to the Twitter platform were introduced in 2017, following the initial analysis; first, the expansion of the character limit per post from 140 to 280 characters; and second, the exclusion of Twitter handles from counting toward the character limit. To evaluate the potential impact of these changes, crowdsourcing OPs after 11th November 2017 (the date the changes went into effect for all Twitter users) by the authors included in the initial analysis were collected and reanalyzed in June, 2018. Statistical differences were determined using the Chi-squared test for categorical variables and the two-tailed *t* test for continuous variables.

Institutional review board approval was not required for this analysis of public data.

Results

A total of 91 US urologists' Twitter accounts were identified from the AUA's list. After review of the crowdsourcing OPs, seven additional urologists who had authored reply posts and had not been part of the initial sample were added. Their accounts then underwent review. The final sample included 98 Twitter accounts.

From these accounts, 276 crowdsourcing posts were identified and included in the analysis. These posts consisted of 23 OPs linked to 253 reply posts. The 23 OPs were posted by 15 unique urologists, 6 of whom had authored ≥ 2 OPs. Characteristics of the 15 OP authors are summarized in Supplementary Table 1. All were men, and most (14 users, 93%) were in an academic practice. The median number of years in practice was 7 (interquartile range [IQR] 4.5–8.5). The median number of Twitter "followers" was 935 (IQR 242.5–2009.5), while the median number of Twitter accounts followed was 456 (IQR 186.5–531). The median Klout Score of OP authors was 44 (IQR 33.5–47.5). For comparison, the average Klout Score of all social media users is 40, and a score of 63 represents the 95th percentile [16].

The 23 crowdsourcing threads elicited 253 reply posts. A total of 22 threads (96%) contained at least one reply to the OP, and the majority (15 threads, 65%) had more than ten replies. The median of the number of unique non-OP authors replying to the OP was 5.5 (IQR 2–7) per thread. In the 22 threads that contained at least one reply, the OP author frequently posted a follow-up reply (19 threads, 86%), such as to offer clarification, respond to a reply, or pose another question. Responses to OPs were typically rapid;

among the 22 threads with replies, the time to the first reply was less than 24 h in all threads. Crowdsourcing threads also concluded quickly; among the 22 threads with replies, the median time to the final reply was one day (IQR 0–2). In terms of the clinical experience of OP authors, 13 crowdsourcing requests (57%) were initiated by urologists with ≤7 years in practice. Supplementary Table 2 summarizes the crowdsourcing posts.

Multivariable regression was performed to determine predictors of responses to OPs, based on the number of reply posts. Comparing the OP author's number of Twitter followers, number of Twitter accounts followed, number of years in practice, and Klout Score, only the author's Klout Score predicted the number of replies to a crowdsourcing request ($P=0.022$).

In the content analysis of the 276 crowdsourcing posts, four categories of reasons for crowdsourcing emerged: requests for ideas or solutions to a clinical dilemma (82 posts, 30%); requests for advice about a surgical plan (77 posts, 28%); requests for colleagues' experiences with a device, medication, or finding (64 posts, 23%); and requests for feedback about a proposed course of action (53 posts, 19%). Representative examples are in Supplementary Table 3. Topics of discussion spanned urological oncology, calculous disease, endourology and minimally invasive surgery, and reconstructive surgery. The majority of crowdsourcing requests (15 threads, 65%) were initiated about a specific patient or case. About half of these patient-specific OPs (eight posts, 53%) contained images or radiographs pertaining to the crowdsourcing request, while only one (7%) mentioned having obtained the patient's consent to post the image or discuss the case online. Finally, in about half of the OPs (12 threads, 52%), the author included the Twitter handles of other urologists to pose the question directly to specific users.

Interconnectedness among authors of original and reply posts is shown in the network connectivity graph (Fig. 1). Each node is an author; the more interconnected an author to other users, the closer the distance between the nodes. OP authors who received ≥10 replies (red) had significantly higher Klout Scores than those with <10 replies (yellow) ($P<0.001$). Authors of reply posts are shown as black nodes. OP authors' Klout Scores were also positively correlated with the volume of replies (Pearson $R^2=0.61$, $P<0.001$). There was no association between the reason for crowdsourcing of each OP, grouped by category, and number of replies to that OP.

Crowdsourcing OPs by the authors in the initial analysis posted after the expansion of the character limit and discounting of Twitter handles in 2017 were collected to assess potential changes in crowdsourcing patterns. A total of 184 posts in 17 threads were analyzed (Supplementary Table 2).

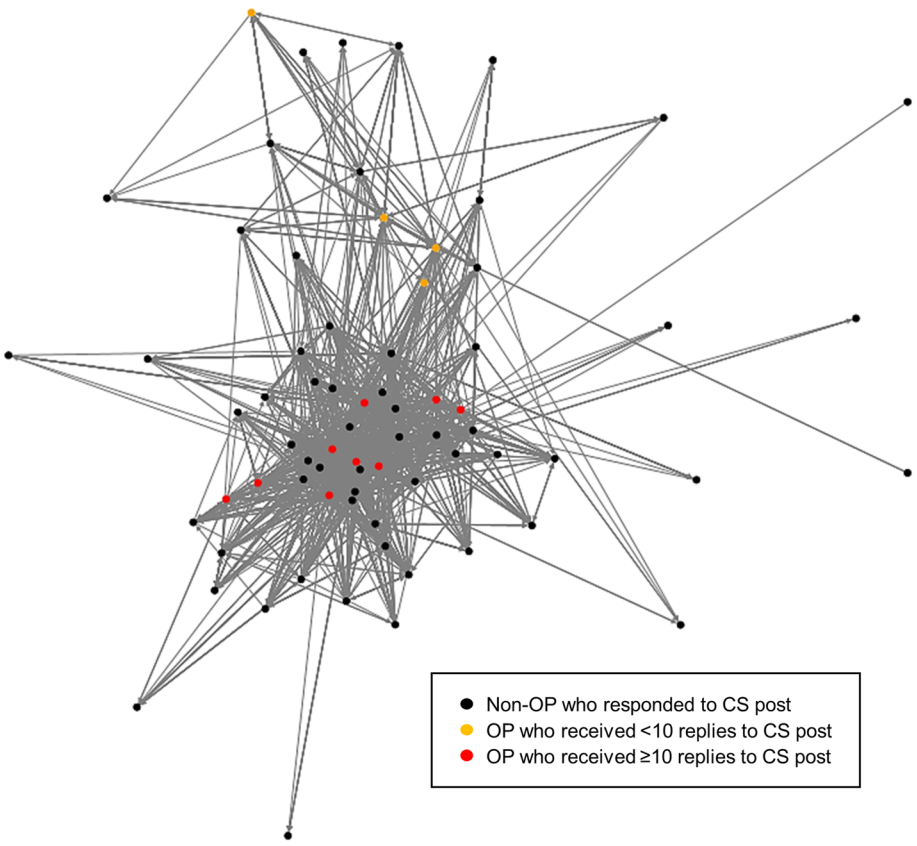

Fig. 1 Network connectivity graph of authors of original and reply crowdsourcing posts. Authors of original posts are shown in red (≥10 replies) and yellow (<10 replies). Authors of reply posts are shown in black. *OP* original post, *CS* crowdsourcing

Significant increases in the median number of non-OP authors replying per thread ($P=0.01$), the number of OPs that included handles of other urologists ($P=0.048$), and the median number of handles of other urologists included in OPs ($P=0.01$) was found. There were no significant changes before and after the expansion in the purposes for crowdsourcing or in the number of OPs containing patient-specific images or citing patient consent.

Discussion

Twitter is a potential vehicle for crowdsourcing clinical advice from a diverse audience of content experts. In this study, the large majority of urologists' crowdsourcing requests on Twitter were robust exchanges of inquiry and feedback, involving a median of 5.5 authors, and covering diverse clinical topics. Most crowdsourcing was motivated by a specific case, but there were also requests for colleagues' experiences with devices or findings. While urologists engaging in crowdsourcing in this sample were mostly men in academic practices, there was a 22-year range in practice, representing breadth in experience among authors of both original and reply posts.

This is the first study to systematically characterize crowdsourcing content generated by urologists using Twitter. The results expand our understanding of a dimension of urologists' social media use that has been proposed [5, 17–19], but about which evidence has been limited. In a recent survey of Canadian urologists, 44% of respondents reported that Twitter could be "useful for clinical decision-making," and 33% had made or clarified a clinical decision following information gathering and discussion on Twitter [5]. A case report has described offering a patient with a complex urological condition crowdsourcing on Twitter as an opportunity to seek a second opinion and international expertise [20]. The present study elaborates on the content of Twitter discourse that may drive these decisions. Urologists frequently used Twitter to make specific, data-directed inquiries about surgical planning or clinical management (Supplementary Table 3), underscoring Twitter's potential to synthesize knowledge from content experts more rapidly than might be possible in a single practice or via email.

Another interesting finding was that crowdsourcing requests originated from urologists with a range of experience, and that recent completion of training, as a proxy for inexperience, did not appear to disproportionately motivate crowdsourcing. Recent studies of social media trends have reported that the prevalence and frequency of social media use is highest among individuals less than 40 years old for urologists [1, 21] and the general population [22]. The data from our sample suggest that older urologists not only participate in crowdsourcing discussions, but also initiate their own requests. This use of Twitter may be particularly effective for inquiries related to the dispersion of new technologies or dissemination of clinical practice guidelines [12], which might be less likely to be affected by age or years in practice. Furthermore, we found that the number of responses to crowdsourcing requests was highly associated with the Klout Score of the OP author, suggesting that the "success" and quality of a crowdsourcing request, as measured by the number of replies, may depend on the author's social media engagement overall. However, 22 of the 23 crowdsourcing requests in the initial sample ultimately achieved at least one reply, suggesting that novice users or those without extensive Twitter networks may still benefit.

With respect to public posts of patient-specific information on Twitter, we found that over half of the crowdsourcing threads contained images related to a specific patient. Prior work has shown that when potential violations of patient privacy are found on physicians' Twitter accounts, they usually involve "specific indicatory information," not gross oversights such as the inclusion of names or medical record numbers [23]. Despite the belief of a large majority of urologists that online communications about patients should be accompanied by a legal disclaimer [4], explicit documentation that consent had been obtained was rare in our study. The expansion of the limit from 140 to 280 characters per post changed neither the frequency of patient-specific crowdsourcing (53 vs 56%) nor the mention of patient consent in OPs (7 vs 0%), suggesting that the character limit does not fully explain the discrepancy between what urologists believe and what they do about the discussion of patient information online.

The changes to the Twitter platform in 2017, however, did significantly increase how frequently OP authors included the handles of other urologists in their crowdsourcing requests (52 vs 82%), as well as the median number of handles included in each OP (one vs five handles), resulting in a significantly greater median number of urologists replying to the requests (5.5 vs 7 urologists). Insofar as increased participation by "the crowd" may improve the quality of crowdsourcing, these findings suggest that crowdsourcing among the urologists in our sample has benefited from the most recent changes to Twitter. Specifically, discounting users' handles from the character limit may have enhanced the volume and frequency of intellectual exchange.

Several limitations should be noted. While the sample of urologists whose Twitter profiles were examined was chosen to reflect active Twitter users, the sample was not definitively comprehensive and may be subject to selection bias related to age, geography, and practice type. For instance, we suspect that there are female urologists who are crowdsourcing, despite the absence of women among OP authors in our sample. We also limited this exploratory study to US urologists because the list maintained by the AUA largely captures its US-based membership, and

to our knowledge no similarly curated list exists for non-US urologists. Of note, urologists' use of Twitter may not be representative of all surgeons; an analysis of Twitter use during professional conferences for different surgical specialties reported significantly more users and posts for urology conferences, suggesting greater and potentially more advanced use of this technology by urologists compared to other specialists [24]. Finally, we cannot be certain whether the discussions on Twitter aided OP authors in making decisions or changing their practice.

Despite the limitations, the study has several important implications. First, these data support the use of Twitter as a novel mechanism to examine how urologists develop solutions to dilemmas and share clinical advice. The principles and precautions of using social media data to analyze practice patterns [19, 25] can be elaborated to include the crowdsourcing functions articulated here. Second, the present study indicates that Twitter can support crowdsourcing by urologists with a range of experience and subspecialty practices. The findings can inform strategies not only to engage clinicians from non-academic practices, but also develop novel functions for Twitter crowdsourcing, such as strengthening clinical trial recruitment or outreach to centers of excellence. Finally, the findings suggest that the protection and confidentiality of sensitive patient information on social media remain concerns. The social media guidelines of three urological organizations—the AUA, the European Association of Urology, and the journal *BJUI*—all include statements about maintaining and respecting patient confidentiality [26–28]. In practice, however, very few urologists are aware that such guidelines exist [4], and there has not been a consensus approach to documenting consent on Twitter. More work is needed to examine the complexity of patient consent in online crowdsourcing and ensure that the precautions taken to protect patients offline extend to social media.

In conclusion, urologists are now leveraging Twitter for crowdsourcing clinical guidance and experiential knowledge. As urologists' Twitter use expands, crowdsourcing exchanges are likely to grow in breadth and sophistication. Although users with greater interconnectedness received more replies, nearly all crowdsourcing requests were answered, suggesting low barriers to entry for novice users of this technology. Public dissemination of identifying data and the protection of patient privacy on social media remain a concern.

Author contributions KK: project development, data collection and management, data analysis, and manuscript writing/editing. KS: project development, data collection and management, data analysis, and manuscript writing/editing. EAG: project development, data analysis, and manuscript writing/editing.

Compliance with ethical standards

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

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent No special informed consent was obtained for this analysis of public data.

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