





European Society for Medical Oncology (ESMO) 2018 Congress Twitter analysis: from ethics to results through the understanding of communication and interaction flows

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ABSTRACT

Background Twitter is a microblogging service providing a platform for social networking. For medical information, Twitter is an interesting channel for sharing and spreading information and as an engagement platform for different stakeholders. Benefits and caveats of uncontrolled medical information must be carefully pondered, considering the possible intended and unintended adverse outcomes of uncontrolled influencing. The aim of this study was to describe the non-commercial content shared on Twitter and to analyse the level of influence of commercial tweeters during the European Society of Medical Oncology (ESMO) 2018 annual meeting held in Munich.

Design/methodology A retrospective analysis of the tweets shared in the period 19–23 October 2018 indexed with the hashtag #ESMO18 or #ESMO2018 was performed; methodology of systematic reviews was mirrored. Commercial tweeters (pharmaceutical and biotechnology companies, device manufacturers and spam tweeters) were excluded from the primary analysis, and only non-commercial tweets from and about the congress were included. Tweets were analysed using a network analytical tool (NodeXL).

Results A total of 7100 tweets posted by 1334 tweeters were identified for the period of interest. Less than 10% of tweeters were identified as commercial, posting 15.7% of tweets and receiving almost one-quarter of retweets. However, pharmaceutical and biotech tweeters were substantially less likely to be mentioned by other tweeters. All of the top 10 retweeters of non-commercial content were clinicians and/or professional organisations, in stark contrast with the commercial content.

Conclusions The use of social networks in medical meetings, including oncology, is increasing for real-time communication and informed opinion-making. The uncontrolled spread of information on Twitter can both stimulate discussions on non-official and non-canonical channels of communication and provide uncontrolled influencing of diverse stakeholders. The disclosure of financial declarations of interest on Twitter could enhance the transparency of the information, as is already happening in medical journals.

Key questions

What is already known about this subject?

► The use of social networks, especially Twitter, has become common for sharing and spreading scientific information, including in oncology. For the possibility to deliver effective short messages and join online discussions, Twitter has removed some traditional barriers in the communication between key stakeholders in oncology, enhancing the use of this channel as preferential during medical events

What does this study add?

► The analysis of the communication and interaction flows during ESMO 2018 meeting confirmed Twitter to be a common platform of live data sharing during the one major oncology meeting. Intense participation of commercial and non-commercial users has been reported, showing that Twitter may serve as an effective channel for pharmaceutical companies and biotech investors. However, the main users had for non-commercial purposes, intended to share news in oncology for a variegated audience.

How might this impact on clinical practice?

► Despite commercial users are generally identifiable on Twitter, the absence of a clear disclosure of potential conflict of interests (COIs) of non-commercial users may represent an aspect deserving more transparency. Safe and high-quality tweeting during oncology meetings calls all the relevant stakeholders to action, committing for transparency. Our proposal is to disclose relevant COIs when elsewhere provided, such as in peer-reviewed publications, to ensure consistency across the different sources and appropriately inform who access the tweets.

INTRODUCTION

Twitter (Twitter, San Francisco, California, USA) is a microblogging online service established in March 2006.¹ News and updates are posted as tweets, which can reference other

users and include images and links to web pages (URLs). Tweets were originally restricted to 140 characters, but this was extended to 280 characters in November 2017. Brevity is key, sometimes aided by humour, although this can sometimes be misread as sarcasm. Users on Twitter can follow and be followed, but reciprocity is not mandatory. Users can be mentioned (or tagged) in a Tweet (@ identifier), itemising the message with an indexing word (#hashtag). Tweets can be replied to, liked (♥) or shared (retweeted) (see online supplementary file 3). The success of a tweet can be measured by the number of interactions, both likes and retweets. While Twitter is less commonly used by the general population than other social media platforms (in the USA, the figure is put at around 22% of the general population),² it is the most commonly used social media platform at medical conferences. This might be partly due to the brevity of posts, and partly because it is an open platform without a set hierarchical structure, where posts are visible to all users and can be extracted for further study. The immediacy of tweeting means that individuals or professional groups can share opinions and exert influence over wider decision-making in a way that would have been unimaginable a few years ago and can act as a force for constructive change. New scientific and clinical discoveries can be shared via tweets promoting recent publications. However, commercial interests, including pharmaceutical companies and biotech companies, can also influence discussions and have been observed participating in conference tweeting. While commercial influence is heavily regulated by national and international bodies in the physical world (eg, General Medical Council in the UK³ and WHO internationally⁴) and is easily circumscribed in conference venues, it is less well understood in social media.

Aim

The purpose of this study was twofold: to describe the most popular non-commercial content at a major international medical oncology congress (annual European Society for Medical Oncology (ESMO) meeting, Munich, 19–23 October 2018) and to analyse the level of influence of commercial tweeters at that conference.

METHODS

This was a retrospective analysis of the tweets shared at the annual meeting of the ESMO in the period 19–23 October 2018, indexed with the hashtag #ESMO18 or #ESMO2018.

Design

Twitter data were collected retrospectively, day by day, between 19 and 23 October 2018 and were combined to produce an extract that covered the full period of the conference. Data from the early period of the conference, on 19 and 20 October, were shared via Twitter to establish a group interested in further analysis and interpretation. After identifying a considerable volume of commercial tweeters during the early congress extracts,

a plan was made to identify and describe the non-commercial tweets from and about the congress. A total of 7100 tweets posted by 1334 tweeters were identified for the period 19–23 October 2018 (inclusive). To optimise and enhance the data reading, the 7100 retrieved posts were inspected using a series of rapid inclusion and exclusion criteria, as described further, to exclude commercial tweets from accounts promoted by pharmaceutical and biotech companies.

Analysis

NodeXL, a social network analytical tool, was used to extract tweets that included either of the congress-related hashtags #ESMO18 and #ESMO2018. Data about tweets, tweeters and retweets were extracted using methods described previously.⁵

The initial data were incomplete, with some prolific tweeters missing from the extract, as identified by the tweeters themselves. The extraction process was repeated until the Twitter Application Programming Interface provided access to the missing tweeters. In order to quantify the completeness of the data, the tweets posted using the congress hashtags were displayed in a standard internet browser, using the text search function in the browser to count the number of instances of the date (eg, 19 Oct) in the tweets.

NodeXL produces an ‘edge’ for each tweet, retweet and ‘mention’ of a Twitter user in a tweet. ‘Edges’ are defined as connections between two elements of the network. This information was summarised to identify Twitter accounts that tweeted, retweeted and/or were mentioned, using the URL of the individual tweets and the unique identifier of the individual retweets to remove duplicate content. The Twitter accounts were categorised by contribution—tweeting, retweeting and/or mentioned—and displayed in a Venn diagram to identify accounts making a contribution across the different categories. Details of commercial tweeters identified below are blanked out.

The most popular content was identified on the basis of the number of retweets, producing a summary that included tweets from each day of the congress. The most successful tweeters were identified by the number of retweets received. An initial exploration of these data identified that there were commercial influencers—pharmaceutical and biotechnology companies, device manufacturers and spam tweeters—posting throughout the congress and generating a considerable number of tweets and retweets. The most successful and prolific commercial tweeters were excluded and the remaining tweets inspected. Further commercial tweeters were identified at successive stages of the analysis and their tweets were also excluded. Potential conflicts of interest (COIs) were surveyed and collected when users disclosed this information on their profile. However, additional potential COIs were not cross-checked with other external sources, as we restricted the analysis to the content and the information from Twitter. Some individuals posted mixed content during the congress, including posts mentioning

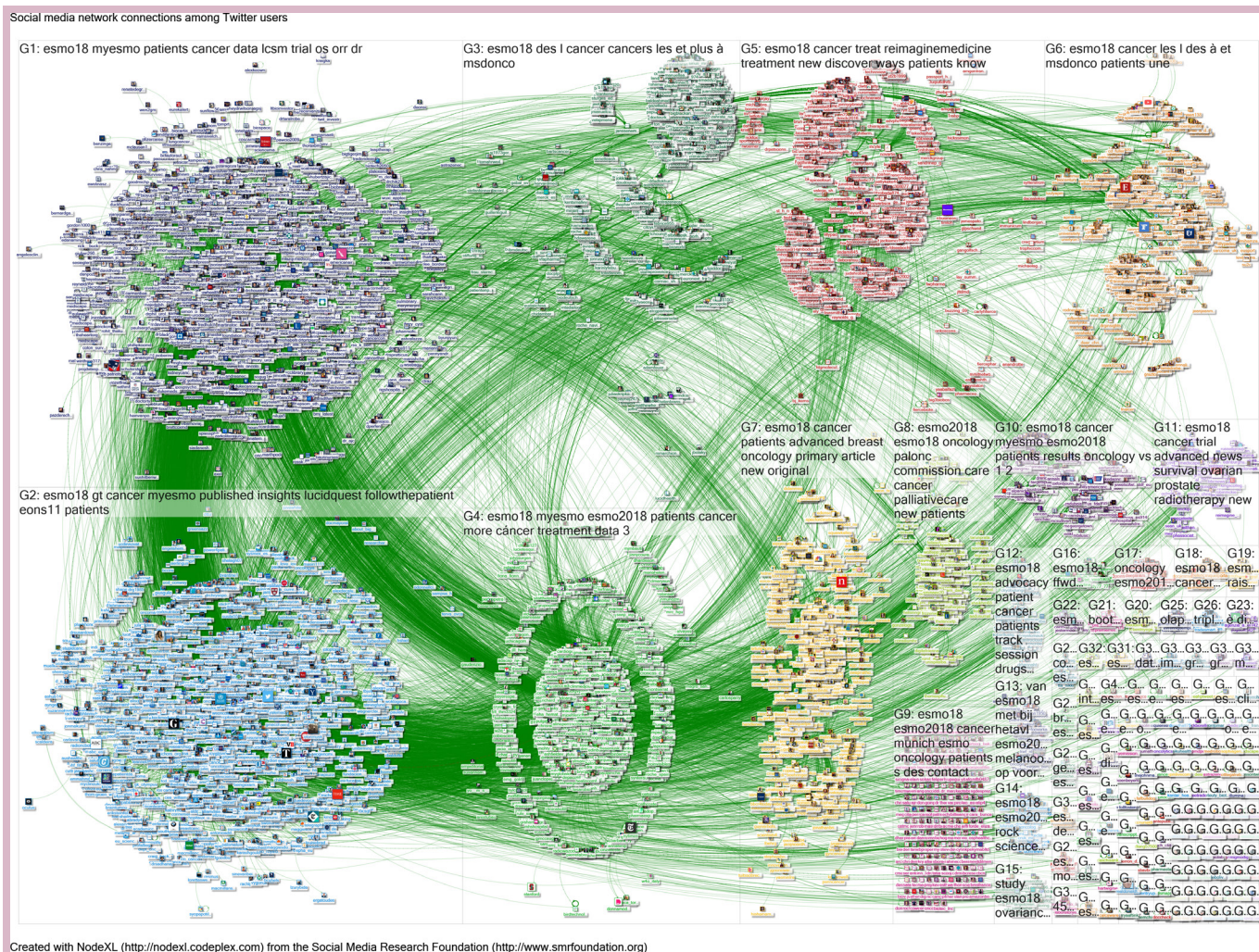


Figure 1 Final NodeXL map of #ESMO18 or #ESMO2018. Source: NodeXL map (14–24 October 2018). ESMO, European Society for Medical Oncology.

pharmaceutical companies and other tweets making clinical/scientific points; where these individuals did not appear to have a link with commercial interests, their clinical/scientific posts were retained in the analysis.

RESULTS

The NodeXL map of interactions between tweeters, retweeters and mentioned Twitter accounts from the full extract is shown in [figure 1](#).

After the initial difficulties extracting a complete dataset, the completeness of the final data was compared with the outputs of a simple Twitter search, displaying the publicly available tweet. Overall, NodeXL identified 7100 tweets, and the Twitter search found 7186 tweets. NodeXL therefore extracted 98.8% of tweets ([table 1](#)).

After applying the inclusion and exclusion criteria shown in [figure 2](#), 9.5% of #ESMO18/#ESMO2018 tweeters were identified as commercial tweeters, posting 15.7% of tweets and receiving 23.6% of the retweets.

After applying these exclusion criteria, the most popular non-commercial content was listed in a Wakelet summary

of ‘top tweets’.⁶ This summary includes some content relating to congress organisation (eg. welcome and details about sessions) and some of the key learning points from plenary speakers and poster sessions. The tweets range from those capturing the comments of speakers to more

Table 1 Number of tweets extracted using NodeXL, compared with Twitter search

Period	Tweets identified using NodeXL	Tweets identified using Twitter search	Concordance (%)
19 October	1448	1453	99.7
20 October	1901	1921	99.0
21 October	1784	1795	99.4
22 October	1408	1433	98.3
23 October	559	584	95.7
All days	7100	7186	98.8

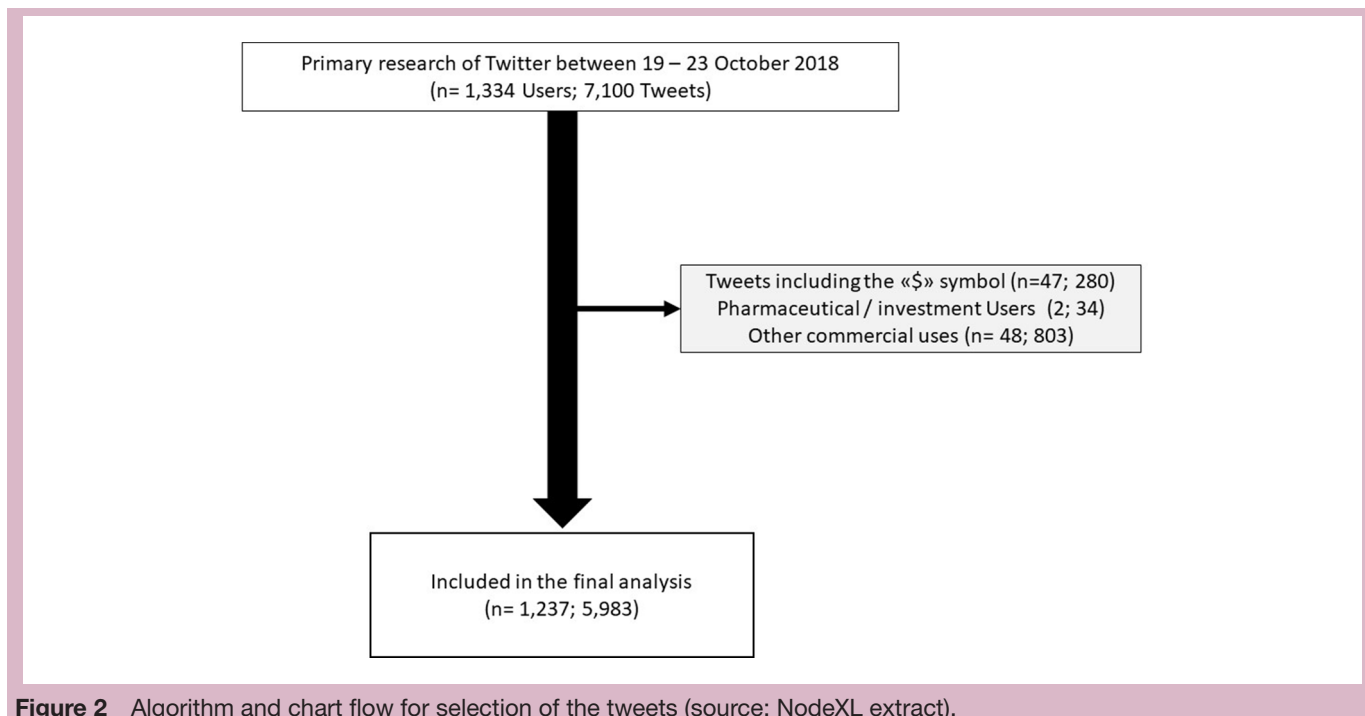


Figure 2 Algorithm and chart flow for selection of the tweets (source: NodeXL extract).

reflective posts, where individual posters add their own views.

The top 20 tweeters included in this analysis, after excluding commercial tweeters, are listed in [table 2](#). The

5983 tweets included in this analysis were posted by 1237 tweeters, with 16 430 retweets.

Eighty per cent of the users delivering ‘non-commercial’ tweets (n=993/1237) had information on the location

Table 2 Top tweeters by number of retweets received 19–23 October 2018 inclusive, after excluding commercial tweeters

Tweeter	RTs received	Tweets posted	% of RTs received	Cum % RTs received	Followers
Myesmo	1060	107	6.5	6.5	27 962
MD	748	50	4.6	11.0	1309
MD	465	67	2.8	13.8	2835
MD	350	27	2.1	16.0	2646
MD	336	138	2.0	18.0	826
Thelancetoncol	311	42	1.9	19.9	19 778
Abcdiagnosis	308	147	1.9	21.8	13 808
MD	307	84	1.9	23.6	1155
Nejm	298	3	1.8	25.5	535 741
Cancernurseeu	253	63	1.5	27.0	2435
Vj oncology	219	83	1.3	28.3	1955
MD	218	25	1.3	29.7	4787
Medscapeonc	196	24	1.2	30.9	24 130
MD	184	25	1.1	32.0	3919
MD	183	13	1.1	33.1	1879
MD	183	18	1.1	34.2	1004
MD	176	14	1.1	35.3	2335
MD	171	35	1.0	36.3	3361
Gustaveroussy	167	34	1.0	37.3	10 856
Onclive	164	70	1.0	38.3	17 573

Source: NodeXL.

Cum, cumulative; MD, medical doctor; RT, retweet.

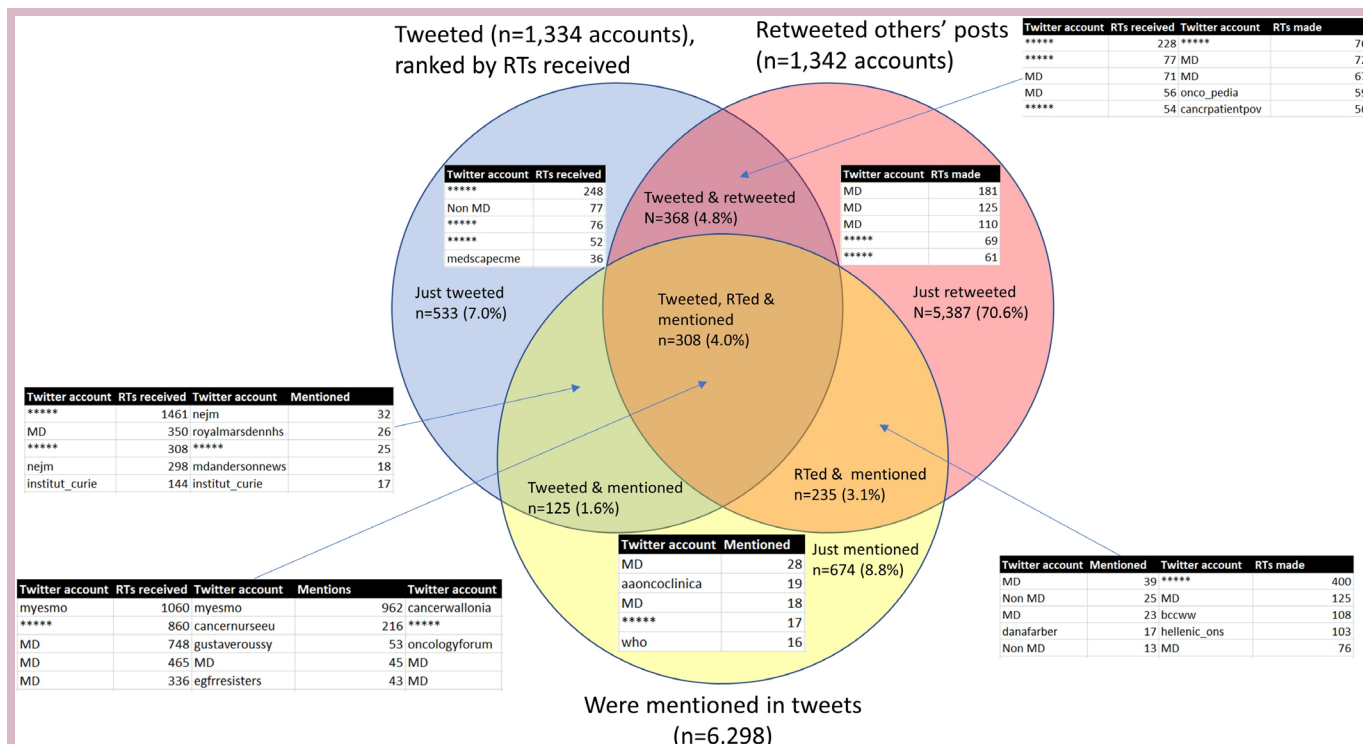


Figure 3 Venn diagram showing tweeters, retweeters and mentioned Twitter accounts for #ESMO18/#ESMO2018 tweets (source: NodeXL (listed accounts were in the top five for that category, for the listed measures)). n=7630 accounts (source: NodeXL extract). Commercial tweeters are blanked out using asterisks. In order to protect anonymity, individual users have been shown as either MD or non-MD. MD, medical doctor; non-MD, non-medical tweeter; RT, retweet.

section of the profile, in terms of regions of the world; of them, for 95.9% (n=952), it was possible to identify also their country (online supplementary appendix 1). More than 90% of the users were registered in a European country (n=575), USA (n=260), Canada (n=26) and Australia (n=21) (online supplementary appendix 2).

Overall, 178 (14.4%) of the included tweeters received 80% of retweets, while 373 (30.2%) of the included tweeters received no retweets. The official account of ESMO, @myesmo, ranked first for the retweets received, leading the information on the network. The most influential tweets were posted by two top oncology journals and oncology web channels and by the members of the ESMO faculty and ESMO committees.

Data on individual tweets, tweeters, Twitter accounts mentioned in tweets and retweeters are shown in figure 3, looking at included and excluded tweeters. Details of pharmaceutical companies and biotech investors have been blanked out in the figure, and details of individuals posting non-commercial posts have been anonymised.

Pharmaceutical and biotech tweeters were among the most prominent Twitter accounts by retweets received, mentions and/or retweets made. Further analysis, however, shows a more complex picture. As identified in figure 1, pharmaceutical company and biotech tweeters made up 9.5% of tweeters but posted a significant number of tweets (15.7%) and received an even higher proportion of retweets (23.6%). However, pharmaceutical and biotech tweeters were substantially

less likely to be mentioned by other tweeters. In total, there were 5241 mentions of 1342 Twitter accounts in #ESMO18/#ESMO2018 tweets; for pharmaceutical and biotech accounts, there were only 215 mentions (4.1% of the total) of 37 accounts (2.8% of the total).

Retweeters also differed for tweets excluded and included in the analysis. Of the 21 511 retweets made, 5081 retweets were by the excluded group. NodeXL recorded details of the individual retweeters for 5071 of these retweets. All of the top 10 retweeters for the pharmaceutical/biotech tweets (making up 21% of these retweets) were themselves pharmaceutical and/or biotech or anonymous (n=3 had no details in their Twitter profile). In contrast, for the included tweets, of the 15 364 retweets with individual details, all of the top 10 retweeters (making up 13% of these retweets) were clinicians and/or professional organisations, with full details in their profile. One of the clinicians stated interest in 'business'.

DISCUSSION

This study describes Twitter activity during the ESMO Congress 2018, a major international forum for sharing new research and updates in medical oncology. It introduces new methods for describing and understanding the social media content and contributors at a conference of this size. The methodology mirrors that of systematic reviews of the scientific literature. The search term, inclusion and exclusion criteria, completeness of data and

publication bias, validity of data and potential COIs were assessed, providing a conceptual framework of reporting social media activity at medical conferences.

One of the weaknesses of the study could be that the Twitter activity recorded relates specifically to tweets using the hashtags, not the subsequent replies, unless they also included the hashtag. Some of the tweets generated a large number of replies; for example, one prominent tweet received 66 replies, only one of which used either hashtag.⁷ Extracting details of all related replies would not be feasible for a congress of this size, so the analysis has focused on tweets using the congress-related hashtags. While Twitter search results are available indefinitely, with tweets available from the start of Twitter (2006), social network analysis has a limit of 9–10 days, and 18000 tweets and/or retweets, which is sufficient for most medical meetings, sometimes combining extracts over several days as was the case here.

Social media have been shown to have a role in disseminating findings at conferences⁸ and, more generally, in public events. Twitter has been proposed as the ideal ground for networking and developing discussions in global oncology, ensuring equal access to education for healthcare providers, including cancer care providers. Clinicians, scientists, patients and the general public rely on evidence-based information, shared safely and free of commercial influence. The role and potential benefit of information and communication technologies for health, including social network platforms, have been highlighted by the WHO as a way to enhance the education of the health workforce.⁹ For instance, according to the WHO EURO report 'From Innovation to Implementation, eHealth in the WHO European Region',¹⁰ 'Healthcare social media can also be a source where relevant activities and discussions can enhance the continued professional development for nurses and other health professionals, as well as for patient education'. In fact, one study showed that non-profit organisations (NPOs) and community groups provide the highest rate of tweets about health literacy, among users of the social networking platform, highlighting the educational role of the key stakeholders operating under the umbrella of medical or scientific NPOs. This emphasises the responsibilities of scientific societies that provide clinical recommendations as well as NPOs advocating for patients' care.¹¹

Oncologists and other cancer healthcare providers, including cancer nurses, are increasingly joining social media platforms for professional purposes, actively participating and sharing case studies and reports.¹² As a result, this provides a key opportunity to allow users to connect directly to experts in the field and enrich their knowledge. Furthermore, the use of a virtual interaction platform reduces issues related to hierarchy, allowing two-way information sharing from trainees to senior physicians and professors and providing a novel e-mentorship platform.

However, commercial influencers are attempting to influence social media, biasing the dissemination of

information. Our study demonstrates the heterogeneous nature of information during a major international medical congress (ESMO Congress 2018), both for dissemination of new knowledge from key opinion leaders and as part of pharma marketing, with pharmaceutical/biotech tweeters receiving almost a quarter of all retweets mainly generated from within the pharmaceutical and biotech community. Nevertheless, pharmaceutical/biotech tweeters were much less likely to be mentioned in congress tweets (4.1% of tweets), suggesting less interest and potential influence on this network of clinical tweeters. While the Wakelet summary has been filtered to remove pharmaceutical companies and other commercial tweeters, the view of the ESMO Congress 2018 from a simple Twitter search for the congress-related hashtags was heavily populated with commercial tweets. The view of tweets depends on Twitter settings, with popular content ranking highly in the 'Top' tab on Twitter. On this basis, it is likely that commercial tweeters achieved extensive visibility, with or without paying for advertising. Delegates searching for the conference hashtag on personal computers or mobile devices may not realise that they are viewing and/or sharing commercial posts. Analysing the category of tweeter, as shown in figure 3, is therefore relevant. This analysis provides insights into the people and organisations leading conversations in the congress venue and on social media, and their further dissemination.

Though there are important potential benefits in scientific communication via Twitter, a number of caveats and potential adverse outcomes in its use have been identified.¹³

First, the diffusion of unpublished data has been argued to reduce the appeal for publication of high-impact journals.¹⁴ However, tweeting can also be part of an effective communication strategy including 'teaser' posts that increase visibility and visual abstracts that translate findings in a more digestible way.

Second, the excitement related to the disclosure of long-awaited data could generate unrealistic expectations. Oncology is, arguably, particularly susceptible to this phenomenon with 'miracle cure' claims commonly posted in the lay press. For instance, the hype for interesting exploratory results and the promotion of results demonstrating narrow benefit for innovative cancer interventions by pharmaceutical companies could outshine the real magnitude of benefit in clinical practice, potentially providing a misleading message for the community, including health providers and patient advocacy groups.

Finally, Twitter does not request the disclosure of declarations of interest for the subscribers, unless representing a company. As a result, it has been argued that pharmaceutical companies can engage health providers to hype drugs, strategically promoting some medicines, as well as stressing the positive achievements of clinical trials. In a report by Kaestner *et al*, almost 80% of haematologists–oncologists on Twitter had some COIs with companies.^{15 16} Interestingly, 80% among the most active haematologists on Twitter mentioned at least one drug

from a company for which a financial COI was disclosed elsewhere. However, 1.3% reported such conflict on their Twitter profile: of the total drug mentions, more than 50% regarded conflicted drugs. The message is that pharmaceutical companies can directly or indirectly highlight and hype their own business, providing ambiguous messages for patients and providers on unregulated but widely used social network channels; an example of *polytropos* pharma influencing strategies. For instance, in our study (figure 2), a substantial proportion of tweets belonged to pharmaceutical companies, raising concerns from medical tweeters, before filtering and exclusions were applied. It is therefore reassuring that 90% of tweeting was not commercially related, demonstrating the level of interest in the ESMO 2018 Congress by scientists and clinicians from within the congress venue and beyond. Wading through commercial posts to find these non-commercial posts was, however, dispiriting and was noted by participants at the congress and on social media.

This analysis shows the extensive tweeting about a major international oncology congress. Understanding the way that information is disseminated on social media is important, particularly considering effectiveness, access and cost of treatment. Professionals, pharmaceutical companies and biotech investors all tweeted about the congress. A more recent cancer conference in the UK (#NCRI2018) did not identify pharmaceutical or biotech tweeters among its top influencers in a NodeXL extract.¹⁷ Analysis of previous conferences on other topics, including infectious diseases and cardiology, has not illustrated a similar level of commercial influence.^{18–20}

Once the commercial posts were excluded from the #ESMO18/#ESMO2018 analysis, we were able to extract clinical and scientific information less likely to present marketing-related bias, even though the volume of tweets initially seemed overwhelming. The Wakelet summary⁶ shows the text and any images and lets the viewer explore further content (eg, replies). The summary captures posts from plenary, parallel and poster sessions, with coverage of the congress that would have been unachievable for individual delegates. The summary also potentially has value beyond this current analysis. Materials presented at conferences may not ultimately be published in peer reviewed high-impact journals. We know that trials presenting positive findings may be favoured over studies showing no effect, as enthusiasm for novelty generally prevails, leading to publication bias. Reading the congress programme, viewing congress-related tweets and searching trial registries could potentially allow the identification of unpublished research and preliminary findings from such research. This could overcome the often described publication bias of scientific publications.

It would be difficult, if not impossible, to regulate the dissemination of health-related information on social media as it is currently organised. Nonetheless, the findings of this analysis should make conference organisers and all the relevant stakeholders consider options for managing such content in the future, either through

voluntary codes, a separate hashtag for pharmaceutical companies and biotech investors to use (eg, #pharma or #biotech), or showing tweeters how to use the Twitter search function to exclude specific tweeters. Adding a '-' symbol in front of a search term excludes that term from the search, so individual tweeters or tweets using specific hashtags can be easily removed from searches (using '-from:' in front of an account name in a Twitter search excludes tweets from that user). Such approaches can equally apply to individuals and campaigns of public health interest, such as those tweeting about vaccination, tobacco control and infectious disease pandemics.

Social media have their place in delivering, learning and sharing data around medical oncology. However, just as with traditional reporting and research, we need to critically appraise content and consider COIs before deciding what to read and believe. The observation that pharmaceutical companies and investors made such a concerted effort to influence this medical oncology congress should raise questions about similar influence on wider tweeting and future conferences. On the other side, healthcare providers and other key stakeholders can play critical roles in the strategies of marketing of tradable goods, even if not directly on behalf of companies, so that it becomes essential to tackle the broader environment that can generate COI. In this, policies and recommendations from international organisations are called for to regulate commercial interests in conference tweeting and more generally.

A quality check for Twitter has not been established so far: a reliable fingerprint to favour the diffusion of high-quality evidence to inform appropriate media communications is currently lacking. Manipulation for profit can still occur, giving false hopes to patients with clear potential for harm from inappropriate and biased messages.

We have quantified the level of commercial tweeting and suggest a call to action, to develop a framework for safe and high-quality tweeting during future ESMO congresses, leaving no stakeholder, patient or user misinformed. Again, it is everybody's commitment for the best care.

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Correction notice This paper has been updated since first published. An extra incorrect affiliation was removed for Dario Trapani and Giuseppe Curigliano, and incorrect initials were removed from the name of Giuseppe Curigliano.

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Competing interests None declared.

Patient consent for publication Not required.

Ethics approval Ethical approval was not required for this study as it used publicly available data shared at or in tweets about the ESMO 2018 Congress, and did not include identifiable patient data.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as supplementary information.

Author note AP served as consultant and had an advisory role for Astra Zeneca, Bristol Myers Squibb, Roche Genentech, Dako/Agilent and Merck Sharp & Dome. GrM and GiM declared no potential COI. ML received speaker honoraria from Theramex and Takeda. SZ reported personal fees and non-financial support as travel support and congress sponsorship from Roche Genentech, Bristol-Myers-Squibb (BMS), Astellas, Merck, Eli Lilly, AstraZeneca and Amgen. PG had personal financial interests with Roche; speaker and advisory roles for AstraZeneca (speaker and advisory roles), BMS (speaker and advisory roles), Guardant Health (advisory role), MSD (speaker and advisory roles), Pfizer (speaker and advisory roles), Janssen (advisory role), Boehringer Ingelheim (speaker and advisory roles), Novartis (speaker and advisory roles), Gilead (speaker), Rovi (speaker), Abbvie (advisory role), Lilly (advisory role), Takeda (speaker and advisory roles), Sysmex (speaker), Blueprint Medicines (advisory role and other); and institution financial interests related to clinical trials with Roche, Lilly, MSD, Novartis, Takeda, Blueprint Medicine, AstraZeneca, BMS, Janssen, BI and Abbvie. GC had personal financial interests as speaker with MSD; advisory board at Mylan; speaker and advisory board at Lilly, Pfizer, Foundation Medicine, Samsung and Celltrion; speaker and consultancy at Seattle Genetics and Nanostring; speaker and consultancy and advisory board at Roche; speaker and writing engagement: Novartis and BMS; scientific affairs group: Ellipsis. Others: member of the executive board of EUSOMA, member of the scientific committee of Europa Donna; member of scientific committee of Fondazione Beretta; member of the executive board of Lega Italiana Lotta ai Tumori (National Public Agency).

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