Journal of
Urology and Renal Problems

Research Article

English MG, et al. J Urol Ren Probl: JURP-100005

Changing Patterns of Male Infertility Twitter Traffic Between 2015 and 2018

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Citation: English MG, Thaker Hb, Samplaski MK (2020) Changing Patterns of Male Infertility Twitter Traffic Between 2015 and 2018. J Urol Ren Probl: JURP-100005

Received date: 16 January, 2020; **Accepted date:** 21 January, 2020; **Published date:** 27 January, 2020

Abstract

Objectives: To assess #Male Infertility related discussions on Twitter.

Methods: We queried the Symplur Signals database for "#Male Infertility" tweet activity for 2015-2018. We assessed Twitter activity, users, and content both over the total time period and by year.

Results: Twitter usage (number of tweets and users) for #Male Infertility increased with time. Twitter users came from 48, 60, and 93 countries in the years 2015-2016, 2016-2017, and 2017-2018 respectively. While USA tweets were most frequent among all time periods, the number of other countries and languages used, increased with time. The most commonly co-used meaningful words were: "infertility" (931 times), "male" (770), "amp" (715), "men" (630), "fertility" (542), and "sperm" (443). Regarding influencers, 56.9% were physicians or health care providers, 17.7% were hospitals or clinics, and 7.8% were academics or researchers. Twitter users were seen to operate within isolated subsets of the #Male Infertility twitter sphere, often communicating with the same users, but not often reaching different users. With time there was a trend for more female fertility co-hashtags.

Conclusions: Twitter use in male infertility continues to grow, both domestically and internationally. Health care providers are the strongest Twitter influencers, suggesting an opportunity to disseminate evidence-based information. An opportunity exists to expand Twitter networking and reach new groups. A growing trend for co-hash tagging between male and female infertility Twitter spheres was seen with time, likely representing an opportunity for increased dissemination of information.

Keywords: Influencers; Male infertility; Social media; Twitter; Urology

Introduction

The microblogging social media platform Twitter allows for rapid and wide-reaching dissemination of information. This technology has been used increasingly in the urologic community to reach both patients and colleagues [1,2]. Interestingly, urologists have been quicker to utilize Twitter than other surgical specialties, and one study found that urological conferences had greater than triple the number of impressions, tweets and 'tweeters', compared with non-urological surgical conferences [3].

Twitter has influenced the urologic online world in several ways. There has been a dramatic increase in its use at conferences to disseminate new data in real time [4]. It has been used successfully for several online journal clubs, including an international journal club and an interactive pediatric monthly journal club [5]. Recent data found that most urology publications are now being shared on Twitter, and that Twitter activity may be an early indicator of ultimate academic impact of an academic urology paper [6]. Twitter activity has also been shown to significantly influence US News and World Report reputation scores for urology departments, by providing a mechanism for communication about academic and educational topics [7]. The use of social media in medicine

has expanded so much guidelines have recently been created to guide clinicians in the effective and professional use of these communication technologies [8].

A 2017 study found that among urologic specialties, male infertility had the second highest number of tweets and users9. We know that male infertility is a relatively "young" urologic subspecialty, with the results of the landmark Vasovasostomy Study Group published in 199110. Likewise, male fertility patients are, by definition, of reproductive age. People ages 20-45 years have been shown to use the Internet as a source of health information more frequently than their older counterparts11. As such, social media platforms like Twitter serve as a source of information for these young patients and physicians, likely more so than for users of advancing age. Supporting this, physicians who tweet are more likely to be <40 years of age 12.

Given the high prevalence of Twitter usage in the male infertility subspecialty, we looked at this group in particular, assessing we assessed the volume, subject matter, authors, and content of male infertility related discussions on Twitter.

Materials and Methods

The study was granted an exempt status from the USC IRB and in October 2018, we used the Symplur Signals analytic platform to gain insights on Twitter posts related to "#Male Infertility". Results were generated for October 2015-October 2018. Tweet analysis involved a comprehensive assessment of overall tweet activity, tweet metrics and tweet language metrics. Symplur was used for tweet analysis. The reports provided by Symplur gave information on the ratio and frequency of retweets, tweets with links, tweets with photos, tweet replies and tweets with user mentions. Language information was also provided.

User analysis included user geolocation and an analysis of the top influencers of the urology related Twitter discussion. Geolocation of users was extracted by Symplur from the location information in each users' individual profile. "Influencer analysis" was also provided by Symplur, as each user was classified into Symplur Signals health care categories. These categories were patient, physician, non-physician health care professional, individual, other, health care organization, organization other and spam. Overall tweet activity was recorded as the number of tweets, users and impressions. "Impressions" were defined as a combined measurement of the number of tweets and the number of followers expressing the overall number of evoked impressions.

Content analysis for male infertility specifically was performed by taking the 100 most frequently used words in tweets on #maleinfertility related tweets. We assessed co-hashtags and their frequencies over the total time period and by year.

We performed further statistical calculations of the Symplur data using Microsoft Excel to calculate percent totals, percent growth, and proportions of each variable in the dataset.

Results

From 2015 to 2016, 2,344 total tweets and 5,789,743 total impressions were made. From 2016 to 2017, 2,906 total tweets and 7,879,365 total impressions were made. From 2017-2018, 5,312 total tweets and 14,677,774 total impressions were made **(Table 1)**. There was a consistent increase in the number of Tweets over time: a 36% increase from 2016 to 2017 and an 86% increase from 2017-2018.

-	**2015-2016**	**2016-2017**	**2017-2018**
Total Tweets	2,344	2,906 (+24%)	5,312 (+83%)
Users	835	908 (+9%)	1,804 (+99%)
Impressions	5,789,743	7,879,365 (+36%)	14,677,774 (+86%)
Influencers (Top 5)	1. Doctor	1. Doctor	1. Doctor
	2. Hospital	2. Hospital	2. Advocating Organization
	3. Hospital	3. Hospital	3. Doctor
	4. Advocating Organization	4. Hospital	4. Doctor
	5. Advocating Organization	5. Doctor	5. Doctor
Influencer Categories (Top 5)	1. Doctor/Health Care Provider (39.5%)	1. Doctor/Health Care Provider (51.0%)	1. Doctor/Health Care Provider (61.4%)
	2. Hospital/ Organization Provider (23.2%)	2. Hospital/ Organization Provider (17.7%)	2. Hospital/ Organization Provider (20.5%)
	3. Other Healthcare Individual (11.6%)	3. Researcher/ Academic (9.8%)	3. Other Healthcare Individual (9.1%)
	3. Journalist/Media (11.6%)	3. Non-healthcare Individual (9.8%)	
	4. Researcher/ Academic (7.0%)	4. Other Healthcare Individual (5.9%)	4. Researcher/ Academic (2.3%)
	-	-	4. Non-healthcare Individual (2.3%)
	-	-	4. Journalist/Media (2.3%)
	-	-	4. Advocate/ Caregiver (2.3%)

Countries (Total)	48	60 (+25%)	93 (+55%)
Countries (Top 5)	1. USA (23.5%)	1. USA (23.5%)	1. USA (17.4%)
	2. India (7.9%)	2. United Kingdom (8.5%)	2. United Kingdom (9.4%)
	3. United Kingdom (4.9%)	3. India (7%)	3. India (5.5%)
	4. Canada (2%)	4. Canada (3.5%)	4. Australia (2.5%)
	5. Nigeria (1.8%)	5. Spain (2.2%)	5. Canada (1.8%)
US States (Top 5)	1. California (24.7%)	1. California (24.8%)	1. California (27%)
	2. New York (12%)	2. Florida (12.4%)	2. New York (15.8%)
	3. Florida (10.8%)	3. Texas (8.7%)	3. Texas (9.9%)
	4. Texas (7%)	4. New York (8.1%)	4. Florida (9%)
	5. New Jersey (5.7%)	5. Illinois (6.8%)	5. Massachusetts (5.4%)
	-	5. Massachusetts (6.8%)	-
Number of Languages	18	19 (+6%)	25 (+32%)

Table 1: Twitter content organized by year.

Regarding influencers (calculated to have the largest effect on the hashtag conversation by Symplur's algorithms), 42% were physicians or health care providers, 17% were hospitals or clinics, and 15% were advocating organizations. Doctors were the top influencers over all time periods.

Of categorized Twitter users involved in the #Male Infertility discussion over the full time period 2015-2018, 56.9% were physicians or other healthcare providers, 17.7% were Hospitals/Organization Providers, 11.8% were other Individuals Involved in Healthcare, 7.8% were Academics or Researchers, and 3.9% were Journalists or Members of the Media. Doctors and Healthcare Providers increased yearly from 39.5% in 2015-2016, 51.0% in 2017-2018, and 61.4% in 2017-2018 **(Table 1)**. Using visual network analysis, Twitter users were seen to operate within isolated subsets of the #Male infertility twitter sphere, often communicating with the same users, but not often reaching different users. **Figure 1** illustrates these communications for the entire time period studied (2015-2018). When the labeled nodes are connected with edges, this indicates communication between the groups. Where there is no connecting line, this indicates isolation from other users.

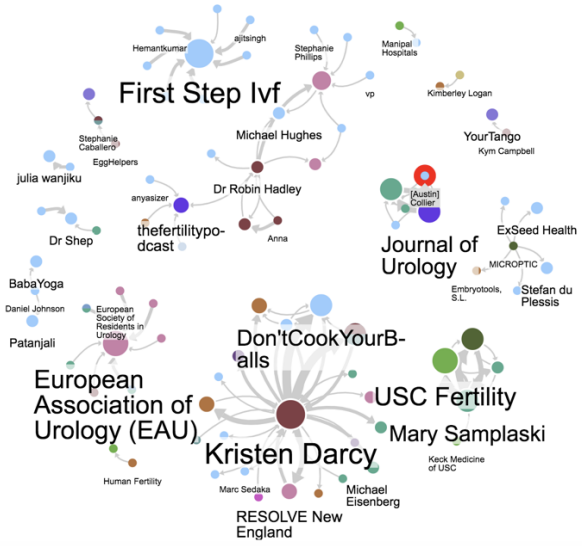

Figure 1: Visual network analysis of Twitter users in the #Male Infertility twitter sphere. Labeled nodes are connected with edges, indicating communication between the groups. Where there is no connecting line, this indicates isolation from other users.

Across all time periods, most Twitter users were from the USA (23.5%, 23.5%, and 17.4% in each respective time frame). Other countries with the most active users were India, the United Kingdom, Australia, Canada, Nigeria, and Spain **(Figure 2)**. Twitter usage (number of tweets and number of users) for male infertility increased with time. While USA tweets were the most frequent among all time periods, the number of other countries involved and languages in which tweets were written, increased with time: 48 in 2015-2016, 60 in 2016-2017, and 93 in 2017-2018. Tweets were written in 18, 19, and 25 languages for each year respectively.

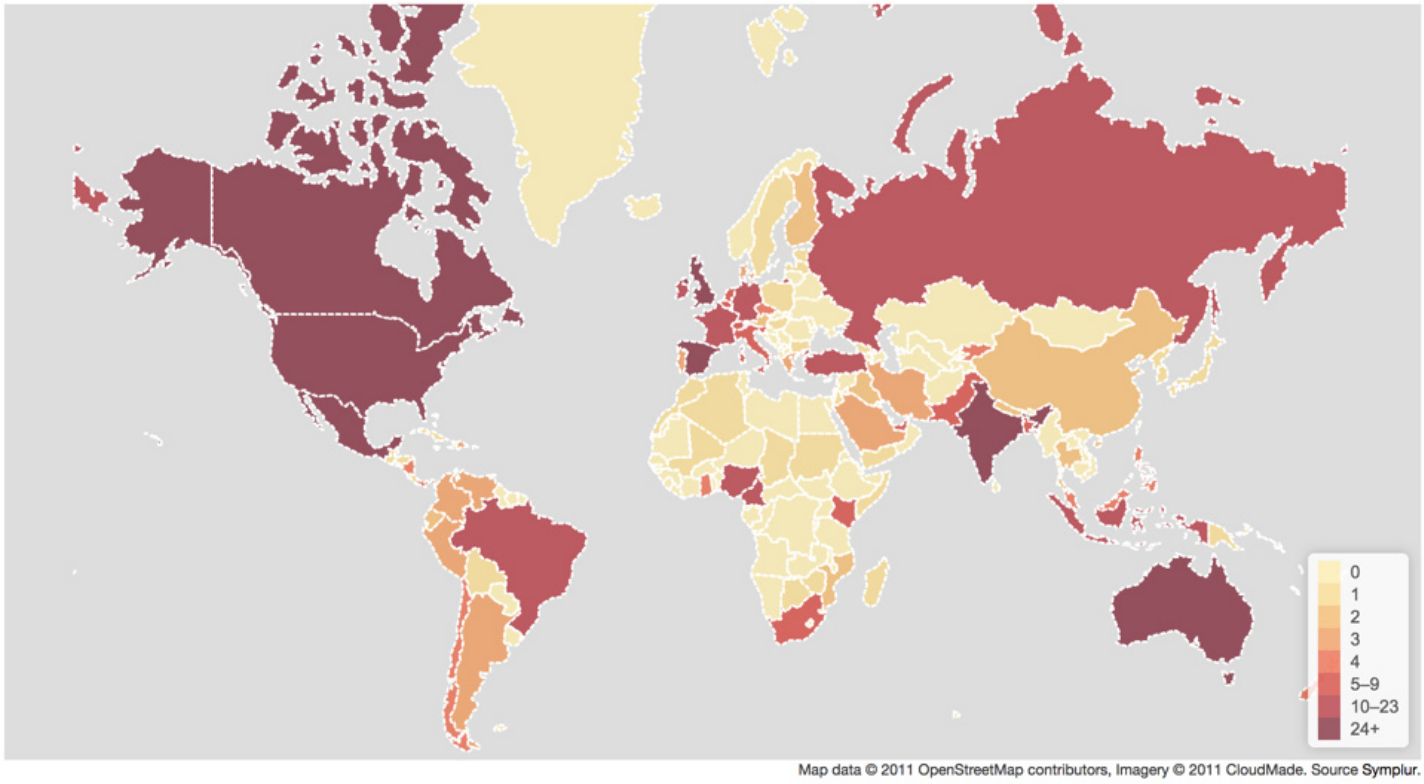

Figure 2: Geolocation heat map indicates countries with the highest usage of the #MaleInfertility hashtags. The darker the country, the more use of the hashtag was localized there.

Excluding articles, prepositions, and conjunctions, the most commonly used words with #Male Infertility tweets for 2017-2018 were: "infertility" (931 times), "male" (770), "amp" (715), "men" (630), "fertility" (542), and "sperm" (443). **Table 2** details the yearly word frequencies.

-	2015 Rank	2015 Count	2016 Rank	2016 Count (% Growth)	2017 Rank	2017 Count (% Growth)
Infertility	1	274	2	330 (+20%)	1	931 (+182%)
Men	2	273	3	310 (+14%)	4	630 (103%)
Sperm	3	267	5	269 (+1%)	6	443 (+65%)
Male	4	223	1	333 (+49%)	2	770 (+131%)
Amp	5	219	4	294 (+34%)	3	715 (+143%)
Semen	6	85	9	93 (+9%)	not in top 50	n/a
Fertility	9	75	6	219 (+192%)	5	542 (+147%)

Table 2: Most common words used in "#MaleInfertility" hashtags.

2015			2016			2017			2018		
Rank	Hashtag	#Tweets	Rank	Hashtag	#Tweets	Rank	Hashtag	#Tweets	Rank	Hashtag	#Tweets
1	#fertility	27	1	#infertility	59	1	#infertility	63	1	#infertility	116
2	#infertility	26	2	#sperm	34	2	#fertility	49	2	#IVF	110
3	#sperm	23	3	#fertility	32	3	#male fertility	27	3	#fertility	79
4	#male fertility	20	4	#male fertility	22	4	#sperm	26	4	#Female Infertility	53
5	#ASRM2015	5	5	#TTC	17	5	#IVF	23	5	#pregnancy	47
6	#Traditional Chinese Medicine	4	6	#ASRM2016	10	6	#varicocele	22	6	#Life Death Whatever	43
7	#drought	3	6	#Fertility Coach	10	6	#Mens Health	17	6	#We Need To Talk	43

Table 3: Co-associated hashtags with #MaleInfertility and the number of tweets.

Immense growth in numbers of co-hashtags associated with #Male Infertility were seen for the time period: 52 in 2015, 105 in 2016 (102% increase), 151 in 2017 (44% increase) and 495 in 2018 (228% increase). The top 7 co-associated hashtags and the number of tweets can be seen in **Table 3**. 2015, 2016, and 2017 had the same, broad top 4 co-hashtags (#fertility, #infertility, #sperm, and #male fertility). For the first time in 2017, a hashtag traditionally associated with female fertility was see in top 5 (#IVF). Also, in 2018 3 female fertility-associated hashtags were seen in the top 6 (#IVF at number 3, #female infertility at number 5, and #pregnancy at number 6).

Discussion

The rapid and continued adaptation of the Urologic community to Twitter is exciting. This adaptation has resulted in several downstream effects, and recent data show that Twitter activity may be an early indicator of ultimate academic impact of an academic urology paper6. Twitter use has also been shown to influence a urology department's US News and World Report reputation7. In particular, the male infertility community has been shown to have the second highest number of tweets and users, compared to other urologic specialties9. This is likely due to the relatively young age of these patients11, and the relatively "young" age of male infertility as a specialty. Supporting this, physicians who tweet are more likely to be <40 years of age [12].

We found that there was a dramatic increase in the number of #Male Infertility tweets over time: a 36% increase from 2016 to 2017 and an 86% increase from 2017-2018, indicating the growing use of Twitter. There has also been a dramatic increase in the global use of Twitter. Across all time periods, most Twitter users were American, but the number of international users and tweets steadily increased. Likewise, the number of languages that these tweets were written in steadily increased over time. This highlights Twitters utility for global exchange of information, and the need for Twitter users to be internationally inclusive in co-hashtags.

Regarding influencers, who were deemed to have the largest effect on the hashtag conversations by Symplur's algorithms, 42% were physicians or health care providers, 17% were hospitals or clinics, and 15% were advocating organizations. Doctors were the top influencers over all time periods. These are influencers who would theoretically post evidence-based information, lending quality and fidelity to urological Twitter content. Patients were not represented and made up 0% of influencers in all years. Although this may be due in part to a mis- or non-categorization of users by Symplur, this would suggest that there is an opportunity for enhanced patient engagement on Twitter. This is especially important because patient engagement on Twitter has been shown to result in improved disease knowledge and reduced anxiety [13].

Similarly, most Twitter users involved in the #Male Infertility discussions were physicians or other healthcare providers, followed by Hospitals/Organization Providers. This again highlights the potential for disseminating evidence-based information, as these are both groups that would likely post from primary research. However, we found that most Twitter users operated within isolated subsets of the #Male Infertility twitter sphere, often communicating with the same users, but not often reaching different users. This may highlight an opportunity for enhanced "cross-pollination", for users to communicate with different users and expand the number of users reached with their posts.

Specific to the infertility world, immense growth in

numbers of co-hashtags associated with #Male Infertility was seen. Increasing integration with male and female fertility groups were also seen. The most common co-hashtags for 2015, 2016, and 2017 were #fertility, #infertility, #sperm, and #male fertility. This is useful information for clinician reach other Twitter users. For the first time in 2017, a hashtag traditionally associated with female fertility was see in top 5 (#IVF). This trend continued and in 2018, three female fertility-associated hashtags were seen in the top 6 (#IVF at number 3, #female infertility at number 5, and #pregnancy at number 6). This integration is highly encouraging and represents an opportunity for enhanced reproductive urologist and gynecologist collaboration and sharing of information.

This is the first study to harness the Symplur signals platform as an analytics tool to quantify Twitter traffic related to male infertility. Limitations of our study include, searching by the "maleinfertility" hashtag. The addition of other commonly used male infertility hashtags, such as "#sperm" may have broadened our scope. In addition, Twitter is a dynamic and ever-changing social media platform, and these results may change with time.

Conclusion

In conclusion, Twitter use in male infertility continues to grow, both domestically and internationally, suggesting that it is a valuable communication platform. The most commonly used words are "infertility" and "male". Physicians and health care providers are the strongest influencers of Twitter activity, suggesting an opportunity to provide evidence-based information to other Twitter users. Twitter users tend to operate within their known twitter sphere groups, indicating the opportunity to expand Twitter networking and reach new groups. With time, we saw a trend for more female fertility co-hashtags, indicating a growing online collaboration between the male and female infertility Twitter spheres.

Conflicts of Interest: None of the contributing authors have any conflict of interest, including specific financial interests or relationships and affiliations relevant to the subject matter or materials discussed in the manuscript.

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