



# Antibiotic-treated acute appendicitis—reception in social media

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Received: 19 December 2018 / Accepted: 13 March 2019 / Published online: 29 March 2019  
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## Abstract

**Purpose** Social media, especially Twitter®, is becoming increasingly important for medical topics. Systematic analyses of the content of these tweets are rare. To date, no analysis of the reception of antibiotic/non-operative-treated acute appendicitis on Twitter® has been performed.

**Methods** Tweets with the content “appendicitis,” “appendix,” and “appendectomy” from December 31, 2010, to September 27, 2017, were recorded. Further analysis was performed by secondary search strings related to antibiotic-treated acute appendicitis. Subsequent systematic analysis of content, author groups, and followers was performed.

**Results** Out of 22,962 analyzed tweets, 3400 were applicable on all search strings, and 349 dealt meaningfully with antibiotic-treated acute appendicitis. 47.9% of the tweets were published by individuals, of which non-surgical consultants comprised the largest group. The tweets published by organizations and institutions were mostly published by publishing platforms. Half of the tweets were neutral, with an overall positive trend for antibiotic-treated acute appendicitis, but significant differences were noted among the authors. The number of followers showed a wide range, with an considerable numeric impact.

**Conclusion** The scientific discussion of antibiotic-treated acute appendicitis is reflected on Twitter®. Overall, antibiotic-treated acute appendicitis is presented in a neutral and differentiated manner on Twitter®, but this picture is exclusively derived from assessment of a variety of tweets. Individual tweets are partially undifferentiated in content and misrepresent antibiotic-treated acute appendicitis. In addition, content and intentions are significantly author dependent. Scientists should therefore use Twitter® to make sound medical information heard. If this policy is not implemented, the importance of inadequate and incorrect information transfer is indirectly increased.

**Keywords** Appendicitis · Antibiotics · Social media · Twitter®

## Introduction

Social media is increasingly important for the formation of opinion on medical topics. To date, communication on medical topics is primarily based on professional medical publication platforms and congresses. Healthcare information published in medical journals, congresses, or internet platforms, such as [Medscape.com](http://www.medscape.com) and [WebMD.com](http://www.webmd.com), is mostly of limited value to medical non-professionals if not strictly restricted to healthcare professionals. Medical non-professionals obtain

information regarding upcoming or changing medical topics typically from the non-specialized media, television or newspapers. Although information on latest scientific and medical topics may be technically accessible for medical non-professionals, the pricing and the complexity of presentation, especially in medical journals, results in an information imbalance to the disadvantage of non-healthcare-professionals. Nevertheless, most patients are not educated, trained, or active in the medical field, and the informed patient is searching information about their own disease, diagnostic options and treatments online.

This gap is filled by social media. Main advantages of gathering medical information on social media are the low-threshold access, the often easy-to-understand presentations, and the immediate dissemination of information. The presentation of medical data on professional platforms is complex, while information on social media platforms is comparatively condensed. Twitter® restricts postings to 280 (140 until November 2017) characters. To spread healthcare

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information, microblogging via Twitter® is the most popular form [1]. Initial studies show that Twitter® is being used by various interest groups and organizations for the targeted dissemination of medical information or to analyze public reception on medical topics [2, 3]. Thus, the analysis of content and goals of these tweets is of great interest.

While professional medical publication systems mostly offer a system of revision and control, social media regularly lacks any control. Moreover, there is very little information regarding who is posting what type of information. While this information is lacking, the effect of Twitter® on public discourse becomes evident and is lately being realized by medical professionals [4]. The aim of this study was to examine the dissemination of healthcare information via Twitter® on a specialized medical topic that is of great public interest. Acute appendicitis is a well-known and frequent disease with a vast number of affected people. Alternative therapies are therefore of great interest, especially non-operative antibiotic-based therapy of acute appendicitis.

Appendicitis and the operative removal of the appendix are broadly known among non-healthcare-professionals. Therefore, the reception of the relatively new and not-yet-conclusive therapy without surgery is of great interest. This interest has also arisen because the scientific discussion of this therapeutic concept is by no means complete [5–7].

## Material and methods

Twitter® has been available since March 21, 2006. All microblogs (“tweets”) containing the words “appendicitis,” “appendectomy,” and “appendix” (primary search strings) posted between the launch of Twitter® and September 27, 2017, were extracted. The latter date was selected because of major changes in Twitter’s® terms of use. Non-medically related and double-tweets were excluded as well as those only describing the personal course of the disease (individual content) or reporting on celebrities. The content of remaining tweets was further analyzed for the secondary search string (“antibiotics,” “antibiotic,” and “drugs”). Picture posts were analyzed, as some contained presentations or diagrams matching the criteria of interest. The content analysis followed the approach described by Holsti and Berelson for communication research [8, 9].

The third step was a detailed analysis of the tweets matching primary and secondary search strings. All tweets addressing non-operative, antibiotic treatment of acute appendicitis were classified according to the date of publication, author, source, and content. The classification of the sources distinguished as medical non-professionals vs. professionals. The later were subdivided in individual tweets and organizational tweets. Individual tweets were published by consultants for surgery (surgeons), consultants not active in surgery (non-

surgery consultants), general practitioners, and other medical professionals. Organizational tweets were published by hospitals/governmental organizations, enterprises and non-governmental organization, or publication platforms (e.g., on-line platforms of publishing houses or media companies) and news agencies.

The monthly number of tweets published on antibiotic-treated acute appendicitis was analyzed. Noticeable peaks in tweet numbers were correlated with the publication of manuscripts on the topic, as determined by a *PubMed* search (search strings “antibiotic,” “antibiotics,” “appendicitis,” and “surgery” in the timeframe of the peak  $\pm$  1 month).

Content classification was conducted by analysis of all tweets by the authors (AR, JL) individually, and classification was compared. Inconsistently classified tweets were submitted to another author (SSR). A two-out-of-three vote was used for classification. If this vote could not be achieved, the tweet was excluded. Content classification criteria were as follows:

- *Unfairly positive*—antibiotic-treated acute appendicitis as the only or superior therapeutic option. Concealment of possible negative side effects
- *A positive option*—antibiotic-treated acute appendicitis as a therapeutic option that may have advantages compared with operative therapy. Emphasized the pros of this non-operative therapy
- *Neutral*—introduction of antibiotic-treated acute appendicitis as a therapeutic option without judgment. Equal presentation of pros and cons
- *A negative option*—antibiotic-treated acute appendicitis as a therapeutic option. Underlining the superiority of surgical treatment and the cons
- *Unfairly negative*—antibiotic-treated acute appendicitis as a careless, negligent or widely ineffective therapeutic option

Fisher’s exact test was used to analyze the differences in the categorical variables for predicted values  $< 5$ ; otherwise, the two-sided chi-square test was used. Unless otherwise stated, all tests were two-tailed, and  $p$  values  $< 0.05$  were considered significant. All data analyses were performed using SPSS, version 24 (IBM, Armonk, USA).

## Results

Between the launch of Twitter® and December 31, 2010, 443 tweets contained the primary search strings. Of these, none matched the secondary search string. Further analysis was restricted to January 1, 2011, to September 27, 2017.

Between January 1, 2011, and September 27, 2017, a total of 22,962 tweets containing “appendicitis,” “appendectomy,” or “appendix” were analyzed. A total of 3400 of these tweets

matched the inclusion criteria and were analyzed for the secondary search strings. The percentage of serious medically related tweets ranged from 9.5% (“appendix”) to 38% (“appendectomy”). The primary reason for exclusion was individual content (65%). We were able to identify 364 tweets addressing antibiotic, non-operative therapy of acute appendicitis. In further analysis, 15 tweets were excluded for deficient author information, nonsense content, repetition, or inconsistent classification vote.

## Timeline

Viewing the number tweets published per year did not provide a definite conclusion. The maximum number of tweets was published in 2015—134. In 2013, a notable drop was recorded with just four evaluable tweets (Fig. 1).

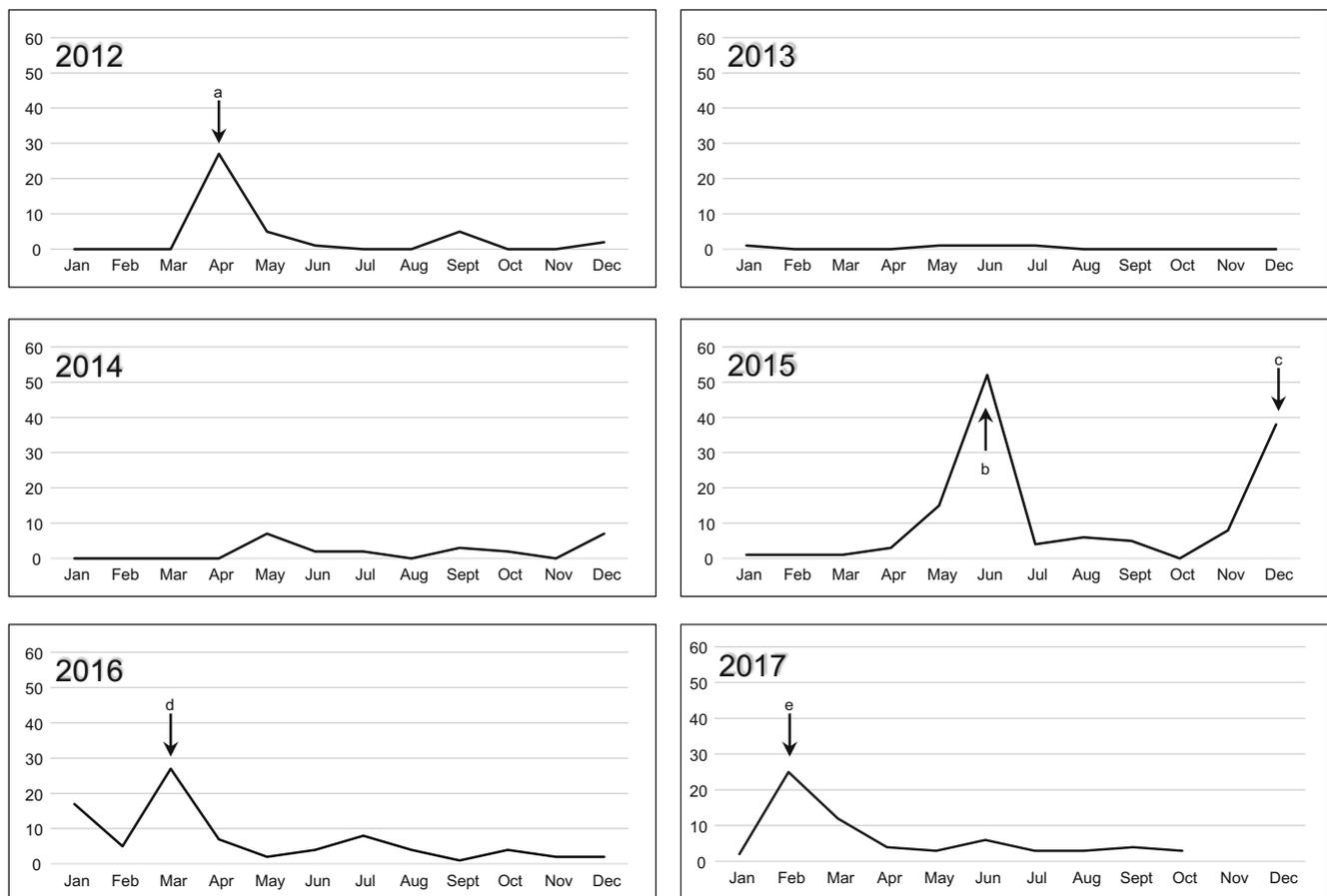
We noticed distinct peaks in tweet publication on antibiotic-treated acute appendicitis. The *PubMed* search revealed that prior to each peak, a manuscript on non-operative antibiotic treatment of acute appendicitis was published in a highly reputed medical journal (Fig. 1). The evaluation of the therapeutic approach in the identified papers ranged from negative to positive.

The papers that triggered an increase in tweets were published in high-level medical journals (impact factor 5.7–44). However, not every publication on antibiotic-treated acute appendicitis in a high-profile medical journal led to a noticeable increase in tweets [10–12]. In particular, the much-noticed manuscript on the *Non Operative Treatment for Acute Appendicitis (NOTA)* study by Di Saverio et al. (*Annals of Surgery*) in 2014 triggered no significant increase [13].

## Source analysis

In total, 167 tweets were posted by individuals. Of these, 109 were posted by medical professionals, and 58 were posted by non-medical lay people (individuals without formalized medical education; hereinafter: “medical non-professionals”). A total of 182 tweets were posted by organizations, and the majority of 118 tweets were posted by publication platforms.

Of the 109 medical professional individuals, 26 (24%) identified themselves as surgeons, and 48 (44%) were non-surgical consultants. Furthermore, 9 individuals claimed to be general practitioners (8% of medical professional individuals), leaving 24% ( $n = 26$ ) as otherwise classified medical professionals.



**Fig. 1** Time-dependent presentation of the tweet number and publications in *PubMed*. (a) Varadhan et al., *BMJ* [10]. (b) Salminen et al., *JAMA* [11]. (c) Minneci et al., *JAMA Surg* (Epub) [12]. (d) Sallinen et al., *BJS* (Epub) [7]. (e) Georgiou et al., *Pediatrics* [21]

A total of 16.6% of all tweets were published by non-healthcare-professionals.

Among 182 tweets published by organizations, 118 (65%) were issued by publishing platforms. The remaining tweets were posted in similar proportions by enterprises or non-governmental organization ( $n = 33$ ; 18%) and hospitals or governmental organization ( $n = 31$ ; 17%). The relations outlined above did not change during the observation period.

## Content analysis

The content of approximately half of the tweets were classified as *neutral* ( $n = 178$ ; 51%). Forty-one (12%) tweets were *unfairly positive* tweets compared with only 1 *unfairly negative* tweet (0.3%).

The relationship of a *positive option* versus a *negative option* tweets was clearly in favor of a *positive option* tweets. In total, 29% of all tweets were a *positive option* tweets ( $n = 102$ ), which is approximately four times more than a *negative option* tweet ( $n = 27$ ; 8%). In summary, 41% of all tweets on antibiotic-treated acute appendicitis were in favor of this therapeutic concept.

## Source-content correlation

In the general study cohort, as well as in each subanalysis, most tweets had a neutral content. However, there were noticeable differences between tweets by individuals and organizations as well as in each of these groups.

Comparing medical professionals and non-professionals, we observed a slight tendency towards a *positive option* tweets for non-professionals ( $p = 0.23$ ).

We observed a tendency towards fewer *unfairly positive* tweets by non-surgical consultants that reached significance compared with the individuals ( $p = 0.09$  vs.  $p = 0.02$ ). Only 4% of the tweets by non-surgical consultants were *unfairly positive*, while 8% of the tweets by surgeons and 22% (2 of 9) tweets from general practitioners were *unfairly positive*. Interestingly, 26% of the tweets by medical non-professionals were *unfairly positive*, which is significantly more than tweets by other individuals and the general study population ( $p = 0.002$  vs.  $p = 0.001$ ). There was no difference in the rate of *unfairly positive* tweets between medical professionals and surgeons.

Furthermore, non-professionals posted significantly fewer a *negative option* tweets compared with other individuals ( $p = 0.02$ ) but not in comparison with the general population ( $p = 0.27$ ).

A total of 3% of the tweets posted by hospitals or governmental organizations were *unfairly positive*; this is the lowest rate among organizational tweets (enterprises/non-governmental organizations 18%, publication platforms 9%).

Surgeons published significantly more negative and significantly fewer positive tweets compared with other individuals (a *negative option*,  $p < 0.0001$ ; a *positive option*,  $p = 0.01$ ) or the general study population (a *negative option*,  $p < 0.0001$ ; a *positive option*,  $p < 0.0001$ ). We observed a strong tendency towards positive tweets in the non-surgery consultants group ( $p = 0.058$ ). This observation evens out if the non-surgery consultants are compared with the remaining individuals ( $p = 0.29$ ). Tweets published by individuals represented significantly more often a *positive option* ( $p = 0.02$ ) or a *negative option* ( $p = 0.02$ ) than tweets released by organizations.

A noticeably low rate of a *negative option* tweets was posted by publication platforms (3%), and this rate was significantly less than the remainder of the study population (10%,  $p = 0.01$ ). The overall analysis showed that most tweets on antibiotic-treated acute appendicitis were *neutral*. However, on the whole, there was a tendency towards a positive image, but this exhibited noticeable differences between the groups of authors (Table 1).

## Impact analysis

The number of followers of tweets on antibiotic-treated acute appendicitis ranged from 9 to 393,000. The mean number of followers did not differ significantly among the publishers of *unfairly positive/a positive option*, *neutral*, or *unfairly negative/a negative option* tweets and ranged from 10,061 (a *positive option*,  $SD \pm 22,853$ ) to 11,871 (*unfairly positive*;  $SD \pm 61,080$ ). The mean number of followers of organizational tweets was significantly higher than that of individuals ( $13,010 \pm 29,565$  vs.  $1468 \pm 345$ ,  $p < 0.0001$ ); > 100,000 followers on antibiotic-treated acute appendicitis tweets were reached exclusively by hospitals/governmental organizations and publication platforms.

A total of 105 (30%) tweets were “liked,” ranging from 1 to 119 “likes” (median 4.0/ $SD \pm 11.9$ ).

Ninety-two (26%) tweets were re-tweeted, ranging from 1 to 119 times (median 4.8,  $SD \pm 13.7$ ). All re-tweeted tweets were also “liked.” The mean number of “likes” per tweet ranged from 1.25 (*unfairly positive*;  $SD \pm 0.4$ ) to 5.0 (*neutral*;  $SD \pm 15.0$ ); however, no significant differences were noted between the groups.

The count of “likes” was significantly higher among *neutral* tweets compared with all other groups ( $p < 0.0001$ ). Interestingly, significantly more readers “liked” a *positive option* tweets than a *negative option* tweets ( $p < 0.0001$ ).

The latter findings were similar to the analysis of the re-tweets. The only difference was found in a lower degree of significance between a *positive option* and *neutral* tweets ( $p = 0.04$ ).

**Table 1** Distribution of the content evaluation by author groups (%)

		unfairly positive		a positive option		neutral		a positive option		unfairly negative	
Individuals	Non-professionals	26		42		29		3		0	
		4	9	7	14	5	10	1	1	0	0
	General practitioners	22		44		11		11		11	
		1	1	1	2	0	1	0	1	0	1
	Medical professionals; other	8		35		50		8		0	
		1	1	3	5	4	8	1	1	0	0
	Consultants, non-surgery	4		42		44		10		0	
	1	1	6	12	6	13	1	3	0	0	
Surgeons	8		8		50		35		0		
	1	1	1	1	4	8	3	5	0	0	
Individuals (cumulative)		8	13	18	34	19	40	6	11	0	1
Organizations	Enterprises, non-governmental organization	18		27		45		9		0	
		2	3	2	5	4	8	1	2	0	0
	Hospitals, governmental/public organizations	3		23		68		6		0	
		0	1	2	4	6	12	1	1	0	0
	Publication platform and news agency	9		23		65		3		0	
	3	6	8	15	22	42	1	2	0	0	
Organizations (cumulative)		5	10	12	24	32	62	3	5	0	0

Legend	[%] of Group		[%] of all						
	[%] of all	[%] of subgroup	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9

## Discussion

Our work is among the first comprehensive analyses of the discussion of a current broad-based medical topic in a social medium. Until recently, social media played a subordinate role in medical research. However, the importance of social media for medical research is also becoming increasingly obvious [14].

Social media is used both to generate primary data on diseases and to examine the benefits of social media for the dissemination of medical information [15–17]. For the latter purpose, Twitter® is the most important social medium besides Facebook. Thus, the number of studies dealing with social media in the medical context quintupled in the years 2016 and 2017 compared with that of 2010. Our investigations reflect the following: Tweets dealing with antibiotic-treated acute appendicitis could be observed to a significant extent from 2012 onwards. The total number of these tweets in 2015, 2016, and 2017 was significantly higher than that in previous years.

The proportion of tweets about antibiotic-treated acute appendicitis with useful content was between 9.5 and 38% in our study. These values are comparable to the observations of Chandrasekaran et al., who identified 39% of the tweets examined as “not useful” and 14% as “misleading” [16].

The number of followers of tweets regarding antibiotic-treated acute appendicitis however is remarkable. Tweets about non-operative, antibiotic-treated acute appendicitis reached a median of greater than 10,000 followers. This number is interesting compared with the readership of scientific journals. Data on this issue are scarce, but even the most

highly rated surgical journals, such as *Annals of Surgery*, report only approximately 2500 subscribers and 50,000 monthly site visits [18]. Other well-known surgical journals report 800–2200 downloads per article [19]. Therefore, this analysis proves that medical tweets have a notable reach of readers compared with the specialist press. Most readers, up to greater than 100,000, are reached by tweets from professional publishing platforms. The content neutrality of these platforms cannot be assumed, and tweets should be critically questioned and announced.

Our research also shows that social media reflects publications in medical journals. We observed peaks in the number of tweets following publications on this topic in high-level journals. However, we identified only four evaluable tweets in 2013 possibly because only the announcement of a prospective study on the antibiotic-treated acute appendicitis was noticeable in this year [20].

Our study shows that the current controversy is reflected in social media [6, 7]. Meta-analyses and randomized controlled trials tend to be to the detriment of antibiotic-treated acute appendicitis [5]. However, there are also articles that reported very positively on this treatment [21, 22]. The content spectrum of the tweets ranged from *unfairly positive* to *unfairly negative* with a maximum of *neutral* tweets. Overall, we observed a tendency towards positive tweets. Articles in medical journals reported predominantly neutral points of view on antibiotic-treated acute appendicitis; however, to a large extent, they stressed the disadvantages/risks of non-surgical therapy. The crucial difference between medical publications and tweets is that the latter usually report unilaterally. The

controversy of the discussion is therefore only revealed by the overall view of numerous tweets.

We observed significant differences in the rating of non-operative therapy of acute appendicitis with antibiotics by different groups of authors. These differences were found between groups of medically professionals, between medical professionals and non-professionals, as well as between individuals and organizations. Such differentiations cannot be made when looking at articles in medical journals. Fung et al. performed an analysis of various tweets authored by different groups on “Global Health” in 2014–2015. Its results were comparable to ours [2].

In a study by Hanson et al., the percentage of patients who chose a non-operative, antibiotic treatment for acute appendicitis for themselves or their child was less than 15% [23]. This finding is in contrast to our observation of a rather positive reception of antibiotic-treated acute appendicitis, especially among medical non-professionals. We suspect that this reflects the ambivalence regarding the respect for surgery or anesthesia versus the fear of complications caused by delayed surgery. This finding would be consistent with the results of the survey by O’Connell et al. [24]. While our study also proved that medical non-professionals were more positive regarding antibiotic-treated acute appendicitis, the survey by Althans et al. showed a different picture. In that study, only 24.3% of medical students would want antibiotic treatment for appendicitis for themselves [25].

Our study showed that medical topics are reflected in the social media in a broad and timely manner. The discussion in social media is led by a range of authors, going far beyond what has thus far shaped the scientific discussion. Even though our study provided little information about the recipients of the tweets, it must be assumed that the readership is much wider than that of medical journals. Our study showed that the lack of a review process in social media also gives rise to the publication of inadequate, useless and harmful information. This finding emphasizes the necessity for medical specialists to publish their findings in social media, as this is the only method to provide the public with evidence-based information on this channel. Abandoning this task would increase the importance of interest-guided or completely unscientific tweets.

There are distinct limitations to this study. There is a possibility of duplicate or fake accounts or wrong authors’ statements regarding their profession. The study was only a snapshot of the rapidly changing opinions in social media. Compared with analysis on medical topics that are more interesting to the general public, especially drug abuse or plastic surgery, the number of tweets analyzed is rather lower [3, 26].

In this context, further studies are necessary, i.e., the targeted analysis of the recipients of publication in social media.

## Conclusion

The scientific and non-scientific discussion of antibiotic therapy of acute appendicitis is reflected on Twitter®. The Twitter® discussion of this therapeutic option for acute appendicitis reaches a large readership compared with medical journals and is influenced by scientific publications. The presentation of this treatment option varies significantly between different groups of authors and is presented in a manner intending to promote a one-sided point of view that is not a fair discussion of the pros and cons.

Only by observing a large number of utterances does a differentiated picture emerge of the topic.

**Authors’ contributions** Study conception and design—A. Reinisch and J. Liese. Drafting of the manuscript—A. Reinisch and J. Liese. Acquisition of data—A. Reinisch and S.R. Schröder. Analysis and interpretation of data—A. Reinisch, S.R. Schröder, and J. Liese. Critical revision of the manuscripts—J. Liese, F. Ulrich, and W. Padberg. Final approval of the version to be submitted—all authors.

## Compliance with ethical standards

**Ethical approval** This article does not contain any studies with human participants or animals performed by any of the authors. This study was not funded.

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

## References

- Bartlett C, Wurtz R (2015) Twitter and public health. *J Public Health Manag Pract* 21(4):375–383. <https://doi.org/10.1097/PHH.0000000000000041>
- Fung IC, Jackson AM, Ahweyevu JO, Grizzle JH, Yin J, Tse ZTH, Liang H, Sekandi JN, Fu KW (2017) #Globalhealth twitter conversations on #malaria, #HIV, #TB, #NCDS, and #NTDS: a cross-sectional analysis. *Ann Glob Health* 83(3–4):682–690. <https://doi.org/10.1016/j.aogh.2017.09.006>
- Kalandar A, Al-Youha S, Al-Halabi B, Williams J (2018) What does the public think? Examining plastic surgery perceptions through the Twitterverse. *Plast Reconstr Surg* 142(1):265–274. <https://doi.org/10.1097/PRS.0000000000004484>
- Nawa N, Ishida H, Sugino H, Katsuragi S, Baden H, Takahashi K, Narita J, Kogaki S, Ozono K (2018) Analysis of public discourse on heart transplantation in Japan using social network service data. *Am J Transplant* 18(1):232–237. <https://doi.org/10.1111/ajt.14527>
- Harnoss JC, Zelenka I, Probst P, Grummich K, Müller-Lantzsch C, Harnoss JM, Ulrich A, Büchler MW, Diener MK (2017) Antibiotics versus surgical therapy for uncomplicated appendicitis: systematic review and meta-analysis of controlled trials (PROSPERO 2015: CRD42015016882). *Ann Surg* 265(5):889–900. <https://doi.org/10.1097/SLA.0000000000002039>
- Podda M, Cillara N, Di Saverio S, Lai A, Feroci F, Luridiana G, Agresta F, Vettoretto N, Appendicitis AISoHSSGoA (2017) Antibiotics-first strategy for uncomplicated acute appendicitis in adults is associated with increased rates of peritonitis at surgery. A systematic review with meta-analysis of randomized controlled trials comparing appendectomy and non-operative management with

- antibiotics. *Surgeon* 15(5):303–314. <https://doi.org/10.1016/j.surge.2017.02.001>
7. Sallinen V, Akl EA, You JJ, Agarwal A, Shoucair S, Vandvik PO, Agoritsas T, Heels-Ansdell D, Guyatt GH, Tikkinen KA (2016) Meta-analysis of antibiotics versus appendectomy for non-perforated acute appendicitis. *Br J Surg* 103(6):656–667. <https://doi.org/10.1002/bjs.10147>
  8. Berelson B (1952) Content analysis in communication research. Free Press, Glencoe
  9. Holsti OR (1969) Analysis for the social sciences and humanities. Addison-Wesley, Reading
  10. Varadhan KK, Neal KR, Lobo DN (2012) Safety and efficacy of antibiotics compared with appendectomy for treatment of uncomplicated acute appendicitis: meta-analysis of randomised controlled trials. *BMJ* 344:e2156
  11. Salminen P, Paajanen H, Rautio T, Nordström P, Aarnio M, Rantanen T, Tuominen R, Hurme S, Virtanen J, Mecklin JP, Sand J, Jartti A, Rinta-Kiikka I, Grönroos JM (2015) Antibiotic therapy vs appendectomy for treatment of uncomplicated acute appendicitis: the APPAC randomized clinical trial. *JAMA* 313(23):2340–2348. <https://doi.org/10.1001/jama.2015.6154>
  12. Minneci PC, Mahida JB, Lodwick DL, Sulkowski JP, Nacion KM, Cooper JN, Ambeba EJ, Moss RL, Deans KJ (2016) Effectiveness of patient choice in nonoperative vs surgical management of pediatric uncomplicated acute appendicitis. *JAMA Surg* 151(5):408–415. <https://doi.org/10.1001/jamasurg.2015.4534>
  13. Di Saverio S, Sibilio A, Giorgini E, Biscardi A, Villani S, Coccolini F, Smerieri N, Pisano M, Ansaloni L, Sartelli M, Catena F, Tugnoli G (2014) The NOTA Study (Non Operative Treatment for Acute Appendicitis): prospective study on the efficacy and safety of antibiotics (amoxicillin and clavulanic acid) for treating patients with right lower quadrant abdominal pain and long-term follow-up of conservatively treated suspected appendicitis. *Ann Surg* 260(1):109–117. <https://doi.org/10.1097/sla.0000000000000560>
  14. Househ M, Borycki E, Kushniruk A (2014) Empowering patients through social media: the benefits and challenges. *Health Informatics J* 20(1):50–58. <https://doi.org/10.1177/1460458213476969>
  15. Chen X, Deldossi M, Aboukhamis R, Faviez C, Dahamna B, Karapetiantz P, Guenegou-Arnoux A, Girardeau Y, Guillemin-Lanne S, Lillo-Le-Louët A, Texier N, Burgun A, Katsahian S (2017) Mining adverse drug reactions in social media with named entity recognition and semantic methods. *Stud Health Technol Inform* 245:322–326
  16. Chandrasekaran N, Gressick K, Singh V, Kwal J, Cap N, Koru-Sengul T, Curry CL (2017) The utility of social media in providing information on Zika virus. *Cureus* 9(10):e1792. <https://doi.org/10.7759/cureus.1792>
  17. Lachmar EM, Wittenborn AK, Bogen KW, McCauley HL (2017) #MyDepressionLooksLike: examining public discourse about depression on twitter. *JMIR Ment Health* 4(4):e43. <https://doi.org/10.2196/mental.8141>
  18. Wolters Kluwer (2018) Media kit annals of surgery. Wolters Kluwer. <http://advertising.lww.com/media-kits/annals-surgery.html>. Accessed June 6th 2018
  19. Springer (2018) Media kit Springer. Springer. [https://www.springer.com/medicine/surgery/journal/11605?wt\\_mc=Other.Other.8.CON546.JS\\_surg\\_11605&utm\\_medium=other&utm\\_source=other&utm\\_content=10122017&utm\\_campaign=8\\_vmeyer\\_js\\_surg\\_11605](https://www.springer.com/medicine/surgery/journal/11605?wt_mc=Other.Other.8.CON546.JS_surg_11605&utm_medium=other&utm_source=other&utm_content=10122017&utm_campaign=8_vmeyer_js_surg_11605). Accessed June 6th 2018
  20. Paaianen H, Grönroos JM, Rautio T, Nordström P, Aarnio M, Rantanen T, Hurme S, Dean K, Jartti A, Mecklin JP, Sand J, Salminen P (2013) A prospective randomized controlled multicenter trial comparing antibiotic therapy with appendectomy in the treatment of uncomplicated acute appendicitis (APPAC trial). *BMC Surg* 13:3. <https://doi.org/10.1186/1471-2482-13-3>
  21. Georgiou R, Eaton S, Stanton MP, Pierro A, Hall NJ (2017) Efficacy and safety of nonoperative treatment for acute appendicitis: a meta-analysis. *Pediatrics* 139(3):e20163003. <https://doi.org/10.1542/peds.2016-3003>
  22. Park HC, Kim MJ, Lee BH (2017) Randomized clinical trial of antibiotic therapy for uncomplicated appendicitis. *Br J Surg* 104(13):1785–1790. <https://doi.org/10.1002/bjs.10660>
  23. Hanson AL, Crosby RD, Basson MD (2018) Patient preferences for surgery or antibiotics for the treatment of acute appendicitis. *JAMA Surg* 153(5):471–478. <https://doi.org/10.1001/jamasurg.2017.5310>
  24. O'Connell EP, White A, Cromwell P, Carroll E, Khan W, Waldron R, Khan IZ, Barry K (2018) Non-operative treatment of appendicitis: public perception and decision-making. *Ir J Med Sci* 187:1029–1038. <https://doi.org/10.1007/s11845-018-1758-5>
  25. Althans AR, Tamer P, Brady JT, Steinhagen E, Ho VP (2017) Surgery versus antibiotics for uncomplicated appendicitis: which would a medical student want? *Surg Infect* 18(8):868–873. <https://doi.org/10.1089/sur.2017.129>
  26. Allem JP, Dharmapuri L, Unger JB, Cruz TB (2018) Characterizing JUUL-related posts on twitter. *Drug Alcohol Depend* 190:1–5. <https://doi.org/10.1016/j.drugalcdep.2018.05.018>

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