



## DOCENCIA - INVESTIGACIÓN

### Use of Twitter at 17th and 18th International Nursing Research Conferences

El uso de Twitter en los XVII y XVIII Encuentros Internacionales de Investigación en Cuidados

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### ABSTRACT

The aim of this paper is to propose a roadmap to analyze the use of the Twitter social network during the days when a conference is held. The main reason is the lack of practice to perform this task in the Spanish context, against the habit of doing at international conferences, with special emphasis in Health Sciences. With the Opileak technology, all messages were monitored on the social network Twitter during four days of the International Nursing Research Conferences, organized by Carlos III Healthcare Institute's, Nursing and Healthcare Research Unit (Investén-ISCIII). The process was made when the conferences were closed in the years 2013 and 2014, both had their own hashtags: #inves13 and #inves14. The results show that users tend to retweet more over time than original tweets; the main days of the conference have also the highest activity on the social network; users take different roles, being some good informers or well-informed users; the words used are a tribute to the cities where the conferences are held, the theme of the conferences and their international character. This type of analysis should perform by the organization of any meeting to discover the event impact on a communication channel 2.0.

### RESUMEN

El objeto de este artículo es proponer una hoja de ruta para analizar el uso de la red social Twitter durante los días en los que se celebra un congreso. La principal motivación se fundamenta en la poca práctica de realizar esta tarea en el contexto español, sí es habitual hacerlo en congresos internacionales, con especial énfasis en el campo de los encuentros en ciencias de la salud. Con la tecnología propia de Opileak se monitorizaron todos los mensajes difundidos en la red social Twitter, durante los cuatro días del Encuentro Internacional de Investigación en Cuidados y que son organizados por la unidad Investén del Instituto de Salud Carlos III. El proceso se realizó tras haber finalizado las conferencias celebradas en los años 2013 y 2014, contando cada una con su propio hashtag: #inves13 e #inves14. Los resultados demuestran que los usuarios tienden a retuitear más con

el paso del tiempo que a emitir tuits originales; los días centrales del congreso también lo son en cuanto a la actividad en la red social; los usuarios toman diferentes roles siendo algunos buenos informadores y otros estando bien informados; las palabras que utilizan son un reconocimiento a las ciudades donde se celebran los encuentros, a la temática del encuentro y a su carácter internacional. La organización de cualquier encuentro debe realizar este tipo de análisis para descubrir el impacto del evento en un canal de comunicación 2.0

## INTRODUCTION

### Scientific communication and Twitter

The emergence of Twitter's microblogging service in 2006 and its popularisation in 2007 on the occasion of the South by SouthWest (SWSX) conference changed the dynamics of everyday communication <sup>(1)</sup>. The main characteristic of the service is its 140-character limitation on the length of texts briefly describing users' moods, which are automatically conveyed to other users to whom they are connected via Internet.

These processes, which form part of what is known as communication 2.0 <sup>(2)</sup>, have also impacted the many scientific encounters attended periodically by professionals in a wide variety of fields. While such meetings are important in all specialities, bringing together healthcare professionals is especially beneficial for efficient organisational operation <sup>(3)</sup> as well, secondarily, as for the people involved and their patients.

In what might be referred to as the pre-social network world, congresses were announced as broadly as possible among potential participants, namely professionals, students, teachers and researchers. They were publicised primarily in the form of hard copy diptychs, triptychs or posters. In the late twentieth century, organisers quickly identified the potential of (then) 'new' avenues such as the internet and electronic mail. At the time, the materials submitted to such events and their content were only accessible by attending or obtaining a copy of the proceedings, published in hard copy or on CDs distributed exclusively to participants. With such restricted circulation, this type of documents was relegated to the status of grey or non-conventional literature <sup>(4)</sup>. Like so many other areas of everyday and professional life, congresses have been affected by the great and ongoing recession, in two ways. On the one hand, the resources available for organising such events have contracted. And on the other, potential participants have had to adapt to attendance with less financial support. That has frequently led to a pursuit of alternative forms of participation to avert the cost of several days' attendance at a distant venue. Professionals and researchers participating in these periodic meetings have noted a substantial downturn in the number of face-to-face participants in recent years.

To counter that trend, two technological alternatives have been deployed to make scientific encounters more open and convert what might have been the beginning of the end of scientific meetings into options to meet the purpose for which they were created. One is to stream the sessions live, on occasion subject to payment of virtual attendance fees <sup>(5)</sup> but enabling participants to save on travel expenses; and others with no cost to the viewer, in real time or a posteriori. The second is to capitalise on what are generally known as social networks through which congress highlights can be disseminated <sup>(6)</sup>.

Networks such as Twitter, Facebook, Google+ and Youtube, inter alia, propagated so swiftly after their appearance that they presently form a significant part of everyday

life<sup>(7)</sup>. Rare is the well-organised congress with quality content today that does not make use of at least one social network.

Of the various possibilities, the present study focused on Twitter, which can be used at different stages of an event. Timing (before, during or after the conference) conditions the number of potential followers and the purpose for which its use is best suited<sup>(8)</sup>. Before a congress, network use is geared to disseminating information on the programme, the keynote speakers, registration details or logistics such as the exact location of the venue or recommended lodging. In this stage the organisers attempt to motivate and guide the target community. During the congress, the vehicle can be used to announce changes, distribute photographs or focus on specific content. Issues directly associated with the content of greatest significance are generally addressed in this stage. In the post-congress stage, the network is used to thank participants for attending, share final reflections or report statistics. As appropriate, it may also afford the opportunity to announce forthcoming events.

Congress organisers generally have a Twitter account (often among others) and establish one or several hashtags<sup>(9)</sup> with which users can label their event-related instant messages.

This study analysed the use of the hashtags (#inves13 and #inves14) created for meetings held in two consecutive years, 2013 and 2014. The information conveyed under the respective labels was analysed with a view to replying to the following questions about the events at issue. The answers aim to provide event organisers with a roadmap for the mandatory post-congress analysis of Twitter use. The questions explored were as follows.

- Do users interact in ways which, like formal bibliographic citations, constitute a record of the mentions in their re-tweets?
- Does hashtag use peak at certain times during a congress?
- Do tweeters play different roles of potential significance, acting, for instance, as good informers or well-informed users?
- Do the terms used reveal semantic content closely associated with the theme of the congress?

### **Previous research**

International interest around the analysis of communicating with this social medium is on the rise in the health sciences<sup>(10)</sup>. Papers have been published on the use of Twitter at scientific meetings for anaesthesiologists<sup>(11)</sup>, clinical oncologists<sup>(12)</sup>, urgent care specialists<sup>(13,14)</sup>, nephrologists<sup>(15)</sup>, ophthalmologists<sup>(16)</sup>, surgeons<sup>(17,18)</sup>, Radiologists<sup>(19)</sup>, health promoters<sup>(20)</sup>, pharmacologists<sup>(21)</sup> and urologists<sup>(22,23)</sup>, to name a few.

These are not, however, the only fields where attempts are being made to ascertain the communication patterns characteristic of social networks. Research has also been conducted around international congresses on multi-media education<sup>(24)</sup>, web bloggers<sup>(1)</sup>, modern language<sup>(25)</sup>, the Semantic Web<sup>(26)</sup> and community managers<sup>(27)</sup>.

Contrary to this international interest, research on the subject in connection with national congresses has been largely neglected<sup>(28)</sup>. That is unfortunate, for the

feedback that can be obtained in the wake of scientific meetings in general and of healthcare congresses in particular is very valuable.

### **The International Nursing Research Conference**

One of the many international events held in Spain is organised by the Carlos III Healthcare Institute's Nursing and Healthcare Research Unit (*Spanish acronym, Investén-isciii*), which since 1996 has hosted the International Nursing Research Conference to enhance nursing professionals' qualifications and strengthen the scientific basis for nursing. In Spain the Carlos III Healthcare Institute is a prominent public research body (Spanish initials OPI) that finances, manages and conducts nationwide healthcare research. Investén, as a research unit under the aegis of the aforementioned institute, aims to promote and coordinate overarching and interdisciplinary nursing research on a national scale.

Since 1996, every year in November professionals and researchers engaging in different areas of healthcare present their findings to the scientific community in an atmosphere that encourages reflection, exchange of opinions and knowledge sharing. The sessions address the application of new technologies to healthcare; cancer; healthcare for women, children and teenagers; nursing and mental health; palliative care; nursing education; ageing and health; gender, healthcare and vulnerable populations; evidence-based practice; the use of research; and assessing healthcare outcomes.

The sessions in which participants present their communications are supplemented by training workshops. Two plenary sessions are held, with prominent healthcare experts as keynote speakers.

### **MATERIALS AND METHODS**

Twitter activity was monitored during the 17<sup>th</sup> International Nursing Research Conference held at Lleida, Spain, on 12 to 15 November 2013 and the 18<sup>th</sup> edition of the same conference held at Vitoria-Gasteiz (also in Spain) on 11 to 14 November 2014. All the tweets bearing the official conference hashtags (#inves13 and #inves14) were compiled from the first day, a Tuesday, at 3:00 PM through the last, a Friday, at 3:59 PM.

These data, gathered with Java-based Opileak technology <sup>(29)</sup> included all the tweets so labelled, including re-tweets and basic user information. All the data collected were subsequently anonymised for analysis. To facilitate interpretation, social network analysis (SNA) methodology was used to generate graphics showing, among others, participants' nodes and their inter-relationships. The social structure inferred from user interaction was then analysed to ascertain structural dynamics. All the records generated in the period studied were also described. Lastly, the tweets collected were analysed for their semantic content. In many of the studies cited in the section on previous research messages were classified into categories, a method that calls for intensive human intervention. The automated determination of their semantic content, the procedure chosen here, can be as or more informative, however.

The software used for these purposes included a Microsoft Excel 2007 spreadsheet for the descriptive analysis, Pajek for network analysis and R for semantic analysis.

In addition to labelling messages with a hashtag indicative of content, tweeters can mention other network users in their tweets. Information can be gleaned from the resulting network of mentions, which reveal a web of asymmetric relationships, in which tweeter A's mention of tweeter B is unlikely to be reciprocated.

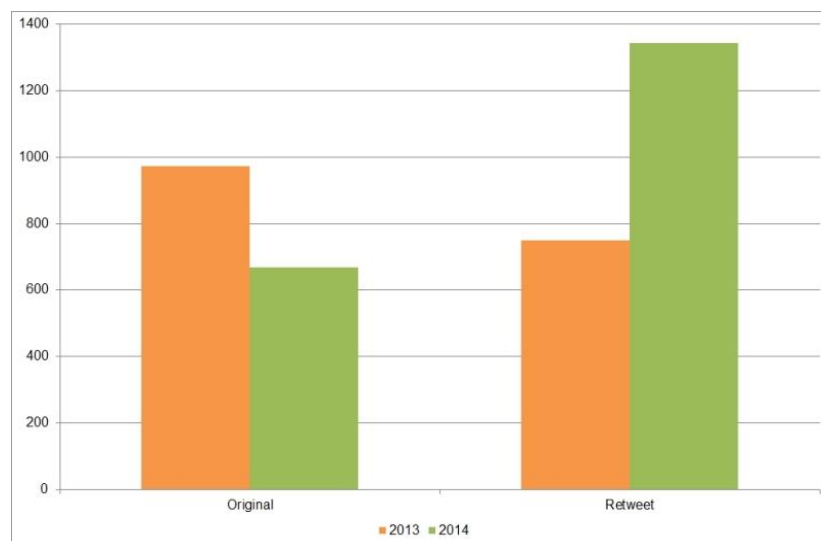
Hashtags are identified in tweets by the use of the symbol #, whereas mentions are preceded by an @. Hence, a hypothetical tweet with two mentions might look something like this: '@userA RT: @userB: presenting a communication at #inves14 with @userC'. The message type would be a re-tweet and the relationships would be recorded as mentions by tweeter1 of tweeter2 and tweeter3. All users' mentions were compiled to build a 1-mode, two-dimensional matrix with the asymmetric and weighted relationships.

The semantic analysis covered all the tweets sent over the period defined earlier in this section. To simplify generation of the word cloud<sup>(30)</sup> based on the semantic content of the meetings, all the information identifying hashtags (#), re-tweets (RT), users (@) links and all other punctuation marks were deleted. All articles, prepositions and conjunctions were likewise deleted and all letters were converted to lower case. The outcome of these operations was a word cloud in which each term was assigned a colour and its position and typeface were indicative of its frequency of use.

## RESULTS

The 2013 encounter attracted a total of 498 participants. In response to its call for papers, the congress organisers received 585 abstracts and accepted 473. While more participants attended the 2014 edition of the conference (527), fewer abstracts were received: just 510, 433 of which were accepted.

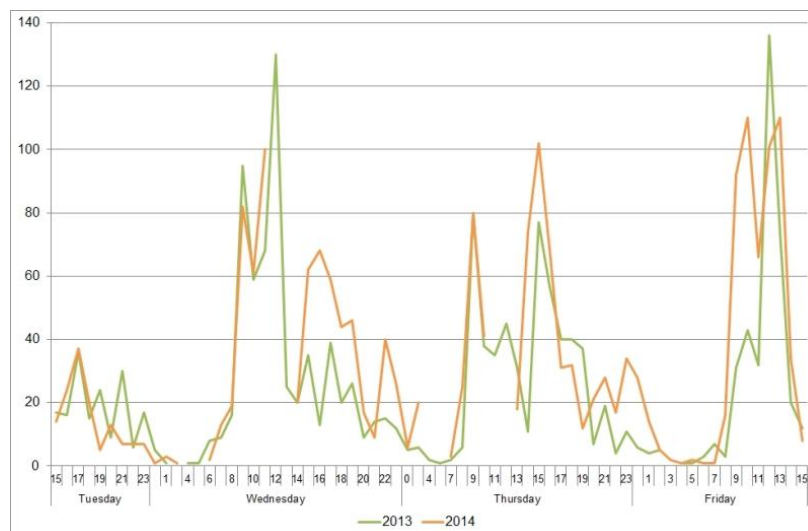
The 3 734 tweets recorded in the periods studied in the two years formed the body of data from which user interaction was analysed. Of these, 1 640 were original tweets and 2 094 re-tweets, a procedure comparable to the use of bibliographic citations in scientific papers. Year-by-year, based on the use of the hashtags #inves13 or #inves14 (orange and green series, respectively, in Graph 1), in 2013 more original tweets than re-tweets were sent (973 versus 750). These numbers were reversed in 2014, when re-tweeting prevailed (1 344 to 667 tweets).



Graph 1. Original and re-tweeted messages using the event hashtags

The volume of activity labelled by the hashtags fluctuated over the periods studied. This finding is of interest to any congress organiser, for whom information on the days and times of day when activity is most intense is instrumental for the dissemination of key information. The yearly event studied traditionally lasts 4 days, generally from Tuesday through Friday in nearly the same week every year. During the two editions of the congress studied, network traffic tended to be scant on the first Tuesday. The other three were the key days for this meeting.

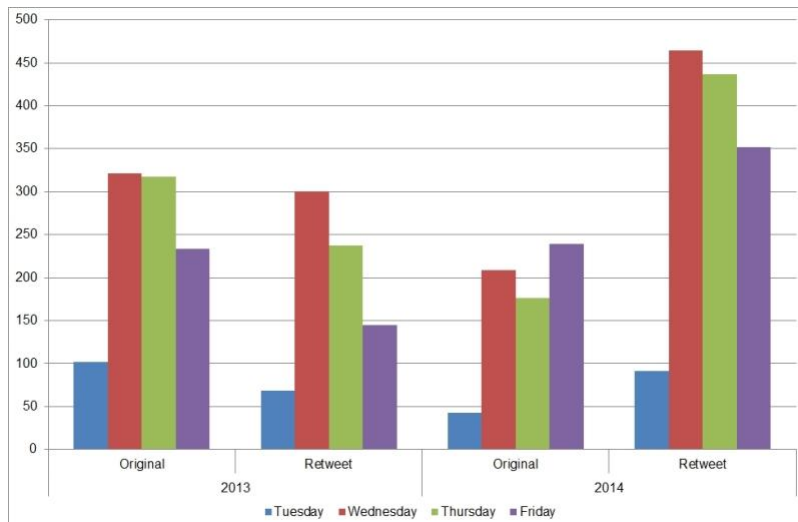
Day-by-day, in 2013 traffic peaked at 5:00 PM on Tuesday, 12:00 noon on Wednesday, and at 9:00 PM on both Thursday and Friday. In the second year, 2014, intensity was highest on Tuesday at 5:00 PM, on Wednesday at 11:00 AM, on Thursday at 3:00 PM and on Friday at 10:00 AM and 3:00 PM. A detailed account of message volumes by day and time is provided in Graph 2.



**Graph 2.** Messages labelled with the congress hashtags by day of the week and time of day

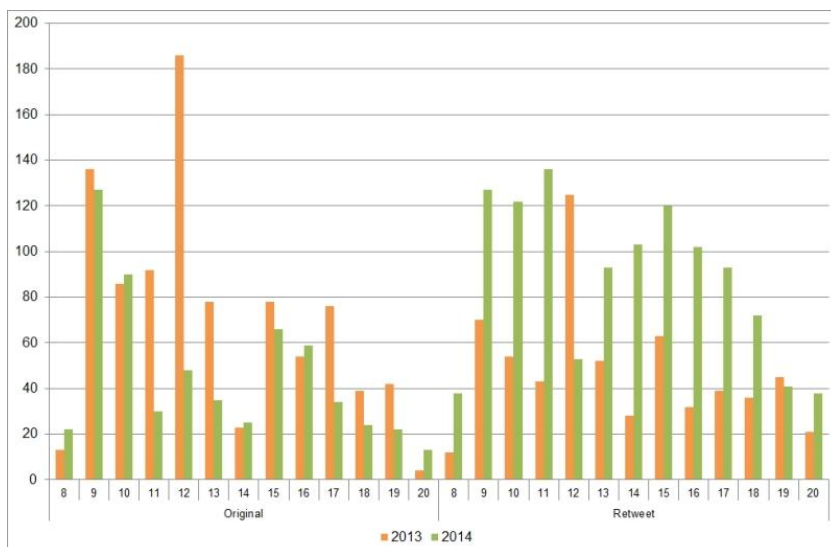
Differences were also detected between original tweets and re-tweets by day of the week: in 2013 the number of the former was highest on Wednesday, followed closely by Thursday. In 2014, the number of tweets was slightly lower than the year before and activity was most intense on Friday, followed by Wednesday. In both years, Tuesday's traffic was substantially lighter than on the other three days.

The re-tweet dynamics in 2014 mentioned earlier were confirmed by the data in Graph 3. Activity was very similar on Wednesday and Thursday that year, with mean values of nearly 450 messages per day. With the exception of Tuesday, day-by-day, the number of re-tweets in 2014 exceeded all the other types of messages sent in either of the two years. In 2013, original content prevailed and the differences between tweets and re-tweets were similar on all four days, with somewhat smaller absolute values recorded for the latter.



**Graph 3.** Tweets and re-tweets labelled with the congress hashtags by day of the week

Although activity was recorded all day long, this analysis focused on the 8:00 AM to 8:00 PM time frame to exclude normal rest periods (Graph 4). That lowered the total number of messages from 3 734 to 3 260. Original tweets were sent primarily at 12:00 noon or at 9:00 AM in 2013 and at the latter hour in 2014. Re-tweeting was also most intense at 12:00 noon in 2013, whereas no prominent peak times for re-tweeting were observed in 2014. Frequency was similar between 9:00 and 11:00 AM and 3:00 and 6:00 PM.



**Graph 4.** Tweets and re-tweets labelled with the congress hashtags by time of day (8:00 AM to 8:00 PM)

Tweeting activity is determined by tweeters. In addition to varying the intensity of their activity on the days of the congress, users adopted different roles. Although the criteria for defining such roles vary, here the approach consisted in differentiating between good informers and well informed users.

In the 4-day duration of the 2013 congress, 332 users sent tweets with the #inves13 hashtag, while nearly double that number, 612, were active in 2014. With such large numbers, all users were unlikely to have assumed the same role in connection with mentions, with some acting as good informers and others as well-informed tweeters.

HITS (initials for Hyperlink-Induced Topic Search), an algorithm often but not exclusively used to detect structures in cyberspace <sup>(1)</sup>, was deployed here to identify such roles. Two were detected: hubs and authorities <sup>(31,32)</sup>. According to Jon Kleinberg (in reference to websites), a node is a good hub if it points to good authorities, defined in terms of the characteristics of its outgoing links. Conversely, a node is a good authority if it is pointed to by many good hubs, defined in terms of the characteristics of its incoming links. This mutually reinforcing mechanism is described by the relationships calculated from the following expressions <sup>(33)</sup>:

$$\lambda y_i = \sum_{j:i \rightarrow j} x_j = \sum_j A_{ji} x_j = (A^t x)_i$$

$$\mu x_i = \sum_{j:i \leftarrow j} y_j = \sum_j A_{ij} y_j = (A y)_i$$

These may be rewritten as simple equations, with the eigenvalue substituting for the values of x and y:

$$\lambda \mu x_i = (A A^t x)_i$$

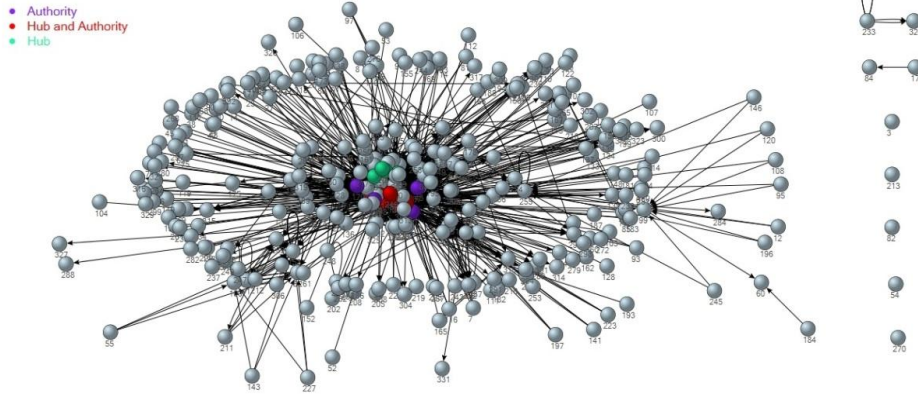
$$\lambda \mu y_i = (A^t A y)_i$$

Hub and authority scores are the vectors for matrices  $A A^t$  and  $A^t A$ , both of which are symmetrical, whereas A may be symmetrical or otherwise. The scores for x and y are determined by the vectors for their respective matrices.

The network of 332 users sending tweets labelled #inves13 had a strong component that included 97 % of the nodes. The nodes on the right-hand side of the graphic in Figure 1 represent tweeters who made no mention of other users and where thus excluded from that component. Some users self-mentioned in their tweets, a practice comparable to self-citations. This was represented in the network with an arrow beginning and ending at the same node. Purple was the colour chosen to identify good authorities, i.e., good informers. The good hubs or well-informed users are shown in green. Red nodes denote users that were both good informers and well informed tweeters.



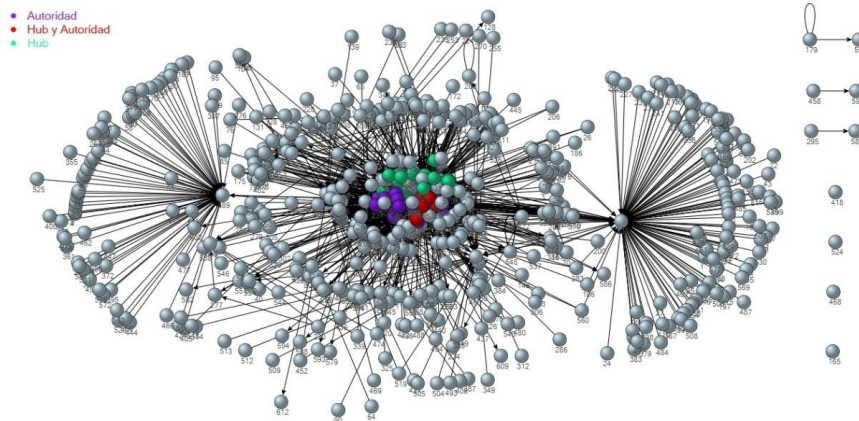
*Network of mentioned users #inves13*  
(Twitter, November 12 - 15, 2013)



**Figure 1.** Mentions among users sending tweets labelled #inves13

The network topography for the 612 #inves14 hashtag users did not exhibit the same centre-periphery structure as the #inves13 user network. Here (see graphic in Figure 2) the centre was connected to the periphery by two key users, 489 and 536. Nonetheless, both the hubs and the authorities were located in the centre of the network. The percentage of users in the strong component was similar: 98 %.

*Red de usuarios mencionados #inves14*  
(Twitter, 11 - 14 noviembre 2014)



**Figure 2.** Mentions among users sending tweets labelled #inves14

The SNA <sup>(34)</sup> measurements given in Table I synthesise the main properties of these two graphics.





Figure 4. Term cloud for tweets labelled #inves14

Just as users are inter-related by means of mentions, terms appear in contexts that place them alongside other terms. The proximity between terms is measured by their correlation and provides information about the context in which they were used.

For the four most prominent terms in Figure 3, the words with the closest correlation to Lleida were *acoger*, *evento* and *orgullo* (host, event and pride). The expressions closest to *investigación* (research) were *cuidados*, *internacional* and *conoces* (nursing, international and you know). The expressions closest to *cuidados* (care) were *investigación*, *internacional* and *conoces* (research, international and you know) and for *salud* (health) they were *impacto*, *helena*, *crisis*, *legidoquigley* (impact, helena, crisis and legidoquigley). Table II lists the correlation values for each term.

Lleida	Corr.	investigación	Corr.	cuidados	Corr.	salud	Corr.
acoger	0.39	cuidados	0.53	investigación	0.53	impacto	0.44
evento	0.39	internacional	0.37	internacional	0.38	helena	0.41
orgullo	0.35	conoces	0.34	conoces	0.36	crisis	0.40
						legidoquigley	0.40

Table II. Word correlations in tweets labelled #inves13

The words with the highest correlation to *investigación* (research), one of the four most prevalent terms in Figure 4, were *cuidados*, *escalando*, *internacional* (care, climbing and international). For *enfermeras* (nurses) they were *cuidarte*, *investigan*, *mejor* (taking care of yourself, they research and better) and for *enfermería* (nursing), *crear*, *tecnología*, *transmitir* (create, technology and convey). For *mejor* (better) they were *cuidarte*, *muyfan*, *investigan* (taking care of yourself, bigfan and they research). The correlation coefficients are given in Table III.

investigación	Corr.	enfermeras	Corr.	enfermería	Corr.	mejor	Corr.
cuidados	0.53	cuidarte	0.69	crear	0.31	cuidarte	0.94
escalando	0.44	investigan	0.66	tecnología	0.31	muyfan	0.78
internacional	0.39	mejor	0.65	transmitir	0.31	investigan	0.76

Table III. Word association frequencies in tweets labelled #inves14

## DISCUSSION

The analysis of the use of Twitter during the 17<sup>th</sup> and 18<sup>th</sup> editions of the International Nursing Research Conference revealed keys for understanding the characteristics of this medium. The *Twitter* data monitored were compiled using a qualitative data

collection method able to furnish information on the use of social networks and compatible with its joint use of others such as surveys, interviews or the observation of participants at events <sup>(28)</sup>. The optimal approach would be to combine more than one method to gather data on registered congress participants and request the information needed to follow their individual Twitter accounts on the registration forms for the event <sup>(17)</sup>.

While more participants registered for the 2014 conference, fewer papers were submitted and consequently accepted than in 2013. The number of tweets rose from 1 723 to 2 011 in those two years, in keeping with general trends with respect to network use.

Tweeting was encouraged in both events, at which a reward was offered for the most active congress tweeter. A second reward was awarded to the participant sending the tweet that induced the largest number of retweets. Although the rewards were governed by the same terms in 2013 and 2014, they apparently prompted more retweeting in the second, when the retweets exceeded the number of original messages. The earlier year was characterised by a higher proportion of original messages and 2014 by intense retweeting, a practice that has become more common of late <sup>(25)</sup>, particularly among users in the same community <sup>(26)</sup>.

Activity peak timing concurred in #inves13 and #inves14 on occasion, while other peaks were specific to each event. As a rule, tweeting was timed arbitrarily <sup>(24)</sup>, although some parallels could be drawn between tweeting volumes in the two years.

Congress organisers should note that according to the data gleaned from Twitter, the network appeared to be less impacted by the first day's than by the following days' content. While judging from the absolute volume of tweets, the key days were Wednesday and Thursday; Wednesday, in turn, was the day with the most intense tweeting and retweeting activity in both years. The inference is that activity in Twitter appeared to cluster in the middle days of this congress <sup>(35)</sup>.

Users retweeted routinely during the day in both years, while tweeting was characterised by considerable peaking. In contrast to those peaks, retweets were sent at a very even pace on the four days of the congress.

The number of hashtag users nearly doubled from the first to the second year. That finding would appear to denote an upward trend from one year to the next in the use of communication 2.0 media in this type of events <sup>(25)</sup>.

To ensure the widest possible dissemination of key aspects such as the announcement of the next edition of the congress at issue, organisers should maintain their links with users adopting the role of authorities. Organisers should also follow good hubs in Twitter with a view to detecting information of possible utility. Any normal user with an interest in the subject matter addressed in the congress should also logically follow users who were both hubs and authorities in earlier editions.

From the standpoint of social network analysis, Twitter can be regarded as a 'scale-free network' exhibiting the 'small world phenomenon', properties characteristic of the web and the blogosphere <sup>(1)</sup>.

The rewards offered may have contributed to the change in the network structure in the second year. In 2014, the users connecting the centre to the periphery of the mentions network were two candidates for the award, for a single tweet sent by one of them induced the largest number of retweets. Communication per se is very dynamic and post-event networks evolve, while nonetheless tending to maintain similar structures. This is not exclusive to congress networks, but also observed in social and political networks <sup>(36)</sup>.

The terms used by tweeters in their messages, devoid of mentions and hashtags, can define the backbone of a congress. Twitter contains a record, for instance, of the venues of the congress studied here (Lleida and Vitoria), the theme (nursing research) and their international nature. As attested to by the findings on the words most commonly tweeted and re-tweeted, Spanish is the predominant language in these international nursing meetings held in Spain.

Primarily although not exclusively, Twitter is a powerful tool for propagating the content of scientific meetings, above and beyond the information disseminated during a given time or at a given place <sup>(23)</sup>. The network can also be regarded as essential, particularly in connection with the information needed to establish good dissemination strategies for the organisation of future events.

## CONCLUSION

The analysis of Twitter use during scientific meetings can furnish information of considerable value. The process can reveal communication patterns such as participant interaction, the times when activity is most intense and the roles adopted by social network users, while affording the opportunity for semantic analysis of the terms used. Spanish organisers of scientific congresses should implement strategies to capitalise on this information; the roadmap charted in this paper contains the guidelines for working toward that objective.

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